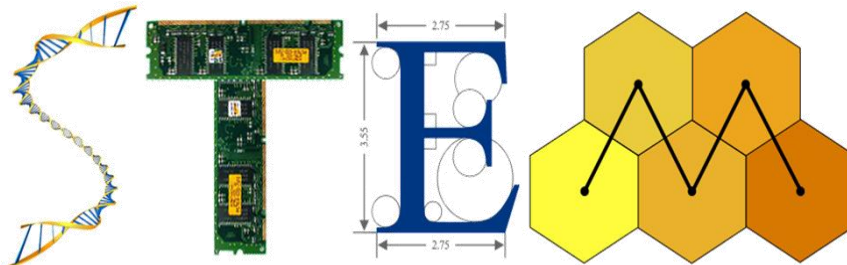


ANA G. MÉNDEZ UNIVERSITY SYSTEM
VICE-PRESIDENCY FOR PLANNING AND ACADEMIC AFFAIRS
Student Research Development Center
"Developing Minds Through Research Experiences"

WINTER 2015

Pre-College Research Symposium



Science, Technology, Engineering and Mathematics

December 12, 2015
Universidad Metropolitana
San Juan, Puerto Rico



UMET **UNE** **TURABO**

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

ARE PROUD TO HOST THE

**WINTER 2015 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

UNIVERSIDAD METROPOLITANA

SAN JUAN, PUERTO RICO

DECEMBER 19, 2015

TABLE OF CONTENTS

Table of Contents.....	2
Ana G. Méndez University System (AGMUS) Profile.....	3
Conference at a Glance.....	4
Message from the Vice President for Planning and Academic Affairs	
Dr. Jorge Crespo.....	5
Message from the Chancellor of Universidad Metropolitana	
Dr. Carlos Padín, Chancellor.....	6
Message from the Chancellor of Universidad del Este	
Lic. Alberto Maldonado.....	7
Message from the Chancellor of Universidad del Turabo	
Dr. Dennis Alicea.....	8
Message from the Director and Principal Investigator	
Dr. Juan F. Arratia.....	9
Prologue.....	10
Schedule of Events.....	11
 Abstracts:	
Applied Physics.....	11
Astronomy.....	24
Atmospheric Sciences.....	27
Biology.....	32
Bio-Engineering.....	39
Bio-Mathematics.....	42
Bio-Statistics.....	50
Chemistry.....	54
Computer Sciences.....	55
Engineering.....	56
Environmental Sciences.....	66
Neurocircuitry.....	67
Acknowledgements.....	68
Index of Presenters.....	69

**Ana G. Méndez University System
Student Research Development Center
AGMUS Institute of Mathematics**

MISSION

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.

EXECUTIVE SUMMARY

The Model Institutions for Excellence ended in 2009. The primary goal of this cooperative agreement with NSF was to increase the number of BS degrees granted to underrepresented students in STEM fields at Universidad Metropolitana. Over 247 UMET STEM majors got their BS degrees and 156 were transfer to graduate school. In order to increase the number of BS degrees transferred to graduate school, we will continue with the strategy of an early undergraduate research program and partnership with key research institutions in the US mainland, Puerto Rico and abroad. Research mentoring will be the central component of the knowledge transfer and creative thinking activities at AGMUS. Cooperative and collaborative learning strategies, presentations at scientific conferences, scientific writing and co-authorship, technology literacy, and preparation for graduate school are activities that are transforming the philosophy of the institution. Now, with the NSF grant, the AGMUS Institute of Mathematics goals are reaching institutions outside the AGMUS campuses in Puerto Rico and the US Virgin Islands.

GOALS

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

**ANA G. MENDEZ UNIVERSITY SYSTEM
Vice Presidency for Planning and Academic Affairs
STUDENT RESEARCH DEVELOPMENT CENTER**

**WINTER 2015 PRE-COLLEGE
RESEARCH SYMPOSIUM**

CONFERENCE AT A GLANCE

SATURDAY, DECEMBER 19, 2015

**UNIVERSIDAD METROPOLITANA
ARTURO MORALES CARRION BUILDING**

8:00–9:15 a.m.	Registration Poster Session Set-Up	Morales Carrion West Lobby Rooms MC 105-106A & East Lobby
8:00–9:15 a.m.	Judges Meeting and Breakfast	Room MC 117A
8:00–9:15 a.m.	Light Breakfast	Exterior East Lobby
9:15–9:30 a.m.	Opening Ceremony	Arturo Morales Carrión Theater
9:30–11:00 a.m.	Poster Session	Rooms MC 105-106A & East Lobby
11:00–11:40 p.m.	Oral Research Presentations	Session I Room MC 111A Session II Room MC 112 Session III MC 112A
11:40-12:40 p.m.	Lunch Boxes	Exterior East Lobby
12:40–1:30 p.m.	Awards Ceremony and Closing Remarks	Arturo Morales Carrion Theater
1:30 p.m.	Symposium Adjourns	

UMET TURABO UNE



Sistema Universitario Ana G. Méndez
Vicepresidencia de Planificación y Asuntos Académicos

Tel. 787 751-0178
Ext. 7371, 7288
Fax. 787 751-3299

UNIVERSIDAD DEL ESTE
UNIVERSIDAD DEL TURABO
UNIVERSIDAD METROPOLITANA
SISTEMA TV/WMTJ-TV CANAL 40

PO Box 21345
San Juan, PR 00928-1345

www.suagm.edu

December 19, 2015

Dear Winter 2015 Pre-College Symposium Participants:

The Ana G. Méndez University System (AGMUS) is proud as well as honored to be part of the Winter 2015 Pre-College Research Symposium organized by the AGMUS Student Research Development Center, which supports early scientific research activities in Puerto Rico.

The AGMUS Institute of Mathematics Saturday Academy Program have been working on the strengthening of students' skills with research experiences and outcomes disseminated in oral and poster presentations. This conference is designed to motivate pre-college students to pursue careers in STEM fields.

Congratulations to the participants for their outstanding research projects.

Sincerely yours,



Jorge L. Crespo Armáiz, Ph. D.
Vice President for Planning and Academic Affairs



Universidad Metropolitana
Office of the Chancellor

Tel. 787 766-1717
Ext. 6400, 6402
Fax. 787 759-7663

PO Box 21150
San Juan, PR 00928-1150

www.suagm.edu/umet

December 19, 2015

Dear students, teachers and parents:

Universidad Metropolitana has been a groundbreaker in offering support to undergraduates and pre-college students from Puerto Rico to search for opportunities and careers in science, technology, engineering and mathematics (STEM) fields. I would like to welcome you to the Winter 2015 Pre-College Research Symposium. Furthermore, our congratulations to all of you who have participated in this Winter 2015 Pre-College Research Symposium experience.

The Student Research Development Center of the Ana G. Méndez University System (AGMUS) organized the Symposium to disseminate the research work of students who have worked in the Pre-College Program. This new avenue will bring together the talent of high school students who dedicate long hours to scientific endeavors.

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

Yours truly,

Carlos M. Padín, Ph. D.
Chancellor

Chancellor's Office

UNE | UNIVERSIDAD
DEL ESTE
SISTEMA UNIVERSITARIO
ANA G. MÉNDEZ

PO Box 2010
Carolina, PR 00984-2010
Tel. 787.257.7373 ext. 2002
Fax 787.776.1220

December 19, 2015

Dear students:

The Ana G. Méndez University System (AGMUS) and Universidad del Este (UNE) welcome you to the Winter 2015 Pre-College Research Symposium to be held at Universidad Metropolitana, in San Juan, Puerto Rico. AGMUS is proud to host this event organized by the AGMUS Student Research Development Center.

The Winter 2015 Pre-College Research Symposium presents research projects and shares the outcomes of those experiences as a contribution that inspires others and helps improve knowledge in the scientific community. This Symposium promotes the participation and supports the hard work of high school students who are aware of the importance of science in their lives and have dedicated many hours to the preparation of research projects that may make a difference.

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

Yours truly,



Alberto Maldonado-Ruiz, Esq.
Chancellor

Oficina del Rector

TURABO | UNIVERSIDAD
DEL TURABO
SISTEMA UNIVERSITARIO
ANA G. MÉNDEZ

PO Box 3030
Gurabo, PR 00778
Tel (787) 743-7979, ext. 4002
Fax (787) 744-5394
www.suagm.edu/ut

December 19, 2015

Dear participants,

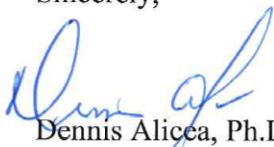
On behalf of Universidad del Turabo, congratulations to all of you who have worked very hard during this academic semester on such excellent scientific research projects. You will present the outcomes of your research at the Winter 2015 Pre-College Research Symposium to be held at Universidad Metropolitana, in San Juan, Puerto Rico. This is an event organized by the Student Research Development Center of the Ana G. Méndez University System (AGMUS).

I am very pleased, as well as proud of the number of research projects presented by such a talented group of student researchers. It is both a privilege and an honor to have contributed to the development of scientific research skills in young scientists.

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

We also thank all of the faculty mentors for their commitment and contributions in the development of the future scientists and engineers of our nation.

Sincerely,


Dennis Alicea, Ph.D
Chancellor



Sistema Universitario Ana G. Méndez
Vicepresidencia De Planificación Y Asuntos Académicos
STUDENT RESEARCH DEVELOPMENT CENTER

Tel. 787.751.0178
Ext. 6000, 6001
Fax. 787.759.6411

PO Box 21345
San Juan, PR 00928-1345
<http://srdc.suagm.edu>

December 19, 2015

Dear Pre-College Students:

The Winter 2015 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 2015, all of you, ninety-five (95) pre-college students from fourteen private and public high schools in Puerto Rico worked long hours in the research laboratories of the AGMUS campuses, Bautista de Caguas School, Bautista de Puerto Nuevo Academy, Caguas Private School, CIMATEC School, CROEM School, Fruto de la Vid Christian Academy, Josefina León Zayas School, Lourdes School, Notre Dame School, Puerto Rico Gifted School Alliance (PRGSA) School, St. Mary's School, Thomas Armstrong Toro School, University Gardens High School, and University of Puerto Rico High School, with the guidance and mentorship of ten professors and student research mentors in seventy-four research projects in the areas of Applied Physics, Astronomy, Atmospheric Sciences, Biology, Bio-Engineering, Bio-Mathematics, Bio-Statistics, Computer Sciences, Engineering, Environmental Sciences and Neurocircuitry.

One of the objectives of the Winter 2015 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 2015 Saturday Academy Program and the Winter 2015 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 2015 Saturday Academy Program and the Winter 2015 Pre-College Research Symposium.

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 2015 Pre-College Research Symposium showcases the research experiences of two hundred five (205) pre-college students from public and private high schools from Puerto Rico. The mentorship of faculty and undergraduate research mentors made possible the concretization of the research projects. Their results are documented in the pages of these proceedings.

The Ana G. Méndez University System, the Student Research Development Center are proud of the research work conducted by the Saturday Academy Winter 2015 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.

SCHEDULE OF EVENTS

SATURDAY, DECEMBER 12, 2015	UNIVERSIDAD METROPOLITANA ARTURO MORALES CARRIÓN BUILDING
------------------------------------	--

8:00 – 9:15 a.m.	REGISTRATION POSTER SESSION SET-UP	Morales Carrión West Lobby Room MC-105-106A & East Lobby
8:00 – 9:15 a.m.	Judges’ Meeting and Breakfast	Room MC-117A
8:00 – 9:15 a.m.	Light Breakfast	Exterior East Lobby
9:20 – 11:20 a.m.	OPENING CEREMONY	Arturo Morales Carrión Theater
9:30 – 11:00 a.m.	Poster Session	Room MC-105-106A & East Lobby

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

9:30 – 11:00 a.m.	POSTER SESSION
--------------------------	-----------------------

APPLIED PHYSICS, ASTRONOMY, ATMOSPHERIC SCIENCES, BIOLOGY, BIO-ENGINEERING, BIO-MATHEMATICS, BIO-STATISTICS, COMPUTER SCIENCES, ENGINEERING, ENVIRONMENTAL SCIENCES AND NEUROCIRCUITRY

Chairperson: Dr. Juan F. Arratia, Universidad Metropolitana

APPLIED PHYSICS

Kattia M. González Aponte, Bautista de Caguas School, Caguas, Puerto Rico. **1**

Why the Solar Flare Affects the Satellite?

ASTRONOMY

Melany D. Valle Feliciano, CROEM High School, Mayagüez, Puerto Rico. **2**

Structural Building Muon Resistance

Michael A. Hernández: C.R.O.E.M. High school, Mayagüez, Puerto Rico. **3**

The Sunspot Theory and the Relation with Solar Wind

Jeiselynn N. Ríos Rivera, CROEM High School, Mayagüez, Puerto Rico. **4**

Parallax And Stellar Spectroscopy

ATMOSPHERIC SCIENCES

Patricia Carolina de León Rivera, CIMATEC School, Caguas, Puerto Rico. **5**

Impacts on Climate Changes and Precipitation Affect Agricultural Waters, Soils and Crops Resources in Puerto Rico

Alondra L. Díaz López, Bautista de Caguas School, Caguas, Puerto Rico. **6**

What Effect El Niño has in Puerto Rico

Reniel Irizarry-Del Toro, CROEM High School, Mayagüez, Puerto Rico. **7**

Minimizing Ambient Heating Effects on a Geonor Gauge

Jorge A. Quiles-Gordillo, Josefina León Zayas School, Jayuya, Puerto Rico. **8**

A New Freezing Drizzle Climatology for KOKC and KRAP Based on Automated Detection

Amanda F. Robles López, CIMATEC School, Caguas, Puerto Rico. **9**

Elimination of Space Debris

Desireé Zavala Osorio, Caguas Private School, Caguas, Puerto Rico. **10**

Forecasting Diurnal Temperature Range

BIOLOGY

- Génesis C. Cartagena Marrero**, CIMATEC School, Caguas, Puerto Rico. **11**
Demonstration of Brain Degeneration Throught Alzheimers Disease
- Carolina I. Delgado Maymó**, CIMATEC School, Caguas, Puerto Rico. **12**
The Effects of NFB Treatment on Parkinson’s Disease-Affected Circuit
- Diego E. García Ortiz**, Fruto de la Vid Christian Academy, Gurabo, Puerto Rico. **13**
Obesity as a Contributing Factor in Alzheimer’s Disease
- Nathaly M. Lebrón Cruz and Juan E. Adrover Claudio**, Notre Dame High School, Caguas, Puerto Rico. **14**
Comparison of an MSN Neuron when Affected with Huntington’s Chorea
- Amanda Reyes and Sofía A. Rodríguez**, Josefina León Zayas School, Jayuya, Puerto Rico **15**
Young Blood will Help Delay Aging
- Ian J. Rivera Rodríguez**, CIMATEC School, Caguas, Puerto Rico. **16**
Description of Sept2, Sept4, Sept5, and Sept8 Role in Synaptic Plasticity Affected Circuit
- Rafael E. Rodríguez Rivera**, CIMATEC School, Caguas, Puerto Rico. **17**
Analysis of the Magnitude of Neuronal Apoptosis Caused by TAU Protein Level Rise

Valeria Rosario and **Jorge J. Colón Cintrón**, Bautista de Caguas School, Caguas, Puerto Rico. **18**

Comparison Between a Bilingual and Monolingual Exposure Based on the Pyramidal Cells of the Hippocampus

BIO-ENGINEERING

Nathaniel Sánchez Bruno, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico. **19**

The Effects of Methylenedioximethamphetamine on Serotonin Transporters

Brayan Vega, CIMATEC School, Caguas, Puerto Rico. **20**

Circuitry in the Axon of ALS Affected Neurons

BIO-MATHEMATICS

Amanda Cáceres-Vázquez, University Gardens High School, San Juan, Puerto Rico. **21**

Synaptic Connections in Substantia Nigra: Brain Stem Circuitry Dynamics Due to Parkinson's

Valeria Cáceres-Vázquez, University Gardens High School, San Juan, Puerto Rico. **22**

Language Recognition Interface: Neurophysiological Correlation in Audio-Visual Perception

Jennifer N. Figueroa-Cruz, University Gardens High School, San Juan, Puerto Rico. **23**

Characterization of a Neural System: Circuitry in Brain Plasticity with Alzheimer's

Jailynnette M. Heredia Morales and **Odalys M. Cruz Romero**, Josefina León Zayas School, Jayuya, Puerto Rico **24**

