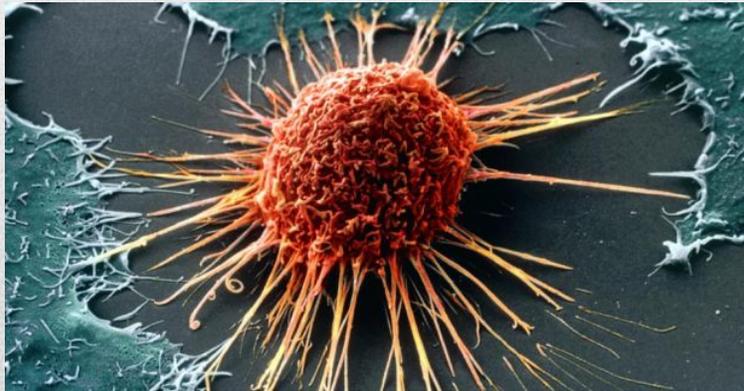


Scientific Caribbean  
Foundation

Scientific Caribbean Foundation  
Student Research Development Center

# Virtual Winter 2020 Pre-College Research Symposium

**Biological Sciences – Neurosciences - Engineering**



**Biomathematics - Computer Science - AI**

**Saturday, December 5, 2020**

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San Juan, Puerto Rico

**SCIENTIFIC CARIBBEAN FOUNDATION  
AND THE  
STUDENT RESEARCH DEVELOPMENT CENTER**

ARE PROUD TO HOST THE

**VIRTUAL WINTER 2020 PRE-COLLEGE  
RESEARCH SYMPOSIUM**

SHOWCASING MINORITY HIGH SCHOOL STUDENTS' MENTORED RESEARCH

Leadership at

SCIENTIFIC CARIBBEAN FOUNDATION, INC.

Juan F. Arratia, Ph. D.  
President and Founder  
Research Professor and Mentor

SAN JUAN, PUERTO RICO

December 5, 2020

## TABLE OF CONTENTS

Table of Contents.....	2
Scientific Caribbean Foundation Mission.....	3
Conference at a Glance.....	4
Message from the Founder-President of the Scientific Caribbean Foundation Dr. Juan F. Arratia.....	5
Research Mentors.....	6
Schedule of Events.....	15
Abstracts:	
Biological Sciences.....	17
Neuroscience.....	22
Computer Science.....	24
Artificial Intelligence.....	25
Biomathematics.....	26
Engineering.....	27
Acknowledgements.....	30
Index of Presenters.....	31

**Scientific Caribbean Foundation  
Student Research Development Center**

**MISSION**

Scientific Caribbean Foundation (SCF) was founded by Dr. Juan F. Arratias, a Chilean American with more than 45 year of academic experience in universities and companies in Chile and Puerto Rico. Recipient of the 2006 US Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring giving at the White House by President George W. Bush. The idea of SCF is to continue the success of the Model Institutions for Excellence (MIE), a grant awarded by the National Science Foundation (NSF) to 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. Dr. Arratia was the Principal Investigator of the MIE grant at UMET. We believe that creative research is one of the best ways to prepare students to become persistent and successful in college, graduate school and professional careers. Today, the Student Research Development Center (SRDC), which is part of the SCF, is the entity that will continues the MIE strategy by impacting pre-college and university students from institutions in Puerto Rico and across the nation, as well as pre-college students from the Puerto Rico Educational System.

**EXECUTIVE SUMMARY**

The MIE ended in 2009 at UMET. The outcome of the program was over 280 UMET STEM-C majors completed their BS degrees and 175 were transfered to graduate school, with 65 achieving doctoral status (PhD, MD, VVM, Pharm D). In order to increase the number of BS degrees transferred to graduate school, we will continue with the strategy of an early research program and partnership with key research institutions in Puerto Rico, the US mainland and abroad. Research mentoring will be the central component of the knowledge transfer and creative thinking activities at SCF. Project based learning, 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 competitive institutions.

**GOALS**

The main goal of the Spring 2020 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-C fields, and set national research standards for pre-college research presentations.