Clothes' Effect on Behavior

Laura I. Marrero-Santana , University High School, San Juan, Puerto Rico.	25
Semantic Processing of Language: Long-Term Declarative Memory Codification in Circuits	
Cristina E. Martes Lugo and Mirelys Negrón Ríos , Josefina León Zayas School, Jayuya, Puerto Rico	26
Solar Cart: How to Minimize the Use of Oil	
Carla N. Martínez-Pérez , University High School, San Juan, Puerto Rico.	27
Resistance in Excitatory Neurons: Epileptic Episode Due to Ionic Circuits Alterations	
Natalia M. Mas-Kildare , University High School, San Juan, Puerto Rico.	28
Dynamics in Neural Circuits: Degeneration in Hippocampal Formation Due to Alzheimer's	
Claudia M. Ramos Rodríguez and Julián A. Batista Lugo , Josefina León Zayas School, Jayuya, Puerto Rico	29
The Effect of the Internet on Human Behavior	
Eliud R. Rivas Hernández , CROEM School, Mayagüez, Puerto Rico.	30
Fractals In Human DNA	
Keishla M. Rivera Torres and Christian Romero Vázquez , Josefina León Zayas School, Jayuya, Puerto Rico	31
Multitasking in Both Genders	
Orlando F. Rodríguez Nieto , CROEM High School, Mayagüez, Puerto Rico.	32
Using Seaweeds to Develop Energy; Dye Sensitized Solar Cells	
Dianelys Saldaña López , CROEM High School, Mayagüez, Puerto Rico.	33
Fingerprint Recognition Algorithm	

Zuany L. Santos-Morales, University Gardens High School, San Juan, Puerto Rico. **34**

Neural Coding in Alzheimer's Disease: Stimuli in Cerebral Response

Angely M. Torres Nieves and **Dahiana de Jesús Rivera**, Josefina León Zayas School, Jayuya, Puerto Rico **35**

Technological Devices that Help the Sightless

BIO-STATISTICS

Carlos I. Ayala Santos, University Gardens High School, San Juan, Puerto Rico. **36**

Computational Study of Amino Acid Changes for Hyperphosphorylated Tau Protein

Natalia Berríos Arroyo, University Gardens High School, San Juan, Puerto Rico. **37**

Computational Study of ATP7B Gene by SIFT

Michael G. De Jesús Soto, University Gardens High School, San Juan, Puerto Rico. **38**

Computational Study of Amino Acid Changes in LMNA Protein

Gabriela Nichole Lugo Claussell, Lourdes School, San Juan, Puerto Rico. **39**

Computational Study of Amino Acid Changes in COL1A1 Gene

Verónica S. Marzán Alvelo and **Joseluis E. Torres Colón**, University Gardens High School, San Juan, Puerto Rico. **40**

Computational Study of Amino Acid Changes in the ACVR1 Gene

Alejandro José Ríos Tirado, University Gardens High School, San Juan, Puerto Rico. **41**

Analysis of ADAM 33 Gene by SIFT

Yaiomy Santiago Rivera, University Gardens High School, San Juan, Puerto Rico. **42**

Computational Study of Amino Acid Changes in the LRRK2 Gene

María Del Mar Zayas-Viera and **Luz Aned Sánchez-López**, University Gardens High School, San Juan, Puerto Rico. **43**

Computational Study of Amino Acid Changes in the Production of the HER2 Gene Based on SIFT

COMPUTER SCIENCES

Kiara N. Maldonado Pérez, Josefina León Zayas School, Jayuya, Puerto Rico. **44**

Perception of Colors and the Use of Electronic Games: A Comparison of Young People Versus Adults

ENGINEERING

Natalia J. Bercero Estrada and **Alondra G. Montalvo Siberón**, Caguas Private School, Caguas, Puerto Rico. **45**

Detecting and Classifying Birds

Faviola Camacho Figueroa, CROEM School, Mayagüez, Puerto Rico. **46**

Exploring Biology with Robots

Alexander Cruz Noriega, CIMATEC School, Caguas, Puerto Rico. **47**

How Greatly are Sensors Affected by Wind, Sound, and Movement?

Luis A. Del Valle Cora, CROEM School, Mayagüez, Puerto Rico. **48**

Thermoelectric Generators: Power Source of the Future?

Natalia L. Díaz López and **Kamila Martis López**, Bautista de Caguas School, Caguas, Puerto Rico. **49**

Making April Tags

Carlos Manuel Gómez Vázquez and Iván Alexis Jiménez Cruz , Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico.	50
Analyzing the Water Used	
Kiria González Rivera , CROEM School, Mayagüez, Puerto Rico.	51
Bicycle Generator	
Saadia P. Jiménez Ñeco and Katia E. Torres Ruiz , Puerto Rico Gifted School Alliance, Guayama, Puerto Rico.	52
Programming a Robot to Identify April Tags Controlling its Speed	
Wilfredo J. Lamberty Bonilla , CROEM School, Mayagüez, Puerto Rico.	53
Earth's Magnetic Field and Cyclone Energy Consumption	
Luis Enrique Lebrón Aponte , Notre Dame School, Caguas, Puerto Rico.	54
Creating Traffic Signs to Prevent Accidents Using Automated Traffic	
Alexis A. Luciano Sánchez and Bianca S. Marina Santana , CIMATEC School, Caguas, Puerto Rico.	55
Aerial Photogrammetry: The Future of 3D Mapping	
Abner X. Peña Carrión and Jeicarlo A. Ruiz Alvarado , CIMATEC School, Caguas, Puerto Rico.	56
Light Pollution in Rural Places and Urban Places in Puerto Rico	
Lilliette Rivera Aponte and Sebastián Disdier Peña , Bautista de Caguas School, Caguas, Puerto Rico.	57
Identifying Traffic Signs to Prevent Accidents Using Automated Traffic	

Manuel Rivera Vélez and Laura Rolón Rentas, Josefina León Zayas School, Jayuya, Puerto Rico **58**

Transfer Energy Without the Need of Petroleum

Bryan A. Rodríguez López and Gustavo de León, CIMATEC, Caguas, Puerto Rico. **59**

Hazardous Particles in the Saharan Dust

Valeria Sofia Serrano Perez and Cristian Ricardo Santiago Solivan, Puerto Rico Gifted School Aliance, Salinas, Puerto Rico. **60**

Application of Drone Technology to Water Potability Analysis

ENVIRONMENTAL SCIENCES

María M. Justiniano Camacho, CROEM High School, Mayagüez, Puerto Rico. **61**

Identifying the Main Sources from the African Dust that Arrives in Puerto Rico

NEUROCIRCUITRY

Sofía Osorio, CIMATEC School, Caguas, Puerto Rico. **62**

The Reaction of the Primary Visual Cortex in ADHD and DNS Patients

11:00 – 12:00 m.

ORAL RESEARCH PRESENTATIONS

11:00 – 12:00 m.

**ORAL PRESENTATIONS
SESSION I**

ROOM MC-111A

ASTRONOMY AND BIOLOGY

Chairperson: Ms. Natalia C. Santiago
Universidad Metropolitana

ASTRONOMY

11:00 – 11:10 a.m.

Rafael Díaz Brenes, PRGSA, Salinas, Puerto Rico.

The Effects of Energy Emissions Over the Cosmos

11:10 – 11:20 a.m.

Orlando J. Martell: C.R.O.E.M High School, Mayagüez, Puerto Rico.

Finding the Classification of the Fractal Dimension in Spiral Galaxies

BIOLOGY

11:20 – 11:30 a.m.

Claudia Cruz Santiago, Notre Dame High School, Caguas, Puerto Rico.

Expression of Vitamin B12, Ubiquinone, and Complex I in Mitochondrial Functioning and Circuitry of Alzheimer's Disease

11:30 – 11:40 a.m.

Luis Enrique Orta Rodríguez, Homeschool.

Analyzing the IFR6 Gene Using SIFT

11:00 – 11:40 a.m.

**ORAL
PRESENTATIONS
SESSION II**

ROOM MC-112

**ATMOSPHERIC SCIENCES AND COMPUTER
SCIENCES**

Chairperson: Ms. Maxine N. González
Universidad Central del Caribe

ATMOSPHERIC SCIENCES

11:00 – 11:10 a.m.

Alejandro J. Rivera Caraballo, CIMATEC School, Caguas, Puerto Rico.

Solar Flares and Auroras

11:10 – 11:20 a.m.

Miguel A. Santana Ducoudray, CIMATEC School, Caguas, Puerto Rico.

Effects of El Niño on Hurricanes in the Atlantic Ocean

11:20 – 11:30 a.m.

Jancie L. Santiago González, Caguas Private School, Caguas, Puerto Rico.

Correlation of Coral Bleaching in Puerto Rico by Temperature Shifting Caused by El Niño

COMPUTER SCIENCES

11:30 – 11:40 a.m.

Adriana C. Marín Massini and **Génesis G. Montalvo**, Josefina León Zayas School, Jayuya, Puerto Rico

The Contribution To Math: Can This Robot Act Like a Teacher for Children?

11:00 – 11:40 m.

**ORAL
PRESENTATIONS
SESSION III**

ROOM MC-112A

**BIO-ENGINEERING, BIO-MATHEMATICS,
CHEMISTRY AND NEUROCIRCUITRY**

Chairperson: Dr. Ángel Arcelay, Universidad del Este

BIO-ENGINEERING

11:00 – 11:10 a.m.

John Lee Soto Vargas, Thomas Armstrong Toro School, Ponce, Puerto Rico.

Morphological Comparison Between PD Neurons and Neurons with High Alpha Synuclein Expression

BIO-MATHEMATICS

11:10 – 11:20 a.m.

Francisco A. Carrasquillo-Gutiérrez, St. Mary's School, San Juan, Puerto Rico.

Tempocerebral Circuitry: Language Acquisition Dynamics

CHEMISTRY

11:20 – 11:30 a.m.

Shania González Lind, CROEM School, Mayagüez, Puerto Rico.

Rational Molecular Designing for Reducing Toxicity

NEUROCIRCUITRY

11:30 – 11:40 a.m.

Paola N. Maldonado-Millán, Homeschooling

Postural Inability in Parkinson's: Bradykinesia in Cerebellar Circuitry

ABSTRACTS
APPLIED PHYSICS

WHY THE SOLAR FLARE AFFECTS THE SATELLITE?

Kattia M. González Aponte, Bautista de Caguas School, Caguas, Puerto Rico.

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

Research Assistants Mentor: Luis López and Abniel Machín, Universidad del Turabo, Gurabo, Puerto Rico.

The solar flare is an enormous explosion that comes to the ionosphere and creates Aurora. Experts say that if an extreme solar storm aimed at the Earth hits in just the right way, it could put interconnected electrical grids around the world at serious risk. In addition to creating beautiful auroras, extreme solar storms could knock out a wide range of electric utilities needed to keep life in the United States and around the world functioning normally. A satellite is an object in space that orbits or circles around a bigger object. There are two kinds of satellites: natural (such as the moon orbiting the Earth) or artificial (such as the International Space Station orbiting the Earth). The space weather receives a direct impact of the sun, especially by the solar flare. Satellite operators focus on four elements of solar weather that can affect satellite communications: solar wind, coronal holes, coronal mass ejections and solar flares. Thankfully, the sun is fairly predictable in this regard, and sunspot activity takes place in 11-year cycles with the maximum or most intense stage lasting about 2 years, and the least intense stage lasting about 5 years. Since 2006, the least active period of major solar weather events in recent history has taken place. In other words, the sun has been very quiet lately. Coping with electrostatic discharges from the sun that can potentially disrupt satellite services is part of the everyday reality of the satellite world. Losing total control and command of a satellite as the result of solar weather is the most severe effect. Solar panels on satellites, and normal erosion rates for solar panels, are the most affected components. It is important to understand the space weather to design a better satellite to improve its effectiveness and duration. Solar flares are explosions that happen in the sun and travel through space and hit the ionosphere of Earth. These solar flares can affect the satellites in various ways because the impact is huge and because of that it can affect the communication of the satellite. The purpose of this investigation was to study the correlation between the solar flare with damages in satellites. The expected result was that the solar flare may disrupt the satellite in some way. That can produce a big explosion that may not have connection to the satellite. This investigation will contribute to the space weather field because now they will know how to build a satellite that does not disrupt the connection.

ABSTRACTS
ASTRONOMY

THE EFFECTS OF ENERGY EMISSIONS OVER THE COSMOS

Rafael Díaz Brenes, PRGSA, Salinas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

This investigation had as its objective to study the energy emissions created by the objects in the cosmos and their effects over their surroundings and some specific areas in space. This one focused over these effects and their study to see how these areas were affected and to discover the sources of the emissions and to examine them. This can give important data about those areas' specific characteristics, the star formations and other important information. The methodology consisted in analyzing data from space observatory satellites. First the sample locations over the cosmos were chosen. Mostly areas that can have high and low energy radiation. Galaxies, nebulae and dust clouds are the main three types of samples. Then observations were made with the satellite telescopes with different types of filters to capture specific electromagnetic energy waves that can be observed over the areas: infrared, ultraviolet, x-ray and gamma ray. After multiple exposures, the data were analyzed with a computer by measuring the levels of radiation of points over the sample areas. Then the possible source of the radiation emission was analyzed. The source was identified and the area was mapped from where the emissions were coming from. The results showed that in some nebulas the radiation and the emission of energy had low levels while in others it contained higher levels. Meanwhile in galaxies the emissions levels of radiation were mostly high to medium presenting no great differences. The dust clouds had always low levels if there were not close to a large number of stars or a nebula. Most of the time the main source of energy emission in most of the samples were the nearby stars that were generating large amounts of energy in their surroundings passing the energy to other areas. Most of the time this caused the nebulae to change their form or shape where the higher levels were and some structures to generate and irradiate energy. But galaxies were irradiating the energy received from the stars. Based on the radiation levels of the emissions of stars over the galaxies, dust clouds, and nebulae it could be concluded that these emissions caused dramatic changes over them based on the intensity of the emissions, while in lower emissions and the type of area over the cosmos the radiation did not have a significant effect nor any change or effect at all.

STRUCTURAL BUILDING MUON RESISTANCE

Melany D. Valle Feliciano, CROEM High School, Mayagüez, Puerto Rico.

Research Mentor: Elba M. Sepúlveda, Ed.D., CROEM High School, Mayagüez, Puerto Rico.

Research Assistants Mentor: Gilberto Jiménez and Marcel F. Corchado, University of Puerto Rico, Mayagüez, Puerto Rico.

Muons are elementary, punctual and without volume particles very similar to electrons. They have a spin of $\frac{1}{2}$, with an equal charge to the electron but with an existence of 2.2 microseconds. Muons are formed when the atmosphere interacts with cosmic rays and they travel at very high speeds. They cause what is called a cosmic shower as a result of a primary particle collision. These muons are interesting particles that are passing over a body without disturbing it. This research showed how different materials can affect particles like muons when they collide with the building. Using a particle detector, the change in the amount of particles was measured. They were detected within a different building floors and based on the amount of material particles must traverse to reach the detector. There was a significant change between the number of particles detected on the top floor, for which the muon should reach without going through many materials, and the number of muons detected in the lower floors because the muons had to travel through more materials to arrive.

THE SUNSPOT THEORY AND THE RELATION WITH SOLAR WIND

Michael A. Hernández: C.R.O.E.M. High school, Mayagüez, Puerto Rico.

Research Mentor: Elba M. Sepúlveda, Ed. D., C.R.O.E.M. High school, Mayagüez, Puerto Rico.

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

Sunspots are darker than other areas of the sun because they spend less energy and have a much lower temperature. Sunspots have lifetimes of days or perhaps one week or a few weeks. There is a theory about behavior in which every 11 years there is a striking variation in their activity. This theory suggests that they are caused by changes in the Sun's magnetic field. The rotation period of the Sun is faster at the equator than towards the poles, and a 'differential rotation' is created. The solar wind is a stream of energized, charged particles, primarily electrons and protons, flowing outward from the Sun. The solar wind streams off of the Sun in all directions at speeds of about 400 km/s. The source of the solar wind is the Sun's hot corona. The temperature of the corona is so high that the Sun's gravity cannot hold on to it. This research focused on studying if the amount of sunspot and the speed of the solar wind during the years 2009 and 2014 was one during the sunspot cycle and one that was not as active as the other. During this research a comparison of the movement of each sunspot was made and how the solar wind was affected. Afterwards, the movement and the amount of solar wind were analyzed and an average speed was calculated. These results could help to understand if the sunspot theory cycle has a direct relationship with solar wind behavior.

FINDING THE CLASSIFICATION OF THE FRACTAL DIMENSION IN SPIRAL GALAXIES

Orlando J. Martell: C.R.O.E.M High School, Mayagüez, Puerto Rico.

Research Mentor: Elba M. Sepúlveda, Ed.D., C.R.O.E.M. High School, Mayagüez, Puerto Rico.

Research Coordinator: Dr. Arturo Portnoy, Department of Mathematical Sciences, University of Puerto Rico, Mayagüez, Puerto Rico.

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

The mathematics of fractals has been well known for about 50 years. They are a group of figures that cannot be described by Euclidian geometry but by their own math because of the rare occurrence of their never-ending pattern. They can be found in nature. For example, the coast of Great Britain, seen from space, has up and downs, peaks and troughs. Because of it, it cannot be described mathematically by Euclidian geometric but by fractal geometry that explains their expanding and evolving symmetry. This brings forward the fractal dimension. The dimension of a circle is an integer. The dimension of a fractal circle is a circle with a coastline of peaks and troughs, is not and integer but a decimal number. When working with the fractal dimension of an astronomical object, a computer program is used to measure the fractal manifestation in that object. A picture of various spiral type a-c galaxies, the computer program, GIMP®, was used to measure the number of pixels that are giving light in the coast line of that galaxy. When done, the natural logarithm is taken from the number of pixels that give light in the border line and from the division factor, which is the dimension of the picture. A graph is made with these measurements to measure the fractal dimension of the galaxy. It is believed that the galaxy can be classified by its unique fractal characteristics and dimension.

PARALLAX AND STELLAR SPECTROSCOPY

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

Research Mentor: Elba M. Sepúlveda, Ed.D., CROEM High School, Mayagüez, Puerto Rico.

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

Parallax can be described as a displacement or difference in the apparent position of an object viewed along two different lines of sight, and is measured by the angle or semi-angle of inclination between those two lines. This concept can be used to measure the distance to some stars that are relatively close to Earth. As for stellar spectroscopy, this is used to determine their chemical composition as well as temperature. Stellar spectroscopy also includes redshift and blueshift which are used to determine how the star is moving in relation to the Earth, if a star is moving towards the Earth, or farther from it. In this project, parallax was used and studied as a means to determine how it affected the visual and spectroscopic analysis of certain stars. Once having determined the elements that compose each star using stellar spectroscopy, taken note of its movement, and having seen their perceived view during established times, all these variables were compared to show how they changed. This process was repeated at different times, as to determine the differences. Thanks to this research project, data was compiled and analyzed so as to show how parallax affects each star and how this changes, if at all.

ABSTRACTS
ATMOSPHERIC SCIENCES

IMPACTS ON CLIMATE CHANGES AND PRECIPITATION AFFECT AGRICULTURAL WATERS, SOILS AND CROPS RESOURCES IN PUERTO RICO

Patricia Carolina de León Rivera, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

The patterns of water in Puerto Rico are changing dramatically and constantly. The purpose of this project was to study and analyze patterns of precipitation in Puerto Rico. These patterns have changed over the years, for that reason they are evaluated. Changes in rainfall patterns could affect agriculture and soils. To identify how an area was affected, this research concentrated on the northwest area of the island where rain is consistent. The northwest area is the most used for growing the one with most agricultural resources, so the changes in precipitation and weather changes drastically affect this area. An assessment was made of how rainfall patterns have changed, as has been production, and how they affect soil and future crops. Results from the analysis indicated that the rainy season affected the production and the agricultural resources; in addition these changes affected the soils that had difficulties in growing and developing healthy crops. The purpose of this research was to study the effects of climate change on the production of agricultural crops. How the climate changes affect the agricultural resources would help to make changes in favor of nature, create awareness of the importance of these resources, and protect them.

WHAT EFFECT EL NIÑO HAS IN PUERTO RICO

Alondra L. Díaz López, Bautista de Caguas School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

El Niño is characterized by usually warmer ocean temperatures in the Equatorial Pacific. El Niño has effects in different part of the world, like in the southern tier of the US and Peru. Some of those effects are: droughts, floods, tornados, and hurricanes. Recently, scientists from all over the world are studying if the global warming of the planet has any effect on El Niño. Global warming makes the oceans warmer and since oceans influence the climate, it is important to study the correlation, if any. This year has had a Super Niño that has a serious effect in a lot of parts of the world. In this investigation, the difference in ocean temperatures of Puerto Rico when the Niño is present was studied. A correlation, if any, between the water temperatures and climate change was established. The parameter that used to establish the correlation was the average precipitation. It was hypothesized that there would be a direct correlation between the oceans' water temperatures and climate change when the Niño is present. It is important to understand how climate can change when the Niño is present and when it is not. Countries from all over the world have to develop effective plans to face the changes in climate when this phenomenon is present. This investigation has made a contribution to that field.

MINIMIZING AMBIENT HEATING EFFECTS ON A GEONOR GAUGE

Reniel Irizarry-Del Toro, CROEM High School, Mayagüez, Puerto Rico.

Research Mentors: Al Jachcik and Scott Landolt, NCAR/UCAR, Boulder, Colorado.

The GEONOR (T-200B) is a precipitation gauge that works with vibrating wire sensors. This gauge uses a bucket to collect the precipitation, which is suspended from the vibrating wires. When it accumulates precipitation, the wire sensors detect the weight in the bucket by frequency of wire vibrations. Unfortunately, due to some reasons such as ambient heat, vibrations and other reasons are causing these gauges to give unreliable data. Even when there is no precipitation, the sensors are showing the opposite. The frequency of the vibrating wires is changing because of the change in temperature, thereby causing errors in data. The main purpose of this research was to find out find a way to minimize the impacts of temperature changes in the measurements. In order to improve these gauges, different tests were done to see the effects of the change in temperature on the vibrating wire frequency. After testing, it was found that the change in temperature during the day is causing great changes in the output of data. When the heat was applied, the frequency went up or down instead of being stable. Results showed that the errors were not only due to heat changes, but that other factors like outer vibrations were causing the gauge to report unreliable data. When a foam pad was placed below the GEONOR, the frequency stabilized; other factors may include wind, loud noises, or something strong enough to affect the frequency of the vibrating wires. There was found a simple solution to one of the presented problems. The material of the GEONOR could be replaced for another material that does not conduct heat like the metal does, such as plastic or acrylic.

A NEW FREEZING DRIZZLE CLIMATOLOGY FOR KOKC AND KRAP BASED ON AUTOMATED DETECTION

Jorge A. Quiles-Gordillo, Josefina León Zayas School, Jayuya, Puerto Rico.

Research Mentors: Scott Landolt and Dominic Carcagno, NCAR/UCAR, Boulder, Colorado.

This work focused primarily on using the ice-detection sensor on the Automated Surface Observing System (ASOS) at the Oklahoma City (KOKC) and Rapid City (KRAP) ASOS locations. Currently, reports of FZDZ in Meteorological Terminal Air Report (METAR) observations are done solely based on human observations, but freezing drizzle can be hard to detect, especially at night. ASOS does not have the ability to automatically detect freezing drizzle (FZDZ), but a new algorithm being developed at the National Center for Atmospheric Research (NCAR) is making this possible. This project's intention is to analyze data from this algorithm for the KOKC and KRAP sites to determine how well the algorithm is doing, and develop new climatologies of FZDZ for these locations based on automated detection of FZDZ from the sensor. To develop the true dataset for comparing the automated sensor output against other meteorological parameters (radar, satellite, soundings, etc.), they were analyzed to verify that the event was freezing drizzle. Once the algorithm was verified as working correctly, a climatology of FZDZ was done to determine if more FZDZ was detected at the KOKC and KRAP sites than what was reported in the METARs. This climatology showed that there were indeed more reports of freezing drizzle using the algorithm than there were based solely on the METAR reports.

SOLAR FLARES AND AURORAS

Alejandro J. Rivera Caraballo, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

Auroras Borealis, in the north, or Auras Australis in the south, are the collisions between electrically charged particles from the sun that enter the atmosphere. They are better known as the beautiful lights in the poles. The sun emits gaseous particles that travel between 300 and 1,000 kilometers per second. When they enter the Earth's Magnetic field, they are attracted by the circle of the North Pole, and the energy that comes out is the one that creates the auroras. The solar winds bring electrons and protons responsible for the creation of the auroras. A solar flare is a big explosion on the Sun's surface which occurs nearly on sunspots. This happens when the magnetic energy that has built up the solar atmosphere is suddenly released. They occur most years around solar maximum, when the Sun is active. Large solar flares are more frequent than the smaller ones. They can long last solar radiation storm and release a coronal mass ejection that can cause a strong geomagnetic storm on the Earth. A geomagnetic storm is a major disturbance in the Earth's magnetosphere when there is a strong exchange of energy coming from the solar wind. Solar flares eject fast moving flows of particles to the magnetic fields from the solar surface and inner corona. These particles travel through space and if the Earth gets in the way, it is going to get blasted by these clouds which travel at millions of miles per hour. These geomagnetic storms could cause auroras too. The purpose of this investigation was to find out how solar flares affect the auroras borealis or australis. The hypothesis of the investigation was: The auroras will be more intense when the Sun emits more energy because of the increase of protons and electrons in the Earth's Magnetic field. The importance of this research is to know the effects of this problem. And, auroras can be damaged by these solar flares because of all the radiation emitted by them. A direct correlation between the amount of electrons and protons caused by solar flares with the intensity and presence of auroras is expected to be found. This study contributes to discover how the solar flares could affect the phenomenon of the auroras.

ELIMINATION OF SPACE DEBRIS

Amanda F. Robles López, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

Solar flare occurs when magnetic energy increases in the solar atmosphere and is suddenly discharged. This phenomenon occurs at the end of the Sun's cycle which is eleven years and extends to the outermost atmospheric layer of the Sun called corona. The radiation released can enter the magnetosphere, damaging the devices found in this magnetic field. Debris or "space junk", remains of anything broken down or destroyed, are found in the magnetosphere. The magnetosphere is the outer region of the earth's ionosphere, where the earth's magnetic field controls the motion of charged particles. The rising population of debris increases the potential danger to satellites or space crafts filled with astronauts. According to the National Aeronautics and Space Administration, orbital debris is a man-made object in orbit about the Earth which no longer serves a useful function. They are more than 500,000 debris around the Earth. This object can travel at speeds up to 17,500 miles per hour, fast enough to damage devices close to that area such as space vehicles but most important, the international Space Station. The National Aeronautics and Space Administration has a set of guidelines on how to deal with each potential collision threat but does not have a device that can eliminate debris without generating more. After completing the first phase of the research, obtaining knowledge of the subject, the second stage will include designing the potential device. The device must be able to complete its standards and after being tested it will be constructed. The purpose of this research project was to investigate the effects of solar flares on electronics located on the magnetosphere. Knowing its effects will allow scientist and engineers to design a device that can capture or destroy debris without creating more "space junk". It will be capable of resisting the majority of effects generated by the solar flare. This will eliminate a current problem that the world is facing and by doing this the different missions would not be disrupted or destroyed and are going to be able to complete their mission.

EFFECTS OF EL NIÑO ON HURRICANES IN THE ATLANTIC OCEAN

Miguel A. Santana Ducoudray, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

El Niño is a climate cycle in the Pacific Ocean with a global impact on weather patterns around the Earth. A hurricane is a type of storm with violent winds, happening most of the time around the Caribbean. The investigation was based on the effects of "El Niño" in hurricanes or tropical storms in the Atlantic Ocean. The methodology of the investigation consisted in recording all the hurricanes that had been named; in other words, the hurricanes that were compared were the hurricanes that had hit the island since 1950. The purpose of this research was to see if the effect of El Niño makes any changes in the creation of hurricanes in the Atlantic Ocean, specifically in hurricanes that have hit Puerto Rico. It has been found that most of the hurricanes that have hit Puerto Rico were during the interchange of El Niño to La Niña and in the time while La Niña was present. The hypothesis of the investigation was that if El Niño is present, then less hurricanes will be formed. At the end of the research it was found the hurricanes were formed during the period of the interchange from El Niño to La Niña and when La Niña was present. Only one out of the seventeen hurricanes studied was formed during the process of El Niño. Three of them were formed during the interchange and the rest were formed during the process of La Niña.

CORRELATION OF CORAL BLEACHING IN PUERTO RICO BY TEMPERATURE SHIFTING CAUSED BY EL NIÑO

Jancie L. Santiago González, Caguas Private School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico

Atmospheric Science is the study of all physical and chemical phenomena occurring within the Earth's atmosphere or the atmosphere of any other planet. The atmosphere has several layers, such as the Troposphere, Stratosphere, Ozone, Mesosphere and Ionosphere. Each of them has a role in the atmosphere. "El Niño" refers to the large-scale ocean-atmosphere climate interaction linked to a periodic warming in sea surface temperatures across the central and east-central Equatorial Pacific, threatening corals in Puerto Rico and the U.S. Virgin Islands. Coral reefs are some of the most diverse ecosystems in the world. Live corals are the most important contributors to the structure of a saltwater reef in nature as well as in reef aquariums. The appearance of some species of corals varies dramatically depending upon the environment. Thousands of species rely on reefs for survival. Thousands of communities all over the world also depend on coral reefs for food, protection and jobs. Some corals can recover from mild bleaching, and severe or long-term bleaching is often lethal. After corals die, reefs quickly degrade and the structures corals build erode. This provides less shoreline protection from storms and fewer habitats for fish and other marine life, including ecologically and economically important species. A correlation is a mutual relation of two or more things. The purpose of this research was to create a correlation to observe if El Niño is responsible for the corals bleaching.

FORECASTING DIURNAL TEMPERATURE RANGE

Desireé Zavala Osorio, Caguas Private School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

The drastic change of climate between day and night is Diurnal Temperature Changes (DTC). First, the purpose of this project was to make people aware of the extreme changes in temperature that might affect the human being's health and property. A great example of DTC takes place in Nevada, USA. There is a geographical reason why these changes occur. DTC takes place in arid regions such as the western and central areas of the U.S. more than in the Northwest and Eastern zones. People would be interested in this project because drastic changes in climate in Puerto Rico are not that conceivable. The first step to showcasing the project was to show Puerto Rico's subtle DTC. It was expected to find a difference between Puerto Rico and Nevada. The procedure included classifying the annual temperature for 2014 to 2015 of Las Vegas, Nevada. The data recording started in the month of July, 2014 and finished in June, 2015. In order to showcase the drastic changes and evident pattern, Puerto Rico's annual data of 2014 to 2015 were also classified. The expected results was the graphs of Las Vegas's temperature to have a pattern as the day to night changes are very predictable. The results were unexpected because no pattern was found although it made a new step into discovering a century of Nevada's temperature changes. This information is essential if someone is visiting the place. People can protect themselves from illness through changes of temperature if they start by slowly dropping the temperature of the room exposing themselves to the outside. This will contribute highly to the field of agriculture in the state of Nevada, hence there is a great change of temperature that might affect how crops grow.

ABSTRACTS
BIOLOGY

DEMONSTRATION OF BRAIN DEGENERATION THROUGHOUT ALZHEIMER'S DISEASE

Génesis C. Cartagena Marrero, CIMATEC School, Caguas, Puerto Rico.

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

Alzheimer's is a type of dementia that affects the memory, thinking and behavior of a human being. In the preclinical stage of AD, people seem to be symptom-free, but toxic changes are taking place in the brain like abnormal deposits of proteins, which form amyloid plaques and tau tangles throughout the brain, and once-healthy neurons stop functioning, loses connections with other neurons, and die. During the first stage, Mild Alzheimer's stage, the affected patient starts to forget recent information and memory lapses, also the entorhinal cortex starts to damage, where neurotic amyloid plaques are spread around the cortex, deteriorating the neuronal material. In the second stage, Moderate Alzheimer's stage, damage occurs in areas of the brain that control language, reasoning, sensory processing, and conscious thoughts, which are the areas of the hippocampus that are being affected, causing its neurons to shrink and degenerate. In the last stage, Severe Alzheimer's stage is where the body does not have enough neurons to perform its normal functions. In this same stage, the temporal lobe and parietal lobe are being damaged, producing different diseases like apraxia, agraphia or aphasia, making the people lose all their memory. In particular, two cortical systems that appear to be involved in the neural processing of memory are selectively vulnerable to degeneration in AD. One consists of connections between the hippocampus and its neighboring cortical structures within the temporal lobe. The second is the cortical cholinergic system that originates in neurons within the basal forebrain and innervates the entire cortical mantle. The circuitry in these systems shows early and severe degenerative changes in the course of AD. The Alzheimer disease, is studied through MRI, FMRI and Pet-Scans. The MRI diagnoses and takes pictures of the disease, while the FMRI measures the brain's activity and lastly, the Pet-Scan evaluates the tissues and organs function. The purpose of this investigation was to compare the numeric measurements of the different stages damaging the brain's circuitries. The program used was CellProfiler and the module Identify Primary Objects. This module helped to compare the numerical measurement of damage it made from each stage to another in the disease. The expected results for this investigation were that the numerical damage done to the brain would increase over the course of the disease.

EXPRESSION OF VITAMIN B12, UBIQUINONE, AND COMPLEX I IN MITOCHONDRIAL FUNCTIONING AND CIRCUITRY OF ALZHEIMERS DISEASE

Claudia Cruz Santiago, Notre Dame High School, Caguas, Puerto Rico.