**SCIENTIFIC CARIBBEAN FOUNDATION  
STUDENT RESEARCH DEVELOPMENT CENTER**

**VIRTUAL WINTER 2020 PRE-COLLEGE  
RESEARCH SYMPOSIUM**

**CONFERENCE AT A GLANCE**

**SATURDAY, DECEMBER 5, 2020**

**VIRTUAL**

- 8:00–8:10 a.m.**      **Opening Ceremony**
- Dr. Juan F. Arratia, Research Professor and Mentor**  
**Dr. Angel Arcelay, Professor of Chemistry**
- 8:10–9:15 a.m.**      **Poster-Oral Sessions**
- Biological Sciences**  
**Neurosciences**  
**Computer Science**  
**Artificial Intelligence**  
**Biomathematics**  
**Engineering**
- 9:15-9:30 a.m.**      **Pre-College Alumni Research Experiences**
- 9:30– 9:40 a.m.**      **Awards Ceremony and Closing Remarks**
- 9:40 a.m.**              **Symposium Adjourns**



Scientific Caribbean  
Foundation

December 5, 2020

Dear Pre-College Students:

The Virtual Winter 2020 Pre-College Research Symposium is the culmination of the activities and dissemination process of the Virtual Fall 2020 Saturday Research Academy Program of the Scientific Caribbean Foundation. For a period of four months, since August 2020, pre-college students from private and public high schools of Puerto Rico worked long hours, virtually, during the pandemic, with the guidance and mentorship of faculty and student research mentors in research projects in STEM–C fields.

One of the objectives of the Virtual Winter 2020 Pre-College Research Symposium is to offer young motivated high school researchers the opportunity to learn and to practice their English 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 outcomes and findings of their research projects to research mentors, family members, and the educational community at large.

We at Scientific Caribbean Foundation are proud of the results obtained by the pre-college students and their mentors in the Virtual Fall 2020 Saturday Research Academy Program. I hope your experience inspires you and your peers to select science, technology, engineering, mathematics and computer science as your field of study in the near future.

My sincere appreciation goes to the faculty, student research mentors and scientific judges for their effort and commitment to implement the Virtual Winter 2020 Pre-College Research Symposium.

Sincerely yours,

Juan F. Arratia, Ph. D.  
Founder and President  
Research Professor and Mentor  
Scientific Caribbean Foundation, Inc.

## *Research Mentors's Biosketch*

**Ángel R. Arcelay Gutiérrez, Ph.D.**



**Dr. Ángel Arcelay Gutiérrez** finished his baccalaurean degree at the Mayaguez campus of The University of Puerto Rico in chemistry. He completed a Master degree with specialization in food chemistry at the same campus. A PhD in biochemistry and biophysics was obtained at The Ohio state University. Post- grade research for chemical environmental remediation was held at the Kennedy Space Center, NASA. Long-term goal throughout my profession has been the service provided to under-represented pre-college, undergraduates and graduate students, which are the individuals that produce the pipeline of higher education at Puerto Rico. The contribution at the pre-college level arose from working at the science fair projects, being judge with students and as the coordinator of the branch of the Caribbean Computer Center for Excellence at Universidad del Este. Most students from this research academy during Saturdays have been accepted to principal universities at Puerto Rico and other states for undergraduate degree and internships. With undergraduates, I have been involved since completing my bachelor as a laboratory instructor mentor, tutor, organic chemistry class assistance, research and personal assistance to professional schools. Several students have performed undergraduate research under my guidance with symposiums presentations and admittance to graduate programs. Many students have been accepted to internships with my guidance. At the graduate level, my involvements have been at the research level and mentorship to complete thesis. I have been advisor to thesis completion and served in several research projects as a member of graduate committees. As a professor I have taught courses, served in committees, worked curriculums and training projects, worked with school science teachers and students. Wrote internally and externally funded proposals and mentored undergraduate research students. I have collaborated with several research colleagues to complete projects of students at different levels.