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

Characterized by severe memory loss, the treatable but incurable neurodegenerative disease, Alzheimer's (AD), is the most common form of dementia. Mitochondria dysfunction plays an important role in the early pathology of AD. It has been shown that oxidative damage occurs before Amyloid Beta plaque formation which is directly linked to AD. Beta-amyloid gradually builds up to form plaques that accumulate outside nerve cells. Amyloid is a protein that is normally found throughout the body. For reasons as yet unknown, in AD, the protein divides improperly, creating a form called beta amyloid which is toxic to neurons in the brain and a cluster of these may block cell to cell signaling at synapsis. This investigation discusses how some causes of AD can be avoided by fixing mitochondrial dysfunction. Many medications or supplements involved in mitochondrial metabolism provide benefits. Among these are the B12 vitamin, ubiquinone (coenzyme Q10; CoQ10), and Complex I. Since Alzheimer's is closely linked to impairments of the mitochondrial citric acid cycle and oxidative phosphorylation (OXPHOS) enzyme, there is energetic insufficiency and depleted energy reserve in brain tissue. The purpose of this research was to compare the effects of these medications on the human brain and find out which one works best in Alzheimer's disease. To conduct this research, CellProfiler was used to compare a magnetic resonance image (MRI) of a brain with deficiency of these medications and an MRI of a brain with the dementia. The Comparing Primary Objects module was used to compare the hippocampus in the absence of one of the supplements to one with Alzheimer's that is not being treated as well as an MRI of a healthy brain. The analysis revealed that the effects of one of the supplements was worse and that the supplement would be needed to avoid some cases of mitochondrial disease and as expected AD.

THE EFFECTS OF NFB TREATMENT ON PARKINSON'S DISEASE-AFFECTED CIRCUIT

Carolina I. Delgado Maymó, CIMATEC School, Caguas, Puerto Rico.

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

Parkinson's disease (PD) is a chronic and progressive disorder of the central nervous system affecting motor movement and the patient's cognition. It is caused by low dopamine concentration on the substantia nigra. Although this disease cannot be cured, some medications can help control the symptoms. There is another ideal kind of treatment discarding the use of drugs named neurofeedback (NFB). Neurofeedback (NFB) is a technology-based learning technique that uses a computer to give information to a person about his or her own brainwave pattern in the form of EEG (electroencephalogram) activity or fMRI, in order to train the person to modify his or her own brainwaves. NFB relies on rapid decoding of brain states from fMRI data to provide participants with feedback, on a moment-to-moment basis, about activity within predetermined brain regions. The purpose of this investigation was to compare the circuits of those who take the medications (drugs) and who that take the NFB as treatment for PD. To analyze the circuitry, the program CellProfiler and the module Identify Primary Object were chosen. Identify Primary Object helps in this investigation, comparing their differences and how each treatment affects those with Parkinson's; as it gives the numeric measurement information about the most abundant objects in the image. The conclusion would be based on the numerical improvement or deterioration of NFB through the stages of PD. The expected results is that the patients under NFB treatment have a higher level of effect (longitude) than those with Parkinson's disease that use drugs, since previous investigations patients who received NFB successfully unregulated a higher cortical motor area and concomitantly influenced activity in basal ganglia circuits implicated in PD, improving motor functions.

OBESITY AS A CONTRIBUTING FACTOR IN ALZHEIMER'S DISEASE

Diego E. García Ortiz, Fruto de la Vid Christian Academy, Gurabo, Puerto Rico.

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

Alzheimer's is a dementia that is known for the degeneration of the neurons and brain to such an extent that causes memory loss, confusion and personality changes. This dementia can affect the brain with symptoms like worsened ability to take in and remember new information, impairments to reasoning, complex tasking, exercising judgment, impaired visuospatial abilities, speaking, reading, writing, and changes in personality and behavior. There are other factors like obesity that can contribute to the acquisition of Alzheimer's. During obesity the brain is not able to let go beta-amyloids, which are a substance that accumulates in the brain. If the brain does not let go of this substance, it can turn into a powerful neurotoxic that can destroy the neurons causing Alzheimer's dementia. Obesity which is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health, leading to reduced life expectancy and/or increased health problems. Obese people show resistance to leptin, which is a hormone that controls weight management, thyroid function, stress, mental capability, among others. If Leptin does not regulate the signal correctly, it can cause the neurons to un-detect the obesity in the body causing hunger and a decrease in metabolic function. Obesity can be caused by an additive in unhealthy food called GMS, which is Glycerol Monostearate, that in large amounts can enter the hypothalamus, the hunger control zone, causing more hunger and consequently, obesity. The purpose of the research was to determine how obesity causes this dementia by comparing images of dysfunctional brain circuitry. The comparison was made with the CellProfiler program using the module Identify Primary Objects to visualize the comparison of a neuron in a normal person, a neuron affected with Alzheimer's, and a neuron with Alzheimer's and obesity. It is expected that the results will make people aware about how obesity can cause Alzheimer's in the future and the importance of eating healthy foods.

COMPARISON OF AN MSN NEURON WHEN AFFECTED WITH HUNTINGTON'S CHOREA

Nathaly M. Lebrón Cruz and **Juan E. Adrover Claudio**, Notre Dame High School, Caguas, Puerto Rico.

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

Huntington Chorea (HC) is an autosomal-dominant genetic disorder characterized clinically by a triad of motor, cognitive, and affective degeneration; this disease is associated with neuronal loss within corticostriatal circuits. The neural loss occurs as a result from the degeneration of neurons primarily in the basal ganglia, caused by the deficiency of Gamma- Aminobutyric Acid (GABA). HC affects the Medium Spiny Neuron (MSN), cells that receive glutamatergic and dopaminergic input, which are found in the corticostriatal circuit. This circuit receives excitatory glutamatergic input and dopaminergic intervention. Since HC affects the corticostriatal circuit, once the circuit is symptomatic it delivers an irregularity of dopaminergic and glutamatergic input signaling to the MSN which affects the communication between these neurons. In the late stages of the disease, the calcium channel binds directly with Huntington causing the affected neuron to lose its dendrites and all communication. The purpose of this research was to potentially demonstrate numerically the degeneration of the MSN neuron when affected by Huntington's Chorea in the event of the disease. By implementing images of the MSN into CellProfiler it was determined how the neurons are affected by HC and how they degenerate from the early stages of the disease on to the late stages. These results were obtained by using the "Identifying Primary Objects" module, which shows a chart with numbers and potentially helps in finding the difference between a healthy neuron and an affected one. This investigation is going to help in the understanding of how Huntington's Chorea affects the MSN.

ANALYZING THE IFR6 GENE USING SIFT

Luis Enrique Orta Rodríguez, Homeschool.

Research Mentor: Elvin Méndez Sotomayor, Universidad Del Este, Carolina, Puerto Rico.

The IRF6 gene encodes a protein that plays an important role in early development. This protein is a transcription factor, which binds to specific regions of DNA. It helps to control the activity of other particular genes. A mutation of this gene can cause the Van der Woude syndrome and the popliteal pterygium syndrome. This mutation affects the development of the face. The purpose of the research was to use SIFT to analyze if this gene had any mutation by changes in amino acid substitution. It was predicted the substitution to be intolerant. Results revealed that 4.25% of amino acid substitutions were tolerant and 95.75% were intolerant. This demonstrates that this protein had a high probability of being mutated.

YOUNG BLOOD WILL HELP DELAY AGING

Amanda Reyes and **Sofía A. Rodríguez**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

In this research a search was conducted on information proving what type of stem cell is responsible for helping to delay or rejuvenate tissues and organs that are damaged due to aging. There are two different types of stem cells; the adult and embryonic or germ cells. Hematopoietic cells are part of the adult cells. These are present in the baby's umbilical cord and bone marrow. This type of cell has the ability to clone and create copies of themselves to regenerate organs and tissues. In this cell, there are three key components; white blood cells, red blood cells and platelets. Germ or embryonic cells are different cells; totipotent, pluripotent, multipotent and unipotent cells. Unlike adult cells, embryonic cells are in the early stages of the embryo. These cells have the ability to produce any type of cell in the body. Under the right conditions these cells retain the ability to divide and make copies of them indefinitely. This type of specific cell is extracted from the second stage of the development of the Amanda embryo, called the blastocyst. Adult cells and embryonic cells are completely different; adult cells are versatile, and are obtained by destroying embryos, since their cell growth is out of control they have the appearance of cancer. Instead, embryonic cells, although they are a little versatile, they are extracted from the embryo and umbilical cord of a baby and their growth is normal with no tumor risk.

DESCRIPTION OF SEPT2, SEPT4, SEPT5, AND SEPT8 ROLE IN SYNAPTIC PLASTICITY AFFECTED CIRCUIT

Ian J. Rivera Rodríguez, CIMATEC School, Caguas, Puerto Rico.

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

Synaptic plasticity can be described as the ability of synapses to strengthen or weaken, in response to increases or decreases of activity. When one neuron drives the activity of another neuron, the connection between these neurons is potentiated; therefore, deregulation of synaptic plasticity could result on the malfunction of control mechanism regulating neural activity, affecting the neurocircuitry of the brain. A highly conserved group of guanoine-5'triphosphate-binding proteins called septins show high neuronal expression and are implicated in the regulation of synaptic vesicle trafficking and neurotransmitter release, affecting the neuronal plasticity and the processes concerning the communication between neurons. There are four members of the septins family that have been strongly linked to synaptic plasticity: SEPT2 which is linked to increased levels of glutamate and overstimulation of NMDARDS; SEPT4 which is linked to EAAT1 like SEPT2 and with diminished dopaminergic transmission; SEPT5 which can form barricades at the presynaptic membrane and also can cause decreased exocytosis; and SEPT8 which is linked with enhanced docking of vesicles to the presynaptic membrane. The purpose of this investigation was to develop a detailed description of the neurological pathways concerning the effects of these septins on synaptic plasticity. The link between the septins and synaptic plasticity on the circuits of the brain is almost evident and well sustained. This research provides new evidence with a more throughout understanding of the septins and their link with synaptic plasticity. In order to archive this, the programs CellProfiler and VMD were used. CellProfiler analyzes a photo of a dendrite affected by septins and a healthy dendrite. With this program two modules were used, Identify Primary Object that identifies the dendrites and Measure Neurons that measures the branching information of these dendrites. With VMD a 3D model of each septin can be made to have a better understanding of each protein. A pathway of how these septins affect the synaptic plasticity was assembled in order to comprehend how these proteins affect the circuits of the brain. It is expected that the dendrites affected with these septins will more likely have abnormal results in the analysis of these branches.

ANALYSIS OF THE MAGNITUDE OF NEURONAL APOPTOSIS CAUSED BY TAU PROTEIN LEVEL RISE

Rafael E. Rodríguez Rivera, CIMATEC School, Caguas, Puerto Rico.

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

Corticobasal degeneration (CBD) is a progressive neurological disorder characterized by nerve cell loss and atrophy, which consists of brain shrinkage in multiple areas, including the cerebral cortex and the basal ganglia; these are responsible for cognitive functioning such as learning and understanding, and physical movements, respectively. Normally, a set of neurons linked together functionally in the brain assume the task of offering the correct response; it is the passage of information through a circuit that gives a response. CBD occurs due to the misfolding of proteins into a toxic form that not only causes them to lose their normal function, but spread to adjacent cells as well. The neurocircuitry of the brain is interrupted because of the tau protein level rise, which builds up, forms clumps and provokes apoptosis. Furthermore, this condition features circumscribed parietal or frontoparietal atrophy, with serious cortical neuronal loss and sharp astrogliosis, spongiosis, swollen, achromatic neurons, and infrequently, neurofibrillary tangles. The purpose of this research was to analyze the magnitude of the multiple brain parts shrinkage, specifically the ones mentioned above in CBD using the results gathered from *CellProfiler*. This was achieved through the “Identify Primary Objects” and “Identify Secondary Objects” modules, along with their count output. The first module served the purpose to identify types of abundancies in the cell that may be causing tau protein levels to rise. With the objects classified from the “Identify Primary Objects,” the second module served to identify those parts of the brain that their cell borders touch each other, and consequently making it harder to delineate. The research’s expected results were that *CellProfiler* would identify an inconsistency in neurons causing parts of the brain to shrink, principally the ones responsible for movement response and cognitive functioning, which will later be analyzed utilizing results obtained.

COMPARISON BETWEEN A BILINGUAL AND MONOLINGUAL EXPOSURE BASED ON THE PYRAMIDAL CELLS OF THE HIPPOCAMPUS

Valeria Rosario and **Jorge J. Colón Cintrón**, Bautista de Caguas School, Caguas, Puerto Rico.

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

Language acquisition can be defined as the process that humans use to acquire or comprehend a language, including learning to speak, write or use sign language. Within language acquisition, the first-language acquisition is included; that is, the study of the first language or the native language of the infant. Also, second-language acquisition is included, which deals with the attainment of a foreign language. Language acquisition occurs in the Hippocampus, a part of the brain that contains the Pyramidal neurons, cells characterized by their stable and constant firing. The main functions of the Hippocampus are short-term memory, long-term memory and learning. The purpose of this research was to compare the bilingual and monolingual exposures to language, and using magnetic resonance imaging (MRI) pictures, to understand how these types of exposures affect the firing of these neurons. First, two different exposures were compared using the verbal format in the monolingual exposure and using the verbal and gestures formats in the bilingual exposure. Secondly, the monolingual and bilingual exposures were compared, both using the verbal format with the only difference being the number of languages. Furthermore, using “Cell Profiler,” with an emphasis on identifying primary objects, MRI pictures of the two different exposures it were analyzed. By comparing these in the program, differences in quantification of the growth in the affected parts could be seen. The numerical results obtained revealed how the exposures affect the firing of the neuron. Finally, by studying other investigations about language acquisition, it was expected that the exposition to a bilingual environment could create neuroplasticity and more brain activity.

ABSTRACTS
BIO-ENGINEERING

THE EFFECTS OF METHYLENEDIOXIMETHAMPHETAMINE ON SEROTONIN TRANSPORTERS

Nathaniel Sánchez Bruno, Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico.

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

3,4-methylenedioxy-methylamphetamine (MDMA) is a drug, also known as ecstasy, which causes a surge in the release of several neurotransmitters, mainly the monoamine: serotonin. This effect may cause the user to feel euphoria and great pleasure, but through research it has been discovered that MDMA causes great dangers. These dangers have been shown to be physical exhaustion, constant sweat or asthma. MDMA may also cause neurotoxicity, since this drug attaches to the serotonin axons through the Serotonin Transporters (SERTs), which are tiny molecular pumps that neurons use to collect serotonin. Once inside, this chemical is broken down by Monoamine Oxidase (MOA). This breakdown process creates oxidizing chemicals, like hydrogen peroxide, that can damage the neuron. Dopamine also may contribute to the neurotoxicity by increasing body temperature, which is extremely important to know if MDMA causes neurotoxicity or not. Studying MDMA and its reaction in the brain is important in order to know this drug's unhealthy outcomes. In order to study the brain, its reaction and effects by MDMA, images of brains under the effects of MDMA and a normal sober one, must be compared. Using the Primary Object Identification that the program CellProfiler provides, the mass of the serotonin in the brains' images of a non-user of MDMA, a regular MDMA user, a recent MDMA user, and a past user were compared. Employing Image J's Automated Counting of Single Color Cells, it was expected that the effects that MDMA on the quantity of serotonin axons could be seen. Both of these results could later be studied in order to see how this could be prevented. While research on this topic is very limited, this investigation contributes to more knowledge to the scientific community and learn how people can benefit from it. MDMA causes great danger to neurotransmitters in the brain; research can be done in order to know how ex-MDMA users can be treated.

MORPHOLOGICAL COMPARISON BETWEEN PD NEURONS AND NEURONS WITH HIGH ALPHA SYNUCLEIN EXPRESSION

John Lee Soto Vargas, Thomas Armstrong Toro School, Ponce, Puerto Rico.

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

Parkinson Disease (PD) is the second most common neurodegenerative disease in elder people after Alzheimer's. Parkinson Disease is related to the dopaminergic neuron (DA) lost in the substantia nigra. Accordingly, PD is a motor disturbance that can cause motor fluctuations, dyskinesia, resting tremor, rigidity, bradykinesia/akinesia, and postural instability. This disease has been linked to the Lewy Bodies, and Lewy Nutrients which are mainly formed by the alpha synuclein (α Syn) protein. Additionally, high levels of this protein may disturb the vesicle density and inhibit the neurotransmitters released causing a possible DA death. Consequently, α Syn has also been known to be important in the pathogenesis and progression of the Parkinson Disease as well as the synaptic plasticity, vesicle-associated membrane protein 2 (VAMP2), and SNARE complex. This investigation aimed to determine if the dopaminergic neurons that are affected with PD and α Syn show a significant morphological change. In order to compare the neurons, the CellProfiler neuron module was used, that includes the Identify Primary Object, Identify Secondary Object, Morph, and Measure Neurons approaches for the multiple comparison of the morphology. The Identify Primary Objects approach was used for the observation between the nuclei of the neurons by the creation of a scatterplots. Moreover, the Identify Secondary Object was used for the identification of the exterior of these cells, while the Morph was used to skeletonize the structure of the neurons. The skeleton in the Morph approach was used in the Measure Neuron for the comparison of the length of the different structures of the neurons. After the measurement of the cell structure, each magnitude was associated and analyzed to conclude if there was a significant difference between the PD, PD with α Syn, and the healthy cells. It was concluded that the PD dopaminergic neurons with α Syn will be affected in the morphology while the healthy controls will not suffer any change. This research will help with the better understanding of α Syn role in the PD as well as the effects on the morphology of DA, and also will help to better identify the α Syn in the PD neurons.

CIRCUITRY IN THE AXON OF ALS AFFECTED NEURONS

Brayan Vega, CIMATEC School, Caguas, Puerto Rico.

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

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease that affects the motor neurons of the central nervous system, causing the axon of the neuron to degenerate and detach from the muscle resulting in motor neuron dysfunction, paralysis and death. This disease is divided into sporadic and hereditary forms; the appearance of sporadic ALS in patients is linked to the Tar DNA Binding Protein (TDP-43), a binding protein in the RNA that regulates the transcription process to produce protein from genes, this protein is also associated with cytoplasmic stress granules (SGs) that are a non-lasting structure that forms in response to stress. These SGs that are formed in the cytoplasm of the neuron are toxic to the cell and are thought to contribute to the degeneration of the axon when the cell is affected with ALS. This investigation is expecting to observe how this disease affects neurocircuits. When the cell is affected with this disease the signal towards the muscle fiber is interrupted, causing the axon to ultimately degenerate resulting it impossible to send the body the instruction. The proposition of this investigation was to express numerically the extent of damage done to the axon of the motor neurons affected with ALS, and also to compare these neurons to a control image from a healthy motor neuron through the image analysis software CellProfiler. This comparison was achieved by using the Measure Neurons module that measures the axon information for neurons calculating the number of difference in length of the axon. In addition, the Identify Primary Object module was also used in the research to calculate every pixel of the image of the nerve cell and establish a threshold that will identify as primary object all the pixels that surpass the threshold value. The predicted results of the investigation were that the value of the measurement for the affected neuron would be lower when compared to the healthy motor neuron.

ABSTRACTS
BIO-MATHEMATICS

SYNAPTIC CONNECTIONS IN SUBSTANTIA NIGRA: BRAIN STEM CIRCUITRY DYNAMICS DUE TO PARKINSON'S

Amanda Cáceres-Vázquez, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico

The human brain is composed of billions of cells called neurons. They each communicate and connect with one another through the synapse in the presynaptic endings of the axon terminals. This is the action that transmits signals through the nervous system in the form of electrical and chemical exchanges. Furthermore, the neurotransmitter secreted in the midbrain area is called Dopamine. It's in charge of controlling movement and posture through the Substantia nigra. But what happens when there's loss of dopamine in this region of the brain? Having Parkinson's affects muscle control and balance and that alone increases the possibilities of future complications for the average person. As the substantia nigra is invaded by damaged brain cells, these deteriorate parts of the brain stem and its circuitry. With a directed approach, a graphical visualization of the stem's circuitry will be simulated in order to test connections with numbers in which changes can be explained. A mathematical component of this is plots in which potential runs will be aimed at modeling the dynamics in which the synapse is altered due to the mentioned neurological disease. It is expected that the duration of the simulation will be measured in the seconds unit with correlations being compared in Hz. Gathered data suggests that the brain stem circuitry is severely affected and for this a decomposition of the illness' structure was done to examine and graph potential areas where the disorder may attack next keeping in mind the integrity of the circuit itself is under degeneration. Accurate results will depend on the accurateness and precision of the functional understanding of the domino effect this may also cause in the cerebral tissue.

LANGUAGE RECOGNITION INTERFACE: NEUROPHYSIOLOGICAL CORRELATION IN AUDIO-VISUAL PERCEPTION

Valeria Cáceres-Vázquez, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

In 2007, the American Community Survey found that about 55 million US citizens spoke more than one language, other than English; which would be an eighteen percent of the population. When the subdivisions in the cerebrum were examined, it was found that there was a specific section in charge of controlling communication processes. Furthermore, the region in the brain where languages meet or communicate with each other is called the language recognition interface. This allows to switch from one language to another and still understand the encoded message received. Even though there are different lobes, which perform different functions, they unite in means to manage the different types of information acquire through the different senses. Moreover, circuits integrated with language characteristics were developed to simulate the electrical current that occurs. Also, to have a correlation, the Hz unit was used for the conversion of the results from milliseconds to frequencies since it is through the auditory component of the brain that this encoded data is received. Another neurophysiological correlation takes place between the occipital lobe and temporal lobe, which correlates in audio-visual perception. Alterations in the recognition section were induced to analyze and view from a stable visualization and the experimented one.

TEMPOCEREBRAL CIRCUITRY: LANGUAGE ACQUISITION DYNAMICS

Francisco A. Carrasquillo-Gutiérrez, St. Mary's School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

The way we learn and acquire new languages is made possible by listening, hearing and the visualization of words, phrases and sentences. This ability is primarily linked to the temporal lobe, also responsible for processing auditory information. It is also key to being able to comprehend or understand a meaningful speech or physical interaction. For the average human being in modern times, phonetics is an essential part of communication nowadays. The circuitry in the tempocerebral region is one of the most active parts because it carries and undergoes millions and millions of chemical exchanges and electrical impulses. For this, a set of words from random languages were chosen and then showed to a group of 100 people. They were subdivided into groups of 25 to have four representations of the averages gathered from the recollection of data. Furthermore, language acquisition was measured in rapidness ranging from milliseconds and then converting them to Hz. Moreover, the dynamics shown was that a majority of people took more time in memorizing the words and then pronouncing them correctly. Applications of Ebbinghaus' Forgetting Curve law were used to correlate results and have a better understanding of the outcomes found in this experimental approach.

CHARACTERIZATION OF A NEURAL SYSTEM: CIRCUITRY IN BRAIN PLASTICITY WITH ALZHEIMER'S

Jennifer N. Figueroa-Cruz, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, PR

Having the ability to change, adapt and mold itself is what is established as brain plasticity. A neurodegenerative disease like Alzheimer's attacks healthy cells in the human brain known as neurons. It may cause major progressive loss of memory, thinking abilities, language skills and motor functions. Furthermore, characterizing a neural system is meant for taking point of how that communications pathway works. Moreover, the network of interconnected neurons can easily be damaged by a decay of the cerebral matter. To function properly, a system must have a central or command center and representatives in which signals can convey and transform information through circuits. After the advancement of the mentioned disease in brain tissue is studied, randomly selected digits are put to the test. This, to relay an encoded message at the beginning of a simulation done with changing environment (plasticity). Additionally, underlying factors are considered; for example, mathematical error or misinterpretation. The circuitry in the brain's plasticity is severely altered and for that a set of circuits displaying healthy cells was developed. It was expected to see a fluctuation in the first run once the circuits were exposed to the initial encoded information.

CLOTHES' EFFECT ON BEHAVIOR

Jailynnette M. Heredia Morales and **Odalys M. Cruz Romero**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Nowadays, clothes is considered as a second skin. Some people do not usually dress like they want, they dress according to the social pressure. To fit into a group, they are able to do things even if they are not of their taste, to be accepted. In this research, the question was if the clothing of a person is related to their behavior. To test this, 25 people were randomly selected and administered a questionnaire. At the end of the interview, they were analyzed and saw if the way they dressed was related to their behavior. After analyzing the results it was concluded that the clothing worn is directly related to behavior.

SEMANTIC PROCESSING OF LANGUAGE: LONG-TERM DECLARATIVE MEMORY CODIFICATION IN CIRCUITS

Laura I. Marrero-Santana, University High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

Human behavior is identified by a variety of mental capacities and abilities. One of them is language. How do we process language, and how is this process called? According to *Bréal*, 1897, the semantics of a language is the relationship between words and the stores of knowledge they signify. Furthermore, the cognitive act of accessing stored knowledge about the world refers to semantic processing. The declarative component of memory formation is essential to this research because it signals the root from where it all begins. Moreover, after a randomized selection of numbers was completed to study the codification in the long time recognition frame, a comprehensive simulation was developed and plotted in Hz. This, together with a model, is expected to display the velocity in which the neural circuit gains the information is being exposed to meaning numbers ranging from hundreds to thousands. Also, precise feedback is expected once the correct alteration is made to see how plot reacts and how it computes changes with duration also being measured in milliseconds. This insight or memory is encoded in the medial temporal lobe of the brain, but is consolidated and stored in the temporal cortex and elsewhere. Consequently, this elaboration of the neural development of the understanding of circuit-programming will show patterns and correlations in sensory and motor activities as shown in background studies made to substantiate this claim.

SOLAR CART: HOW TO MINIMIZE THE USE OF OIL

Cristina E. Martes Lugo and **Mirelys Negrón Ríos**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

The use of solar cars is already possible and is very good for conservation. However these cars still use a lot of oil, which is highly toxic. In this research, a solar vehicle was designed in which the use of oils is minimum. We started doing a web search to expand knowledge of the solar panels, solar power and circuit operation of a toy car. Then there was work with the design of the complete circuit consisting of the car and its performance. The circuit was designed with solar panels. In this circuit, electricity was replaced with sunlight, a prototype was designed and evaluated. After making the prototype, it was evaluated and it was concluded that it was functional.

RESISTANCE IN EXCITATORY NEURONS: EPILEPTIC EPISODE DUE TO IONIC CIRCUITS ALTERATIONS

Carla N. Martínez-Pérez, University High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

The International League Against Epilepsy (ILAE) has defined epilepsy as a disorder that is characterized by a tendency of recurrent seizures. An epileptic seizure is the abnormal neuronal activity that becomes excessive in the brain. Calcium influx into the neuron favors the release of excitatory amino acids contained in the vesicles of the presynaptic axon terminals. However, glutamate is the most abundant and is accumulated in the synaptic space due to the release of an excess and a shortage of active uptake mechanisms. Normal neuronal function involves maintaining a certain difference in transmembrane potential of about 60-80 mV, with intracellular negativity. If for some reason the balance is disturbed between a standard called excitatory postsynaptic potential and the action potential, paroxysmal depolarization occurs. For this, a comprehensive analysis of excitatory neurons was done. A simulation included not only the ionic variables, it also had the range in which resistance in these neurons can cause episodes. The functionality of voltage-gated ion channels in the neuronal membrane was studied to gather more data leading to neuronal inhibition. A genetic background research was used to support the reasons why massive influx of calcium, sodium and water are generated in homeostasis. The encoding of neural circuits in this kind of environment was delicate as it required stable electric and chemical activity. Having an overcharge of abnormal flow of impulses was deathly for the cell and the average person as it could lead to deficits. If this is yet to occur, the brain will exceed its electrochemical gradient, thus provoking an epileptic episode.

DYNAMICS IN NEURAL CIRCUITS: DEGENERATION IN HIPPOCAMPAL FORMATION DUE TO ALZHEIMER'S

Natalia M. Mas-Kildare, University High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

Alzheimer's is a progressive brain disorder that has a negative effect on memories, thinking abilities, and carrying out daily life conversations. This occurs due to neuron death and degeneration in hippocampal formation. According to Alzheimer's Disease International, nearly 44 million people worldwide have this health complication. It can be developed or genetically inherited. Dynamics in neural circuits are responsible for producing and controlling the behavior of a certain person, they also detect signals (Na^+ , K^+ and Ca^+). Therefore, compromised neurons are not able to detect or receive them properly. Furthermore, their somas (cell body) become ineffective leading to no brain activity; brain death because there's no current of electrical impulses. The information flows from the dentate gyrus (located in the hippocampus) to CA3, and finally to CA1, hence the neurocircuit is completed and new information is acquired. Having the mentioned disease causes for the neural network to enter in a phase of dysfunctionality. After the circuits created to simulate degeneration successfully displayed abnormal hippocampal formation, spikes in the plots were observed due to alterations manually entered to observe graph behavior. Moreover, the dynamic in this illness is a domino effect that starts from within brain matter. So, numerical and ionic variables were instituted to stimulate the developed single circuit alone and duration time was gathered and analyzed in milliseconds and then converted into Hz. This kind of mathematical and visual approach helped in providing precise data that when visualized resulted in the better understanding of the decay of the human brain.

THE EFFECT OF THE INTERNET ON HUMAN BEHAVIOR

Claudia M. Ramos Rodríguez and **Julián A. Batista Lugo**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Technology has become an integral part of life. The most known success has been the Internet, which has granted people with tremendous powers and opportunities. Yet the Internet can have positive and negative impacts on humans. The Internet seems to have taken control over people's everyday lives. This investigation consisted on finding how the Internet is affecting human behavior. The Internet affects behavior in many negative ways. It attacks self-esteem giving negative thoughts and feelings of jealousy or envy. It also makes the human being develop an addict's brain. This was proven by giving questionnaires to people who used the Internet daily.

FRACTALS IN HUMAN DNA

Eliud R. Rivas Hernández, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Elba M. Sepúlveda Ed.D., CROEM High School, Mayagüez, Puerto Rico.

Research Coordinators: Edwin Benvenutti, CROEM High School; Dr. Arturo Portnoy, Dr. Omar Colón, University of Puerto Rico, Mayagüez, Puerto Rico.

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

A fractal is a pattern created by the recurrence of a figure that is present in nature. This research focused on the patterns created by the Deoxyribonucleic acid of humans. It included a mathematical approach to explain the scientific basis of fractals. The purpose of this research was to find out if the human DNA had fractals in it. By determining fractals in human DNA, similarities could be identified between healthy fractals and those that are mutated. Furthermore, defining the fractal shape would lead to some results that would lead to identify mutations with more effectiveness. The hypothesis stated in this research was that there would be a similarity between healthy and mutated fractals in DNA. During this research an analysis of incidence could reveal opportunities that this turns out to be true. By finding this similarity tracking and identified each mutation, new approaches are needed for testing the hypothesis. A 2D and a 3D Model simulation were constructed using Wolfram CDF Player ®. The simulation presented nitrogenized bases, as well as their representation in different angle positions. This may be used in identifying mutations in humans during hospitalizations. Better sources of visualization of fractal DNA will be developed in the future. This would have a great impact in scientific fields, especially in Genetics, to help the analysis of mutations.

MULTITASKING IN BOTH GENDERS

Keishla M. Rivera Torres and **Christian Romero Vázquez**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

People do several things at the same time without even noticing, or at least try, on a daily basis. It is a performance done at one point that maybe is not paid too much attention or given importance. For years it has been a struggle in finding out if women or men are better at this kind of skill of multitasking, as it is called, This is what this investigation is about, finding out which gender dominates multitasking, women or men. The hypothesis of this research was that women dominate this task. Through a test by Andrew Heathcoat and David Elliot of the University of Newcastle, and David Strayer of the University of Utah, this test was given to 15 women and 15 men from ages 15-18. As for the results, 10 of every 15 women dominated the test, as for men, 6 of every 15 men dominated the multitasking test. In conclusion, women dominated multitasking.

USING SEAWEEDS TO DEVELOP ENERGY; DYE SENSITIZED SOLAR CELLS

Orlando F. Rodríguez Nieto, CROEM High School, Mayagüez, Puerto Rico.

Research Mentor: Elba M. Sepúlveda Ed.D, CROEM High School, Mayagüez, Puerto Rico.

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

What if every person can own a solar cell to produce his or her own energy? Dye sensitized cells are the most cost-efficient way of producing energy from the sun. To create the dye sensitized cell, four simple materials were used: an anode, a dye-coated Titanium Dioxide, an electrolyte and a cathode. A little amount of seaweed chlorophyll was added to increase the energy production. The purpose of this research was to find more efficient and less contaminant materials to produce green energy. The usage of this type of molecule increases the cell functions by absorbing the light photons and transporting them through the Iodide solution, from the cathode to the anode and then this is converted on a current flow of the electrons, making this the electricity flow needed. The amount of photons that collide to the cell were controlled and the voltage produced by the cell was measured to elaborate the current/voltage graphs. They showed the relation between the variables over time. The future goal of this research will be to develop a great technology that can be in the hands of every single person with a minimum price, compared with a regular silicon solar panel.

FINGERPRINT RECOGNITION ALGORITHM

Dianelys Saldaña López, CROEM High School, Mayagüez, Puerto Rico.

Research Mentor: Elba M. Sepúlveda Ed.D., CROEM High School, Mayagüez, Puerto Rico.