**Juan F. Arratia, PhD**  
**Research Professor and Mentor**  
**Scientific Caribbean Foundation**

**Dr. Juan F. Arratia** was born in Pomaire, Chile. He graduated from Universidad Técnica del Estado with a BS in Electrical Engineering in 1973. He was awarded a MSc in Engineering from Louisiana Tech University, Ruston, Louisiana, in 1979 and a Ph.D. in Electrical Engineering from Washington University, St. Louis, Missouri in 1985. He has taught and conducted research at universities in Chile (Universidad Técnica del Estado and Universidad Austral de Chile), Puerto Rico (Universidad Interamericana de Puerto Rico and the University of Puerto Rico-Mayaguez), and in the US mainland at Washington University, St. Louis, and Louisiana Tech University, Ruston, Louisiana. He has lectured and given conferences on advanced automation, robotics, vision systems, artificial intelligence, total quality management and science and engineering education in Chile, Bolivia, Ecuador, Guatemala, Panama, Mexico, Brazil, Nicaragua, Perú, Canada, Spain, the Netherlands, Turkey, Japan, Philippines, Singapore, Australia, China, Puerto Rico and in the US mainland. He was the Advanced Manufacturing Manager for Medtronic, Inc., a leading pacemaker company, and is a consultant in advanced automation for pharmaceutical and medical devices companies in Puerto Rico. From 1998 to 2008, he was the Director and Principal Investigator of the Model Institutions for Excellence (MIE) Project, a National Science Foundation sponsored program based at Universidad Metropolitana in San Juan, Puerto Rico. From 2008 to 2018, he was the Executive Director of the Ana G. Méndez University System (AGMUS) Student Research Development Center, designed to disseminate MIE best practices at Universidad del Turabo and Universidad del Este. For twenty year he was part of AGMUS and during his tenure he wrote proposal to NSF and was awarded more than 85 million USD for MIE, CCCE, AGMUS Institute of Mathematics, MRI-AMISR, MRI-Puerto Rico Laser, Administration of Arecibo Observatory among others. Since 2018 to present he is the President of Scientific Caribbean Foundation in San Juan Puerto Rico. In November 2007, he was awarded the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring at a ceremony in the White House in Washington DC.



**Keishla M. Sánchez Ortiz** is an undergraduate senior majoring in Industrial Biotechnology with a minor in Biochemistry at the University of Puerto Rico, Mayagüez Campus. Originally from Jayuya, Puerto Rico, she joined the research academy as a sophomore in high school. The academy handed her the opportunity to be part of two summer pre-college research internships in North Carolina State University- (2014), and Washington University at St. Louis, Missouri (2015). During her freshman year of college, she was accepted in a summer internship at Argonne National Laboratory to work in the expression and purification of enzymes found in the human gut. As an undergraduate, she joined the research team headed by Dr. Juan López-Garriga at the chemistry department, where she focuses on the production and interactions of hydrogen sulfide with proteins in the human body. In the same laboratory, she is currently leading a team of her peers studying different crystallization techniques for heme proteins. In 2018, she was part of the SULI research internship at Stanford-SLAC National Laboratory where she worked in the optimization of crystallization techniques and post-crystallization treatments to improve the diffraction resolution of x-ray crystallography experiments. After the internship, she worked as a technical operations co-op student in Abbvie Biologics, Ltd. There, she provided manufacturing support for the drug Humira, as well as ran process optimization experiments at a laboratory scale. Currently, she is working as a hybridoma production intern at CDI Laboratories and taking classes to graduate in December 2020. At this time, she is applying to Ph.D. programs in Immunology and Molecular Biology and hopes to start graduate school in fall 2021.



**Karina N. Martínez Reyes** is an undergraduate student senior majoring in electrical engineering with a concentration in power systems in the Interamerican University, Bayamon Campus. Having participated as a student in the academy she got the opportunity to participate in a summer internship at NASA/Ames in California. After she returned, she worked as mentor for the academy for four semesters in the Catholic University of Arecibo and then at the University of Turabo in Barceloneta, later on she got a summer internship in the MIT Haystack Observatory (2014). Karina has been research leader for outreach programs for high school students and has had the opportunity to have an undergraduate internship in Washington University, St. Louis, Missouri. Graduating next year (2021). Karina plans to begin working in the industry and later on obtain a master's degree.