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

Nowadays there are countless diseases and social issues like crimes and others that are related to DNA. Moreover, they are increasing the boom of the utilities of the fingerprint recognition. Techniques of genetic recognition are used to solve these kinds of problems. The fingerprint is a unique form used to identify every single person, related to any problem. The purpose of this investigation was to identify some characteristics and significant patterns from the recollection of multiple fingerprints that after being analyzed were used as models to create an algorithm and later an identification application. There were some questions about what type of information could be obtained through those fingerprints. The variables that were used were characteristics as the measures of the fingerprint and the characteristics of the person owner of the fingerprint, among others. They were used to establish the relationship among the variables, if there is one, and the solution to the problem. In addition, results are presented through graphics, that help to understand clearly all the data. Is expected that in future, the results of this investigation will help to make predictions or solve special cases.

NEURAL CODING IN ALZHEIMER'S DISEASE: STIMULI IN CEREBRAL RESPONSE

Zuany L. Santos-Morales, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

The way information is represented in the activity of neurons is the neural code. This neuronal connectivity has stimuli that contain all of the memories in the different regions of the human brain. Memories that encode life events are often deteriorated because of neurological disorders such as Alzheimer's Disease. This illness is a type of dementia that causes trouble with memory, thinking and behavior. What is not known is how memories are damaged in the brain. For this, a set of neural circuits were created to simulate the electrical impulses that happen in a healthy brain. Furthermore, an additional set was developed to have the characteristics of an Alzheimer's degenerated neural network. To visualize these two scenarios, the numerical inputs selected as stimuli were shocked at -50 mV. Once the plots reacted to this first exposure of induced electric code, the programming in circuits changed revealing there's in fact a cerebral response to the disease and the circuit integrity itself. Additionally, a trial is included in which there is a contrast between a healthy neuron and an Alzheimer's-infected one.

TECHNOLOGICAL DEVICES THAT HELP THE SIGHTLESS

Angely M. Torres Nieves and **Dahiana de Jesús Rivera**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar, Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Through the last five years, scientists have created a series of devices that help the sightless. The research is based on looking through the thousands of devices that exist and finding the one that is the most efficient for the sightless. It is very meaningful when one wants to help the visually impaired to know which device is better for a lifetime use. To make a better recommendation, a questionnaire was designed that included five of the most popular devices found on the Internet and the public had a chance to recommend the best one. The device that caught more attention was the Duspavoni shoes. This information will help with work on the design of a device contributing more and more to the blind.

ABSTRACTS
BIO-STATISTICS

COMPUTATIONAL STUDY OF AMINO ACID CHANGES FOR HYPERPHOSPHORYLATED TAU PROTEIN

Carlos I. Ayala Santos, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad Del Este, Carolina, Puerto Rico.

Tau proteins are proteins which stabilize microtubules. Tau proteins are abundant in neurons in the central nervous system. This mutation is related to pathological changes in AD, which indicates that accumulated Abeta *in vivo* may initiate the hyperphosphorylation of tau. This mutation causes loss of the ability to bind microtubules. Tau dissociates from microtubules and self-aggregates to form insoluble oligomers which progress to the macroscopic tangles evident in post mortem Alzheimer's disease tissue. The purpose of the research was to find changes in amino acid substitution of hyperphosphorylated tau protein using SIFT (Sort Intolerant from Tolerant). SIFT was used to determine if amino acids substitution could affect protein function. Amino acid substitution were expected to be intolerant. The results revealed that 19.25% were tolerant and 80.75% were intolerant. This means that this protein had a high probability of mutations.

COMPUTATIONAL STUDY OF ATP7B GENE BY SIFT

Natalia Berríos Arroyo, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad Del Este, Carolina, Puerto Rico.

The *ATP7B* gene provides instructions for making a protein called copper-transporting ATPase 2. This protein is part of the P-type ATPase family, a group of proteins that transport metals into and out of cells by using energy stored in the molecule adenosine triphosphate (ATP). This gene causes a mutation called Wilson Disease. This type of mutation alters the 3-dimensional structure of the protein or its stability, preventing copper-transporting ATPase 2 from functioning properly. In this research, the amino acid substitution probabilities were verified using SIFT. This will determine if the amino acids are tolerant or intolerant to changes in specific positions. It was predicted that the amino acid substitution was intolerant. The results revealed that 25% of the substitutions were tolerant and 75% were intolerant. This means that this gene had a high probability to mutate.

COMPUTATIONAL STUDY OF AMINO ACID CHANGES IN LMNA PROTEIN

Michael G. De Jesús Soto, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad Del Este, Carolina, Puerto Rico.

The *LMNA* gene provides instructions for making a protein called LMNA. This protein plays an important role in supporting components of the nuclear envelope. This gene is associated with Hutchinson-Gilford Progeria Syndrome (HGPS), which is a genetic condition. It is characterized by a dramatic and a rapid appearance of aging, beginning in childhood. Mutations that cause HGPS result in the production of an abnormal version of the LMNA protein. These results in activation of a cryptic splice site within exon 11, resulting in the production of an incomplete protein, near the carboxy terminus. The objective of this research was to verify if the substitution of amino acids could affect protein function using SIFT. Results revealed that 90% of amino acid substitution were intolerant and 10% were tolerant. This means that there was a high probability of gene mutation and therefore, it could cause the HGPS disease.

COMPUTATIONAL STUDY OF AMINO ACID CHANGES IN COL1A1 GENE

Gabriela Nichole Lugo Claussell, Lourdes School, San Juan, Puerto Rico.

Research Mentor: Elvin Abdiel Méndez Sotomayor, Universidad del Este, Carolina, Puerto Rico.

The *COL1A1* gene provides instructions for making part of a large portion of Type I collagen. Collagens are a family of proteins that strengthen and support many tissues. Type I collagen is the most abundant form of collagen in the human body. This type of collagen causes infantile cortical hyperostosis called Caffey disease. The signs and symptoms of Caffey disease are usually apparent by an infant age of 5 months old. This condition is characterized by swelling, pain, and excessive new bone formation. The objective of this research was to use SIFT and perform amino acid substitutions. SIFT determines if the amino acids changes are tolerant or intolerant. It was predicted that amino acid substitutions would be intolerant. The results showed that 14.5% of amino acid changes were tolerant and 85.5% were intolerant. This means that the gene had a high probability of mutations.

COMPUTATIONAL STUDY OF AMINO ACID CHANGES IN THE ACVR1 GENE

Verónica S. Marzán Alvelo and **Joseluis E. Torres Colón**, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad del Este, Carolina, Puerto Rico

The *ACVR1* gene provides instructions for making the activin receptor type 1 protein. This protein works as a receptor and spans the cell membrane providing that one end of the protein remains inside the cell and the other end projects from the outer surface allowing communication between the two ends to affect cell development and function. When mutated, the gene causes fibrodysplasia ossificans progressiva (FOP). FOP is a disorder that enables muscle and connective tissue to be gradually replaced by bone. In this research, amino acids substitution probabilities were determined using SIFT. This will show if the amino acids substitutions are tolerant or intolerant when specific positions are changed. It was predicted that amino acid substitution would be intolerant. Results revealed that 13.5% were tolerant and 86.5% were intolerant. This means that this gene had a high probability of mutations.

ANALYSIS OF ADAM 33 GENE BY SIFT

Alejandro José Ríos Tirado, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad Del Este, Carolina, Puerto Rico.

This gene encodes a member of the ADAM protein family (a disintegrin and metalloprotease domain). Members of this family are membrane-anchored proteins structurally related to snake venom disintegrins. They have been implicated in a variety of biological processes involving cell-cell and cell-matrix interactions. This protein is a type I transmembrane protein implicated in asthma and bronchial hyperresponsiveness. The purpose of this research was to use SIFT to find out if amino acid substitution could affect protein function. It was predicted that the amino acid substitution would be tolerant. The results revealed that 42.5% were tolerant and 57.5% were intolerant. This means that the gene had a high probability of being mutated.

COMPUTATIONAL STUDY OF AMINO ACID CHANGES IN THE LRRK2 GENE

Yaiomy Santiago Rivera, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad del Este, Carolina, Puerto Rico.

The LRRK2 gene (leucine-rich repeat kinase 2) provides instructions for making the dardarin protein. Dardarin is active in the brain and other tissues throughout the body. Dardarin has a segment that contains a large amount of leucine and a kinase activity enzyme function. The LRRK2 gene belongs to a family of genes called PARK (Parkinson's disease). Mutations in the LRRK2 gene cause Parkinson's disease. These mutations replace single amino acids in the dardarin protein, which affects the protein's structure and function. Parkinson's disease is a progressive disorder of the nervous system that affects movement. In this disease, neurons gradually break down, causing dopamine levels to decrease and leading to abnormal brain activity. The objective of this research was to predict amino acid substitution probabilities using SIFT (Sort Intolerant from Tolerant). SIFT determines if the amino acids substitution can affect protein function. It was expected that the amino acid substitution would be intolerant. Results revealed that 28% of the amino acid substitutions on the dardarin protein were tolerant, and 78% were intolerant. This means that this protein had a high probability of being mutated.

COMPUTATIONAL STUDY OF AMINO ACID CHANGES IN THE PRODUCTION OF THE HER2 GENE BASED ON SIFT

María Del Mar Zayas-Viera and **Luz Aned Sánchez-López**, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Elvin Méndez Sotomayor, Universidad del Este, Carolina, Puerto Rico

The HER2 gene (human epidermal growth factor receptor 2) can play a role in the development of breast cancer. This gene makes HER2 proteins. HER2 proteins are receptors on various cancer cells. Normally, HER2 receptors help control how a healthy cell grows, divides, and repairs itself. In some cancers, the HER2 gene does not work correctly and makes too many copies of itself (known as HER2 gene amplification). In recent years, some reports have described the prognostic significance of the overexpression of the oncogene c-erbB-2 (HER2/neu) in various human cancers. The HER2/neu has been found in prostate (PC3), breast (MCF7) and ovarian (A2780) cancer cells. Sort Intolerant to Tolerant (SIFT) predicts whether an amino acid substitution affects protein function. SIFT determines if amino acid substitutions are tolerant or intolerant. It was predicted that the amino acid substitution would be intolerant. The results revealed that 27% of amino acid substitutions were tolerant and 73% were intolerant. This shows that this protein had a high probability of being mutated.

ABSTRACTS
CHEMISTRY

RATIONAL MOLECULAR DESIGNING FOR REDUCING TOXICITY

Shania González Lind, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Elba M. Sepúlveda, Ed.D., CROEM School, Mayagüez, Puerto Rico.

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

Toxicity is an issue that has been dealt with throughout the years and in many distinctive manners. It can be considered the cause of an unbalance in nature. Scientists have conducted research looking for many alternatives to avoid the use of these toxics and thus, solve major problems. The riveting thing about toxics is that everything can be considered toxic to a certain degree. An interesting occurrence is that many alternatives to these toxins are toxic themselves. The purpose of this research was to design molecular alternatives to reduce toxicity in the environment by using a 3D Molecular program extension called MolView©. This program runs a simulation that permits molecule formation. The objective was to form molecules by substitution of toxins while maintaining their properties through calculations of the efficiency between alternatives and their electron speed and movement towards reacting upon its use. The properties were analyzed to prove their efficiency at pursuing the role of the toxic at hand. Then proved that theoretically these alternatives are not only possible, but effective. On the contrary, the properties that replace the molecule's toxin prove no relation between the variables. This research provides an intense analytical and descriptive process that explains how the toxic and its alternative react. By testing its efficiency, the truth of its toxicity through molecular design was discovered. This is the beginning of a new step toward molecular designing for toxicity reduction in green chemistry; therefore, it is immensely beneficial for the environment.

ABSTRACTS
COMPUTER SCIENCES

PERCEPTION OF COLORS AND THE USE OF ELECTRONIC GAMES: A COMPARISON OF YOUNG PEOPLE VERSUS ADULTS

Kiara N. Maldonado Pérez, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Is there a difference on the perception of colors between young people and adults from different genders? Is there any relation between the perception of colors with the frequency and type of electronic games media (video games) used by them? To answer these questions, a sample of young people and adults from different genders were selected randomly and asked to answer a questionnaire. Most of the questions were focused on measuring the amount of colors that they were able to identify and the frequency and type of electronic games (video games) they use most. After the questionnaire was administered, it was found that both genders are able to see basically the same colors; however, young people can see more color tones than adults; moreover, youths prefer video games based on color/design diversity and adults based on motion difficulty.

THE CONTRIBUTION TO MATH: CAN THIS ROBOT ACT LIKE A TEACHER FOR CHILDREN?

Adriana C. Marín Massini and **Génesis G. Montalvo**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Advances in the robotics field enable robots to assist humans in many ways. However, only few researches have been done applied to education. This research deals with the use of the robot Roomba Icreate to help teach math. Work was done with programming using Arduinos and an arm was added to I create robot. The arm can write on the board and represent examples and designs. The program was revised and is functional. The robot was used with some small children and they showed great interest in it. Formative evaluations are presented to show the impact of the use the Icreate robot in the classroom.

ABSTRACTS ***ENGINEERING***

DETECTING AND CLASSIFYING BIRDS

Natalia J. Bercero Estrada and **Alondra G. Montalvo Siberón**, Caguas Private School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

Technology has revolutionized at a great scale in the last century, from smart phones to commercially-available electric cars to much more advanced, multiuse drones. With that in mind, a drone is any unmanned aircraft or ship that is guided remotely. In other words, it is a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. The main purpose of this investigation was to be able to identify birds utilizing the camera incorporated into the drone and later on classify if such species was endangered or not. Similar ideas had already been taken on by different corporations, such as the Fish & Wildlife Agency, among others. Additionally, in Australia, marine biologists have already successfully used drones to identify which areas of the ocean would make the best marine mammal conservation zone. When this topic is first mentioned, people might get concerned about whether this experiment might affect the birds, their behavior and their habitats. However, scientists who have previously performed such experiments have documented that it had not, indeed, negatively affected the birds in any way. In addition, further precautions can and will be taken to make certain the birds do not get uncomfortable or uneasy being around such a strange device. For example, different-colored drones could be used to match the color of the sky. Some type of disguise or camouflage could be used to put on the drone so the birds do not feel threatened, endangered or intimidated. In a study presented by Science for Environment Policy, researchers found that 80% of the drones that were used were able to fly within four meters of a flock, without actually disturbing the birds; the birds did not show any type of change in their behavior. Nonetheless, other researchers have specified that once they got too close to a group of birds and they noticed the drone, they flew away from it. This research would be helpful because it would provide a better understanding of bird behavior and habitat. Even though birds and their behaviors have been studied for centuries, it is always beneficial to find out even more traits and characteristics about such creatures. Moreover, the drone could also be used for surveillance on the animals. Hence, if a bird were to be attack or hurt, immediate action could be taken. It was hypothesized that if the drone could be programmed to detect a bird, it will follow it wherever it may go. Still, a normal amount of space between the bird and the drone would be kept so the bird does not get overwrought.

EXPLORING BIOLOGY WITH ROBOTS

Faviola Camacho Figueroa, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Elba M. Sepúlveda, Ed.D., CROEM School, Mayagüez, Puerto Rico.

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

The BEAM Robotics Community prioritizes the integration of simple circuits in a robot to represent a tentative pattern displayed by nature. The BEAM Ant is a sample robot created by the BEAM Community in 2007 that displays a behavior similar to an ant's behavior. The BEAM Ant's tactile sensors allow it to turn away from obstacles by switching into a reverse direction. According to the data revealed by the BEAM Community, the BEAM Ant presented difficulties in obstacle avoidance and its performance in textured surfaces. However, it displays an interesting quality when it rotates to face towards the direction of a direct light source. By eliminating the use of solar-drive, the researcher integrated cost-effective materials. Those materials were: paper clips, a battery holder, and "AA batteries", to create a simpler version of the BEAM Ant model. The researcher also utilized automatic toothbrush motors, momentary switches, and tactile sensors. The researcher's goal was to demonstrate through experimentation that the integration of simple circuits does affect the performance and efficiency of the original BEAM Ants design. Through these alterations, the improved BEAM Ant model's performance will not be affected. The prototype robot used in this experimentation was tested in its efficiency by having it perform tasks within a time limit. These tasks included terrain tests, where the robot had to travel in different kinds of surfaces. The prototype robot was also evaluated on its mass.

HOW GREATLY ARE SENSORS AFFECTED BY WIND, SOUND, AND MOVEMENT?

Alexander Cruz Noriega, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

Most of today's modern technological devices, such as phones, computers, tablets, televisions, and even kitchen appliances contain sensors. Sensors are made to measure a specific variable and its changes, but these can sometimes be affected by other variables, such as heat, light, sound, pressure, magnetism, or a particular motion, among other outside variables. For example, a gyroscope, a sensor that measures its orientation on three axes using the Earth's gravitational pull, can be affected by the movement of a drone while ascending, descending, or making turns. If a program's outcome is based on the measurements given by these sensors, then the program can be vulnerable to end up having a completely different outcome from it was expected to have. A typical solution for programmers facing this problem is to add additional sensors, such as encoders and ultrasonic sensors, to support the readings of the gyroscope and serve as a backup measurement. This investigation project aimed to record any differences between readings of an ultrasonic sensor that were included in the Phantom 3 Standard drone by testing it against wind, sound, and movement. Previous research from other investigators states that ultrasonic sensors do have a range of error, and that these can be increased by the effects of temperature and humidity. Their research showed that these can affect the sensor reading by as much as 25% by just varying the humidity. (Yamada, Tsuchiya, & Endoh, 2003) Should there be a difference in the measurements, this means that sensors are very vulnerable to changing the outcome of a program.

THERMOELECTRIC GENERATORS: POWER SOURCE OF THE FUTURE?

Luis A. Del Valle Cora, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Elba Sepúlveda, CROEM School, Mayagüez, Puerto Rico.

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

Thermoelectric generators produce electricity from heat. They work by employing a phenomenon called the Seebeck Effect. This effect is produced when a temperature difference between two semiconductors is created, which in turn produces electric energy. The main purpose of the research conducted was to experiment with the realistic use of thermoelectric generators on a large scale, and to draw greater conclusions from the results. The generator works with Peltier modules, which produce electricity utilizing the Seebeck effect. The main question was whether it is an efficient way to produce energy. A thermoelectric generator was built and the data from the results were collected from multiple tests, measuring voltage and overall efficiency from each one. This data made it possible to determine whether this method of producing electrical energy was a realistic possibility for new ambitious technologies. The generator produced electricity for a certain time and was measured to show how the difference in voltage behaved. The results were consistent and proved that this method of producing energy was quite reliable; although, not very effective because of the voltage drop. As part of future research, the efficiency of this method may be upgraded, to make it an option for large-scale industrialization. Recently, this topic has been gaining interest among scientists around the world. Many companies that focus on the energy industry would be interested in thermoelectricity if it were not for the lack of intensive research on this topic and its inefficiency.

MAKING APRIL TAGS

Natalia L. Díaz López and **Kamila Martis López**, Bautista de Caguas School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Kriziani De Jesús González, Universidad Del Turabo, Gurabo, Puerto Rico.

AprilTags is a visual fiducial system, useful for a wide variety of tasks including augmented reality, robotics, and camera calibration. April tags were made so that a robot can read the tags and do what the tag says. The tags can make a robot accelerate, reduce velocity or stop. This project could be included in cars in the future and it could help to reduce the percentage of fatalities for speeding and aggressive driving. According to the Commission on Traffic Safety, in Puerto Rico there has been an increase in the fatalities yearly. There were 138 deaths in 2011, 144 in 2012 and 149 in 2013. If cars had that integrated, there would be less traffic accidents.

ANALYZING THE WATER USED

Carlos Manuel Gómez Vázquez and Iván Alexis Jiménez Cruz, Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

In aviation and in space, a drone refers to an unpiloted aircraft or spacecraft. Another term for it is an “unmanned aerial vehicle” or UAV. On Earth, drones are often used for military purposes because they do not put a pilot's life at risk in combat zones. Also, drones do not require rest, enabling them to fly as long as there is fuel in the craft and there are no mechanical difficulties. Do you know the quality of the water of the lakes and rivers you are swimming in or drinking from? Drones carrying cameras or infrared sensors have already found favor with farmers, police forces, and extreme sports enthusiasts. Now engineers are testing versions of the tiny craft that can do more than just observe. Prototypes able to swoop down to scoop up water samples are being developed to help ecologists, the oil industry, and others track oil leaks or invasive species. Some can even perform rudimentary analysis on the water they collect. Commercial drone company Precision Hawk, of Raleigh, North Carolina, is testing a water sampling drone with some clients in the oil industry. It takes the form of a seaplane and has a pump mounted on its pontoons that can handle even viscous swamp water thick with bugs, mud, or algae. The water is sucked into a container and then carried to a lab to check for signs of oil leaks or spills. “If you go up to Northern Canada or Alaska, there are literally thousands of ponds and lakes that are a few acres in size,” says Precision Hawk CEO Ernest Earon. “Trying to walk through or take a boat to get water samples, it’s an almost impossible task”. The goal of this investigation was to collect what is called environmental DNA. Environmental DNA is what is left from plants, animals and other organisms and sometimes all this environmental DNA lands on the lakes. The idea of this investigation was from the professor Yang Quan Chen, an engineer professor who believes that most of the places cannot be reached by boat or vehicle, so a drone must be used. The only difference from his investigation from this one, was that he needed to land in on moving water with bad weather (ocean) and this investigation involves collecting water from lakes to analyze the DNA since most of the diseases come from lakes.

BICYCLE GENERATOR

Kiria González Rivera, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Elba M. Sepúlveda, Ed.D., CROEM, Mayagüez, Puerto Rico.

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

In Puerto Rico petroleum is the most common energy source. This is a nonrenewable resource that greatly increases the levels of air pollution. This research showed the conversion of a bicycle that produces mechanical energy by the alternator. To complete the engineering step, a stationary bike was connected to a truck alternator which outputs a certain amount of power to the electronic equipment. It provided a method of generating electricity by means of a modified exercise bike for use in energy storage and running household appliances. Human/mechanical energy was converted into electrical current by means of a Direct Current (DC) generator that is connected by a fan belt to an exercise bike flywheel. If Alternating Current (AC) appliances are in place then an inverter must be used to transfer the 12 volts of DC current into the standard 110 volts of AC current for usage by these appliances. Finally, the amount of petroleum needed and its price to get to some certain amount of energy were compared with the ones that the bicycle generator holds. Also petroleum energy contaminants were compared with the bicycle generator contaminants to choose the more eco-friendly one. These results implicated that the bicycle generator is more efficient than petroleum because of the use of human power.

PROGRAMMING A ROBOT TO IDENTIFY APRIL TAGS CONTROLLING ITS SPEED

Saadia P. Jiménez Ñeco and **Katia E. Torres Ruiz**, Puerto Rico Gifted School Alliance, Guayama, Puerto Rico.

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

Research Assistant Mentor: Kriziani De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

The purpose of this project was to study how to reduce the percentage of fatalities for speeding and aggressive driving. According to Commission on Traffic Safety, in Puerto Rico there has been an increase in fatalities yearly, 138 deaths in 2011, 144 in 2012 and 149 in 2013. More men have died in speeding accidents than women. In this project, a robot could be programmed to understand April tags, controlling the speed of the robot. Even though it is possible for the robot to go faster, it will not. That could eventually be implemented into cars and other vehicles' programming. That would make roads safer by stopping people from accelerating from the designated speed and lowering car crash percentage, making the road safer for the driver and pedestrians all over the world, making the world a safer place. The robots would be programmed to go a certain speeds using sensitive speed sensors. The robots would be able to specifically stop at the speed it is told to stop at. The sensors would be able to stop at the speed it is indicated to stop at. The robot would then race off making use of the speed sensors and indicators, creating a controlled simulated speed zone.

EARTH'S MAGNETIC FIELD AND CYCLONE ENERGY CONSUMPTION

Wilfredo J. Lamberty Bonilla, CROEM School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Elba M. Sepúlveda, Ed.D., CROEM School, Mayagüez, Puerto Rico.

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

The objective of this research project was to portray what happens in the atmosphere as cyclones are created and how they consume energy from the Earth's magnetic field. A cyclone is a low-pressure system that forms over the warm waters of the ocean. They have very strong winds near the center. Cyclones have a particular area called the eye or center, having a circular form, and it is the area with light winds and mostly clear skies. The eye is surrounded by a dense ring of clouds called the eye wall, which has the strongest winds and heaviest rainfall. How does the energy change as a cyclone passes through the magnetic field? If the cyclone passes through a magnetic field, then the magnetic field will lose energy because cyclones consume energy. A program that detects energy on the magnetic field was used to observe and analyze the changes of energy as a cyclone passes. The energy in the magnetic field will decrease due to the cyclone's energy consumption. The energy is the capacity of a physical system to function. Additionally, energy has various forms: such as heat, kinetic, light, potential, electrical, among others. The magnetic field is the field that extends from the Earth's inferior part to where it meets the solar wind. It is similar to a bar magnet but it is tilted 11 degrees from the spin axis of the Earth. Energy is needed to generate a magnetic field to work against the electric field that a changing magnetic field creates and to change the magnetization of any material within the magnetic field. For non-dispersive material the energy is "stored" in the magnetic field.

CREATING TRAFFIC SIGNS TO PREVENT ACCIDENTS USING AUTOMATED TRAFFIC

Luis Enrique Lebrón Aponte, Notre Dame School, Caguas, Puerto Rico.

Research Mentors: Jenipher D. González, Universidad del Turabo, Gurabo, Puerto Rico.

Research Assistant Mentor: Kriziani M. De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

According to BBC News in July 27, 2010, road casualties have been lower from year to year. What if the road casualties were to be cut in half every year after? April Tags can be used to prevent these casualties. By creating these, robots can identify them and use a program to perform an action that could save a life. One good use for April Tags would be to prevent accidents on the road. If a person is driving recklessly (drinking alcohol, texting, talking on the phone, or driving after hours of being awake), his or her reaction time will be severely increased, which can ultimately cause an accident. In a vehicle that has the tags, or at least this type of technology, the reaction time would be almost nothing compared to a human even if the person is sober or driving appropriately. While a person can think of what is actually happening, the robot can do the action. It is this kind of technology that can save not only lives, but also millions of dollars for injuries. Even if people are killed in accidents, some are not injured as severely and the harm is minimal. For these types of accidents, the tags will make it as harmless as possible. This also accounts for the most severe of accidents. When an accident is imminent, even if it cannot be prevented, at least the severity can be lowered for it to not cause death. The number of car accidents per year is approximately 2.6 million and more than half of those have occurred among young adults from ages fifteen through forty-four. April tags can be created to prevent collisions in the future, whether on the road or at any other situation where a collision can take place.

AERIAL PHOTOGRAMMETRY: THE FUTURE OF 3D MAPPING

Alexis A. Luciano Sánchez and **Bianca S. Marina Santana**, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

Aerial photogrammetry is the act of using overlapping aerial photographs to calculate measurements of surface points. Aerial photographs can be combined to create 2D or 3D models and are taken in two basic forms: oblique and vertical. Both of these forms have different uses and applications. Theoretically, when combining aerial shots, as long as there are two pictures featuring at least two different angles of the same general area, a point cloud can be established. A point cloud is a cloud of points in a three dimensional space that contains one or more channels of data at each point and identifying them is essential to do aerial photogrammetry. The uses of photogrammetry are mostly to make topographical maps so geographical areas can be analyzed. They can be used to create numerous kinds of maps and monitor different types of natural and human activity. Usually, airplane cameras are used to perform aerial photogrammetry, but there is a new way to do this: drones. A drone is formally known as an unmanned aerial vehicle. The objective of this investigation was to figure out if footage could be better for 3D mapping, even though pictures are the most popular way of creating topographical maps and 3D models. The research was focused on combining both pictures and footage taken with the drone using a logarithm to find a point cloud and create two different maps of an area. A third map was also developed by unifying pictures and footage into the same 3D model. The first step was programming the drone and the device used to fly it. The drone was then suspended for twenty minutes while taking numerous pictures of different points of the 140 acre campus of the University. After recharging it, the drone was suspended a second time for another twenty minutes, but this time footage of the campus was taken instead of pictures. Once all of this photographic data were gathered, both the pictures and the footage were digitalized and a logarithm was used to create a point cloud. The program then combined the pictures, the footage and the combination of the two, using the point cloud to produce the three 3D models. After analyzing all of them, it was concluded that the most effective method of aerial photogrammetry is by footage. This is because the maps turned out to be more accurate and detailed when footage was used than when pictures were. The model created by assembling both types of photographic data was also very effective, but did not turn out as well as the one created only with footage.

LIGHT POLLUTION IN RURAL PLACES AND URBAN PLACES IN PUERTO RICO

Abner X. Peña Carrión and Jeicarlo A. Ruiz Alvarado, CIMATEC School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

In a world where light is needed everywhere, in almost every activity, light pollution will always be present. Scientists have agreed that light pollution is excessive, misdirected, or obtrusive artificial (usually outdoor). Too much light pollution has consequences: it washes out starlight in the night sky, interferes with astronomical research, disrupts ecosystems, has adverse health effects and wastes energy.” With this information at hand, it can be established that there is a problem with this kind of pollution and it needs to be managed as soon as possible because of all the negative consequences that it has. One of the many effects that it entails are: Prolonged exposure to artificial light prevents many trees from adjusting to seasonal variations, according to Winslow Briggs in the Ecological Consequences of Artificial Night Lighting (2006). In addition, it causes baby sea turtles that are born at night, to follow artificial lights nearby the beach from which they are born. With migratory birds, it causes them to follow bright artificial light and makes them crash with skyscrapers. Light attracts birds and disorients them. Another side effect is that causes a lack of sleep in human beings because it disrupts the circadian rhythm of the person. With this interruption, it causes people to be counterproductive at their work, become more obese and it can even increase the chances of breast and prostate cancer, but more research is needed to substantiate that claim. Now that the problem has been exposed, the purpose of this investigation was to study the light pollution that is found in urban and rural places to identify the range of contamination to which the people that live in these places are exposed to. To carry out this investigation, a drone with an Arduino attached to it with a photo resistor sensor was used to measure light contamination. The drone went to an urban area in Puerto Rico in San Juan, and flew at different altitudes: 10 ft., 20 ft., 30 ft. and 40 ft. within 3 days at 8:00 PM. Then, the same process was carried it in a rural area of Puerto Rico in Caguas.

IDENTIFYING TRAFFIC SIGNS TO PREVENT ACCIDENTS USING AUTOMATED TRAFFIC

Lilliette Rivera Aponte and **Sebastián Disdier Peña**, Bautista de Caguas School, Caguas, Puerto Rico.

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

Research Assistant Mentor: Kriziani M. De Jesús González, Universidad del Turabo, Gurabo, Puerto Rico.

According to the International New York Times, in 2008, more than 37,000 people died in car accidents. This problem can be solved by using automated cars, which will reduce traffic excess and can generate first a human's reaction on the road. This technology will accurately ensure safety by decreasing the number of accidents. Since these robots are like cars, they can automatically accelerate and decelerate. This way, it helps humanity in different aspects, such as a person with a disability. It will have an emergency system for an automatic stop to avoid any danger. This device will be placed in different tests to ensure that it has the necessary adjustments for these different challenges, it will be charged by solar energy, but will also have an electric charger, for it to be charged when it is not charging with solar energy. By charging it with solar energy, it will make it long lasting and effective. A sign will be encrypted to the robot's program to know what to do in case for an imminent accident to make it the least damaging and it will identify a symbol to know what action it will take. It will be put to good use. According to what will happen, the robot will access certain information. When that happens, it will "save" the situation in case it may happen again, the program will already know what to do best and it will react faster. They will also obey the traffic rules, will be a new innovation in technology, and, since they react better than humans, because they do not need sleep, get distracted or get drunk, they will not cause accidents. Finally, since the robots use solar energy, they will not need gasoline to consume and will not contribute to global warming or to the greenhouse effect.

TRANSFER ENERGY WITHOUT THE NEED OF PETROLEUM

Manuel Rivera Vélez and **Laura Rolón Rentas**, Josefina León Zayas School, Jayuya, Puerto Rico

Research Mentors: Olga Cordero Almodóvar and Evelyn Ortiz Colón, Universidad Metropolitana, Jayuya, Puerto Rico.

Petroleum has taken over the world and although there are many techniques to make things work without it, there is still much to change in the world. This investigation had purpose of searching for a way to transfer the energy through objects without the need of petroleum, but using the magnetic field as a guide. Many theories of power transmission were studied and the Lenz Theory was chosen. The hypothesis was then established. To prove that theory true, first ways to make magnetics fields was studied. The next step was to make and connect the coil to the energy source, in this case the battery. This light bulb turned one without having to use a wire or petroleum to pass the energy. Finally kit was concluded that energy can be transferred through objects using magnetic fields

HAZARDOUS PARTICLES IN THE SAHARAN DUST

Bryan A. Rodríguez López and **Gustavo de León**, CIMATEC, Caguas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

The Saharan dust strikes the Caribbean during certain seasons. When it arrives, it can end up bringing some type of particles that are relatively dangerous to living organisms. Such particles can have devastating effects on humans, plants, and animals, affecting the natural balance of the ecosystem. With this in mind, this investigative project was meant to provide a better understanding of how many particles are inside the big clouds of Saharan dust and from where they could be from by using data captured by a drone. These clouds have particles that have different sizes, which vary between PM 100, PM 10, and PM 2.5. The smaller the particles, the more harmful they are to humans. This investigation was meant to give a better prognostic of the different particles and what concentrations are found in the Sahara dust.