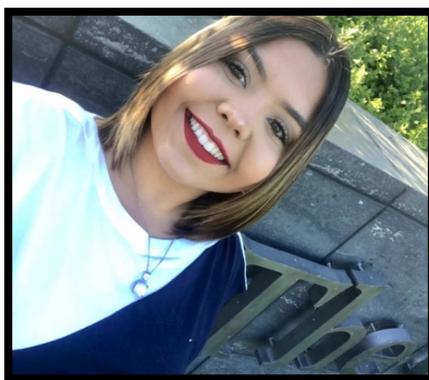
**Diego E. García Ortiz** is an undergraduated student majoring in Natural Sciences with concentration in Biology at the Universidad Ana G. Mendez, Recinto de Gurabo. He participated 4 semester as a neurocircuitry student in the Saturday Research Academy, experience that give him the opportunity to participate in the Puerto Rico Institute for Microbial Ecology Research (P.R.I.M.E.R.) where with Dr. Lisandro Cunci he acquire knowledge on electrochemistry, developing a research about using Electrochemical Impedance Spectroscopy for the detection of neuropeptide Y. On the second semester of his second year he become an assistant mentor with Alexa Pérez in the area of Biological Sciences at Universidad Ana G. Mendez, Recinto de Gurabo research site. Diego is now working on a research proposal on how to use Electrochemistry to improve Alzheimer's Diagnosis and plans to continue his studies on Master's Degree on Pathological Sciences and a Doctorate on Neurobiology aiming to become a researcher to develop and improve treatments for Alzheimer's and other neurodegenerative diseases.



**Pedro R. Trinidad Pérez** started research at the Fall 2014 Saturday Research Academy at UMET. He researched in the area of Bio-Mathematics working with Fractal Areas. His work found that polygons have a specific pattern when they are manifested in fractals. Pedro presented his research at the AGMUS Research Symposia in December of 2014, where he won an award for Best Poster Presentation. After his first semester, Pedro developed an independent research for the School Fair, where he tested and proved an alternative method that is a more efficient and cost-efficient way for pasteurizing the raw milk, so it can comply with the state regulations. This research was performed and analyzed in the Milk Quality Laboratory of the PR Dairy Industry. After a year, he returned back to the Saturday Research Academy to conduct research in the area of Neuroscience under the mentoring of an experienced investigator. In the following three semesters, Pedro developed three different projects, where he used a Neural Simulator to test and simulate different techniques of simulated neurogenesis in different kinds of neurodegenerative diseases. After Pedro graduated from high school, he worked with the academy as a research mentor assistant for the group of neurosciences for a year. Currently, Pedro is an undergraduate student at the University of Puerto Rico, Rio Piedra, where he is completing his bachelor's degree in Chemistry, and also researching in Dr. Cabrera's Lab synthesizing catalyst for Oxygen Reduction Reaction. Additionally, Pedro is the research mentor for the neuroscience group of the Saturday Research Academy Fall 2018.



**Natalia M. Rosado-Díaz** is an undergraduate student majoring in Electrical Engineering with a minor in music at the University of Puerto Rico Mayagüez Campus. Having participated five consecutive semesters in the Saturday Research Academia. She got the opportunity to participate in two summer internships, MIT Haystack (2014) and NC State University (2015) mediated by Dr. Juan F. Arratia, Executive Director of the Student Research Developemnt Center. As an undergraduate, Natalia has been part of different programs at University of Puerto Rico Mayagüez Campus such as the Coki Racing Team, Musicorum and the student council. Last semester she participated in a Neuroscience online program given at Ohio State University in addition with her courses at Puerto Rico.



**Fabiola D. Pagán Torres** is currently a rising senior at the University of Puerto Rico at the “Bayamón” Campus pursuing a bachelor's degree in Biology. She has passed through enrichment opportunities in different areas of science. During her senior year of high school, she started to get involved in research. It began in the program of the Pre-College Saturday Academy of the Ana G. Méndez System sponsored by the National Science Foundation. She was able to complete two scientific investigations. After that, she had the opportunity to attend in an internship at the University of Vermont, where she worked with Dr. Vigouroux. Over time, the opportunity of mentoring was given in the Saturday Research Academy. She applied the skills learned from her past mentors. From that time through now she has mentored over 20 students on what research is. After all this, she had once again the opportunity to participate in the SNURF Program under the guidance of Dr. Ballif in the University of Vermont. The research was focused on being able to study the protein called TLT1 more thoroughly. During this process she acquired skills that are essential in biology. From learning how to culture cells, do immunoprecipitation, SDS-Gels and western blots. Her long-time goal is to acquire an MD / PhD.