APPLICATION OF DRONE TECHNOLOGY TO WATER POTABILITY ANALYSIS

Valeria Sofia Serrano Perez and **Cristian Ricardo Santiago Solivan**, Puerto Rico Gifted School Aliance, Salinas, Puerto Rico.

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

Research Assistant Mentor: Abniel Machín De Jesús, Universidad del Turabo, Gurabo, Puerto Rico.

Do people know the quality of the water of the lakes and rivers they are swimming in or drinking from? This project studied the use of a drone Phantom 3 Standard to detect bodies of water and measure the quality of the water. The Phantom 3 Standard is only able to fly for 25 minutes so it has to be a body of water close or nearby. Water quality sensors are not very big so they will enable the drone to fly fast. To find out if water is polluted, the temperature must be measured because bacteria tend to survive most commonly in hot temperatures. The amount of dissolved oxygen must also be tested, which reveals how much oxygen is available in the water for fish and other aquatic organisms and that is important to note because if fish can survive in that water it means that the water does not have any mortal diseases. This can help a lot people around the world prevent many dangerous diseases. Water and sanitation are the second biggest killers of children under 5 years old worldwide through diseases like cholera. This project was directed at preventing that.

ABSTRACTS
ENVIRONMENTAL SCIENCES

IDENTIFYING THE MAIN SOURCES FROM THE AFRICAN DUST THAT ARRIVES IN PUERTO RICO

María M. Justiniano Camacho, CROEM High School, Mayagüez, Puerto Rico.

Research Mentor: Prof. Elba M. Sepúlveda, Ed.D., CROEM High School, Mayagüez, Puerto Rico.

Research Coordinator: Alexis Orengo, University of Puerto Rico, Mayagüez, Puerto Rico.

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

The transport of minerals has been a trending topic for years. The arid regions of Africa release vast amounts of dust into the atmosphere each year, around 70% of the global total. Scientific interest has been driven by the diverse effects that mineral dust has on the environment. Aerosols have an influence on the atmospheric radiation balance through the scattering and absorption processes, which are considered to be important. The purpose of this research was to identify the main sources of dust from Africa arriving in Puerto Rico. Data from Aeronet, a station from NASA that measures aerosols, was used. When the data were collected during the days when there was an AOD (Aerosol Optical Depth) greater than 0.3 during the months of May to September (previously set parameters) they were observed. Then the data were compared with the NAAPS (Navy Spray Analysis and Prediction System), and the HYSPLIT model (Hybrid Single Particle Lagrangian Integrated Trajectory Model), which gave a possible path (from 10 days back) of particle spray that arrived at the station to identify if it indeed came from Africa. This path was sought at different levels of the atmosphere. Then through models and satellite images, it was identified if there was a concentration of aerosols on the region of Africa where the HYSPLIT model indicated that the particle came. An educated guess of origin of the dust particles was formulated.

ABSTRACTS
NEUROCIRCUITRY

POSTURAL INABILITY IN PARKINSON'S: BRADYKINESIA IN CEREBELLAR CIRCUITRY

Paola N. Maldonado-Millán, Homeschooling.

Research Mentor: Rubén A. García-Reyes, Universidad del Este, Carolina, Puerto Rico.

More than 10,000 people worldwide are diagnosed with Parkinson's Disease each year. People usually develop the disease around the age of 60 or older. Also, men are more likely to develop the disease than women and heredity places a great role on increasing the chances that an individual will develop Parkinson's. It is a progressive mental degeneration of dopamine neurons in the brain, the primary organ of the nervous system. Dopamine neurons are the ones that create the chemical signaling that allows to make normal movements. These neurons are located in the substantia nigra which is the area where the dopamine neurons are created. When bad connection occurs, many signs as tremor, bradykinesia, muscle rigidity, and impaired posture and balance affect the person. Furthermore, when studying the cerebellum, its circuitry is invaded by the complications mentioned above. The electrical impulses are not fully functioning and that leads to the creation of a circuit model in which this phenomenon is displayed. Moreover, the deformation of the integrity is simulated to measure the sensorimotor and sensory scaling abilities the average person loses because of this complication. The spectrum considered is one in which bradykinesia deteriorates the composition and strength of the most vital parts of the human brain. Where the balance and coordination of a person is controlled, the illness tries to infect healthy neurons to damage the arborization inside the cerebellar tissue and it is also modeled.

THE REACTION OF THE PRIMARY VISUAL CORTEX IN ADHD AND DNS PATIENTS

Sofía Osorio, CIMATEC School, Caguas, Puerto Rico.

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

Most of our cognitive functions and perceptual processes are carried out by the neocortex, which is the largest part of the human brain. The primary visual cortex is the part of the neocortex that receives visual input from the retina. One of the DNS syndrome characteristics is a cone shaped cornea, distorting the image captured by the eye. DNS syndrome occurs when an individual has a full or partial extra copy of chromosome 21; this additional genetic material alters the course of development and causes the characteristics associated with Down syndrome. The ADHD syndrome is a chronic condition including attention difficulty, hyperactivity, and impulsiveness. These symptoms are frequently reported in children with Down syndrome, structuring a common factor between the deficits. The purpose of this research was to have knowledge of the signs of these syndrome that affects the neural activity patterns and how do these syndromes affect the signals, images for the neocortex to process, and the sensorial, motor and cognitive circuits that can lead to not paying attention or the incapability to stay calm. The preliminary data was that the people with the syndrome are different in the signal processing and the analysis of the images on the neocortex. The program used for this investigation was CellProfiler because it has the tools for a comparison in graphical precise ways in terms of the neural activity. The area of the program that was used was models of neural "coding" because this experiment was looking for different kinds of motor failures in the processing of information between neurons in these people.

ACKNOWLEDGMENTS

Faculty research mentoring is the main driving force behind the scientific products (posters and oral presentations) presented in this symposium. Our greatest appreciation and gratitude to all the mentors who took part in the Winter 2015 Pre-College Research Symposium by working and training the next generation of scientists whose efforts are presented in this booklet, as well as to the many other faculty members who support the Student Research Development Center and its goals and objectives. Our most sincere thanks are also extended to the following individuals who helped to make this Winter 2015 Pre-College Research Symposium possible.

Judges and Session Chairmen:

Ángel R. Arcelay, Universidad del Este
Valerie A. Carrasquillo, Universidad Metropolitana
Derek C. Champlin, University of Puerto Rico-Cayey
Marcel Corchado, University of Puerto Rico- Mayagüez
Andrea I. Ferrer, University of Puerto Rico
Antoinette García, University of Puerto Rico-Río Piedras
Maxine N. González, Universidad Central del Caribe
Chelsea M. Marrero, University of Puerto Rico-Bayamón
Héctor A. Morales, University of Puerto Rico-Mayagüez
Karoline Ríos, Universidad Metropolitana
Wilmaris Rivera, University of Puerto Rico-Cayey
Keishla M. Sánchez, University of Puerto Rico-Mayagüez
Natalia C. Santiago, Universidad Metropolitana
Amanda S. Soto, University of Puerto Rico-Mayagüez
Priscila A. Vidal, Universidad Metropolitana

Research Mentors and Assistants:

Olga Cordero, Josefina de León High School, Jayuya
Kriziani De Jesús, Universidad del Turabo
Rubén A. García, Universidad del Este
Jenipher D. González, Universidad del Turabo
Gilberto Jiménez, CROEM School
Abniel Machín, Universidad del Turabo
Josué Martes, American School of Milán
Elvin Méndez, Universidad del Este
Evelyn Ortiz, Universidad Metropolitana-Jayuya
Gabriela A. Rodríguez, Universidad Metropolitana
Elba M. Sepúlveda, CROEM School

Symposium Staff:

Dr. Gladys Bonilla, SRDC Consultant
Ms. Thelma Graniela, SRDC
Ms. Zulma Irizarry, SRDC

Ms. Ivette Miranda, SRDC
Mr. Nicholas Natalizio, AGMUS
Wanda I. Rodríguez, SRDC

Symposium Coordinators:

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

INDEX OF PRESENTERS

NAME	SCHOOL	PAGES
Juan Adrover	Notre Dame High School, Caguas, Puerto Rico	13, 35
Carlos I. Ayala	University Gardens High School, San Juan, Puerto Rico	16, 50
Julián A. Batista	Josefina León Zayas School, Jayuya, Puerto Rico	15, 46
Natalia J. Berbero	Caguas Private School, Caguas, Puerto Rico	17, 56
Natalia Berríos	University Gardens High School, San Juan, Puerto Rico	16, 50
Amanda Cáceres	University Gardens High School, San Juan, Puerto Rico	14, 42
Valeria Cáceres	University Gardens High School, San Juan, Puerto Rico	14, 42
Faviola Camacho	CROEM School, Mayagüez, Puerto Rico	17, 57
Francisco A. Carrasquillo	St. Mary's School, San Juan, Puerto Rico	22, 43
Génesis Cartagena	CIMATEC School, Caguas, Puerto Rico	13, 32
Jorge Colón	Bautista de Caguas School, Caguas, Puerto Rico	14, 38
Alexander Cruz	CIMATEC School, Caguas, Puerto Rico	17, 57
Claudia Cruz	Notre Dame High School, Caguas, Puerto Rico	20, 33
Odalys M. Cruz	Josefina León Zayas School, Jayuya, Puerto Rico	14, 44
Dahiana De Jesús	Josefina León Zayas School, Jayuya, Puerto Rico	16, 49
Michael G. De Jesús	University Gardens High School, San Juan, Puerto Rico	16, 51
Gustavo de León	CIMATEC School, Caguas, Puerto Rico	19, 65
Patricia de León	CIMATEC School, Caguas, Puerto Rico	12, 27
Carolina I. Delgado	CIMATEC School, Caguas, Puerto Rico	13, 34
Luis A. Del Valle	CROEM School, Mayagüez, Puerto Rico	17, 58
Alondra L. Díaz	Bautista de Caguas School, Caguas, Puerto Rico	12, 27
Natalia L. Díaz	Bautista de Caguas School, Caguas, Puerto Rico	17, 58
Rafael Díaz	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	20, 24
Sebastián Disdier	Bautista de Caguas School, Caguas, Puerto Rico	18, 64
Jennifer N. Figueroa	University Gardens High School, San Juan, Puerto Rico	14, 43
Diego García	Fruto de la Vid Christian Academy, Gurabo, Puerto Rico	13, 35
Carlos M. Gómez	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	18, 59
Kattia M. González	Bautista de Caguas School, Caguas, Puerto Rico	11, 23
Kiria González	CROEM School, Mayagüez, Puerto Rico	18, 59
Shania González	CROEM School, Mayagüez, Puerto Rico	22, 54
Jailynnette M. Heredia	Josefina León Zayas School, Jayuya, Puerto Rico	14, 44
Michael A. Hernández	CROEM School, Mayagüez, Puerto Rico	12, 25
Reniel Irizarry	CROEM School, Mayagüez, Puerto Rico	12, 28
Iván A. Jiménez	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	18, 59
Saadia P. Jiménez	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	18, 60

NAME	SCHOOL	PAGES
María M. Justiniano	CROEM School, Mayagüez, Puerto Rico	19, 66
Wilfredo J. Lamberty	CROEM School, Mayagüez, Puerto Rico	18, 60
Luis E. Lebrón	Notre Dame School, Caguas, Puerto Rico	18, 61
Nathaly Lebrón	Notre Dame High School, Caguas, Puerto Rico	13, 35
Alexis A. Luciano	CIMATEC School, Caguas, Puerto Rico	18, 62
Gabriela N. Lugo	Lourdes School, San Juan, Puerto Rico	16, 51
Kiara N. Maldonado	Josefina León Zayas School, Jayuya, Puerto Rico	17, 55
Paola N. Maldonado	Homeschooling	22, 67
Adriana C. Marín	Josefina León Zayas School, Jayuya, Puerto Rico	21, 55
Bianca S. Marina	CIMATEC School, Caguas, Puerto Rico	18, 62
Laura I. Marrero	University High School, San Juan, Puerto Rico	15, 44
Orlando J. Martell	CROEM School, Mayagüez, Puerto Rico	20, 26
Cristina E. Martes	Josefina León Zayas School, Jayuya, Puerto Rico	15, 44
Carla N. Martínez	University High School, San Juan, Puerto Rico	15, 45
Kamila Martis	Bautista de Caguas School, Caguas, Puerto Rico	17, 58
Verónica S. Marzán	University Gardens High School, San Juan, Puerto Rico	16, 51
Natalia M. Mas	University High School, San Juan, Puerto Rico	15, 45
Alondra G. Montalvo	Caguas Private School, Caguas, Puerto Rico	17, 56
Génesis G. Montalvo	Josefina León Zayas School, Jayuya, Puerto Rico	21, 55
Mirelys Negrón	Josefina León Zayas School, Jayuya, Puerto Rico	15, 44
Luis E. Orta	Homeschool	20, 36
Sofía Osorio	CIMATEC School, Caguas, Puerto Rico	19, 67
Abner X. Peña	CIMATEC School, Caguas, Puerto Rico	18, 63
Jorge A. Quiles	Josefina León Zayas School, Jayuya, Puerto Rico	12, 28
Claudia M. Ramos	Josefina León Zayas School, Jayuya, Puerto Rico	15, 46
Amanda Reyes	Josefina León Zayas School, Jayuya, Puerto Rico	13, 36
Alejandro J. Ríos	University Gardens High School, San Juan, Puerto Rico	16, 52
Jeiselynn N. Ríos	CROEM School, Mayagüez, Puerto Rico	12, 26
Eliud R. Rivas	CROEM School, Mayagüez, Puerto Rico	15, 46
Alejandro J. Rivera	CIMATEC School, Caguas, Puerto Rico	21, 29
Ian Rivera	CIMATEC School, Caguas, Puerto Rico	13, 37
Keishla M. Rivera	Josefina León Zayas School, Jayuya, Puerto Rico	15, 47
Lilliette Rivera	Bautista de Caguas School, Caguas, Puerto Rico	18, 64
Manuel Rivera	Josefina León Zayas School, Jayuya, Puerto Rico	19, 64
Amanda F. Robles	CIMATEC School, Caguas, Puerto Rico	12, 30
Bryan A. Rodríguez	CIMATEC School, Caguas, Puerto Rico	19, 65
Orlando F. Rodríguez	CROEM School, Mayagüez, Puerto Rico	15, 47
Rafael Rodríguez	CIMATEC School, Caguas, Puerto Rico	13, 38
Sofía A. Rodríguez	Josefina León Zayas School, Jayuya, Puerto Rico	13, 36
Laura Rolón	Josefina León Zayas School, Jayuya, Puerto Rico	19, 64
Christian Romero	Josefina León Zayas School, Jayuya, Puerto Rico	15, 47
Valeria Rosario	Bautista de Caguas School, Caguas, Puerto Rico	14, 38

NAME	SCHOOL	PAGES
Jeicarlo A. Ruiz	CIMATEC School, Caguas, Puerto Rico	18, 63
Dianelys Saldaña	CROEM School, Mayagüez, Puerto Rico	15, 48
Luz A. Sánchez	University Gardens High School, San Juan, Puerto Rico	17, 53
Nathaniel Sánchez	Bautista de Puerto Nuevo Academy, San Juan, Puerto Rico	14, 39
Miguel A. Santana	CIMATEC School, Caguas, Puerto Rico	21, 30
Cristian R. Santiago	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	19, 65
Jancie L. Santiago	Caguas Private School, Caguas, Puerto Rico	21, 31
Yaiomy Santiago	University Gardens High School, San Juan, Puerto Rico	17, 52
Zuany L. Santos	University Gardens High School, San Juan, Puerto Rico	16, 48
Valeria S. Serrano	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	19, 65
John L. Soto	Thomas Armstrong Toro, Ponce, Puerto Rico	22, 40
Angely M. Torres	Josefina León Zayas School, Jayuya, Puerto Rico	16, 49
Joseluis E. Torres	University Gardens High School, San Juan, Puerto Rico	16, 51
Katia E. Torres	Puerto Rico Gifted School Alliance (PRGSA), Guayama, Puerto Rico	18, 60
Melany D. Valle	CROEM School, Mayagüez, Puerto Rico	11, 25
Brayan Vega	CIMATEC School, Caguas, Puerto Rico	14, 41
Desireé Zavala	Caguas Private School, Caguas, Puerto Rico	12, 31
María Del M. Zayas	University Gardens High School, San Juan, Puerto Rico	17, 53

**We gratefully acknowledge the support and sponsorship of the
Winter 2015 Pre-College Research Symposium from:**

Ana G. Méndez University System