**Kenneth J. Martínez Torres** is an alumnus of Universidad del Turabo, PR, who began his research activities in 2015 while assisting a group of students that were building a small vertical turbine, adaptable for light poles. He was in charge of processing installation and operational activities within the lifecycle of the turbine and of applying risk management techniques to mitigate hazardous effects on workers. This required a thorough investigation on how to evaluate risks and on what to suggest in terms of personal protection equipment and proper steps to follow, which allowed him to have his first project, with the title of “Evaluation of Occupational Risks in the Operation and Installation of Small Wind Turbines”. Next, in the year 2016, he had the chance to travel to Paris, France, and collaborate with programmers to work with autonomous systems, which led him to his second project: “ICP Point Cloud Registration for Autonomous Vehicles”. Thirdly, he also had the opportunity to work with professionals, professors, and doctoral students in his field of Industrial and Systems Engineering both in Puerto Rico and the US; his last project was concerned about improving linear-program solvers by inserting cutting planes to the programs. He completed his Bachelor’s Degree in June 2018, being honored as a Magna Cum Laude student and as an awardee of the student with best academic performance in his field, by the Institute of Industrial Engineers of Puerto Rico. A future goal is to complete a PhD in contingency systems as a topic of interest.

## SCHEDULE OF EVENTS

**SATURDAY, DECEMBER 5, 2020**

**VIRTUAL**

**8:00 – 9:40 a.m.**

**POSTER-ORAL SESSION**

**VIRTUAL**

**Chairperson: Dr. Angel Arcelay**

### BIOLOGICAL SCIENCES

- 8:10 – 8:15 a.m.      **Natalia Acosta Laboy**, Colegio Rosa-Bell, Guaynabo, Puerto Rico  
CRISPR CA89 as a Possible Mechanism for Treating Influenza Viral Mutation
- 8:15 – 8:20 a.m.      **Josiel Heredia Carrero**, Josefina León Zayas High School, Jayuya, Puerto Rico  
Decibels Level Hearing Tests to Detect Hearing Problems in Families
- 8:20 – 8:25 a.m.      **Carolina I. Ferrer-Angulo**, Academia Maria Reina, San Juan, Puerto Rico  
Ebola Virus-Like Glycoprotein Communication Between Dendritic Cells and T Cells
- 8:25 – 8:30 a.m.      **Atrim Giselle Rodríguez Santiago**, University Gardens School, San Juan, Puerto Rico  
Study of Schizophrenia Treatments Impact in the Emotional Health
- 8:30 – 8:35 a.m.      **Mariana Sofía Toro Cruz**, Academia María Reina, San Juan, Puerto Rico  
Correlation Between the Development of Glioblastoma Multiforme and a Mutation of the NF1 Gene

### NEUROSCIENCE

- 8:35 – 8:40 a.m.      **Yamilet Nieves Vega**, Academia Maria Reina, San Juan, Puerto Rico  
Dopaminergi Projections Linked to Tourette's Syndrome: Gangalia Abnormalities

8:40 – 8:45 a.m. **María Fernanda Vázquez-Rivera**, Academia María Reina, San Juan, Puerto Rico

Intermittent Explosive Disorder: Fluctuating Serotonergic Levels

### COMPUTER SCIENCE

8:45 – 8:50 a.m. **Vashty A. González Ramkhelawan**, Radians School, Cayey, Puerto Rico.

Mobile APP Development to Treat Anxiety

### ARTIFICIAL INTELLIGENCE

8:50 – 8:55 a.m. **Daniel Purcel Wiltz**, Colegio San Ignacio de Loyola, San Juan, Puerto Rico.

Understanding Engenius Software and its Aplication in the Aerospace Industry

### BIOMATHEMATICS

8:55 – 9:00 a.m. **Danilka Santos Morales**, University Gardens High School, San Juan, Puerto Rico.

The Effectiveness of the Use of the SIR Model in the Spread of Covic-19 in Puerto Rico

### ENGINEERING

9:00 – 9:05 a.m. **Gustavo Carrion Rodriguez**, CIMATEC School , Caguas, Puerto Rico

Analyzing Traffic Congestions in Nevada using Queueing Theory

9:05 – 9:10 a.m. **Andres Guerra-Hernández**, Escuela Especializada en Matemáticas, Ciencias y Tecnología, San Juan, Puerto Rico

Innovation in the New V-280 Aior Vehicle

9:05 – 9:10 a.m. **Alexander Rey Zambrano Tapia**, CIMATEC School, Caguas, Puerto Rico

The Use of SGP as Energy in the Development of Thermal Desalination Process Circuit Model

**ABSTRACTS**  
**BIOLOGICAL SCIENCES**

**CRISPR CAS9 AS A POSSIBLE MECHANISM FOR TREATING INFLUENZA VIRAL MUTATION**

**Natalia Acosta Laboy**, Colegio Rosa-Bell, Guaynabo, Puerto Rico 00966.

Research Mentor: Fabiola D. Pagán Torres, University of Puerto Rico, Bayamón Campus.

Influenza virus is a single stranded negative RNA virus, divided into three types, A, B, and C. This research focused on influenza type A, which mainly affects humans, and its mutations occur mainly through the HA and NA proteins. CRISPR Cas9 is a gene editing tool that can be used to modify or remove genes. The purpose of this research was to determine how CRISPR Cas9 could be a viable option in preventing a mutation in Influenza type A virus. To perform this research, information was gathered from scientific articles and databases on Influenza virus, its mutations, and CRISPR Cas9. Additionally, the changes in genetic sequences of the HA and NA segments of five different Influenza A subtypes were aligned and studied. To determine which subtypes were going to be studied, a table was made that includes the different Influenza A subtypes. Two additional tables were created with the different types of CRISPR mechanism, divided by class and type. Finally, the last results are the genetic sequences of 5 different Influenza A subtypes aligned, presenting the conservation. The GeneDoc results are key in determining where the CRISPR Cas9 be implemented, since it displays the location of the mutations that occurred in the genome segments as new subtypes appeared.

## **DECIBEL LEVELS HEARING TESTS TO DETECT HEARING PROBLEMS IN FAMILIES.**

**Josiel Heredia Carrero**, Josefina León Zayas High School, Jayuya, Puerto Rico

Research Mentor: Keishla M. Sánchez Ortiz, University of Puerto Rico, Mayagüez

Audiology is the science that studies hearing, balance, and related disorders. There are several tests and instruments to diagnose hearing loss, like behavioral hearing tests, otoacoustic emission measurements, and electrophysiological tests. The purpose of this project is to examine the hearing level of close family members. The hearing test used was based on the decibel level with the free application Sound Level Meter. The application measures the levels of sound heard by the test subjects. The test subjects were all part of the same family, two children, two middle-aged adults, and two older adults. The subjects were divided into groups to practice social distancing and protocols recommended by the Health Department to prevent the spreading of COVID-19. Each subject was seated in a chair in front of a television monitor in a closed canopy to ensure no external noises interfered with the test. The sounds were played at different decibel levels until the subject identified the sound. At the volume that the subject heard, the sound level meter was placed on the speaker to measure the television volume's decibels. The data was analyzed, and as expected, the older adults had more trouble hearing clearly than the younger subjects.

## **EBOLA VIRUS-LIKE GLYCOPROTEIN: COMMUNICATION BETWEEN DENDRITIC CELLS AND T CELLS**

**Carolina I. Ferrer-Angulo**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Angel Arcelay, Ana G. Méndez University, San Juan, PR 00926 USA

Ebola virus (EBOV) is not a trivial disease, because it is responsible for the horrid deaths of 11,000 people during the devastating West Africa epidemic of 2014. The Ebola glycoprotein (GP) is responsible with the swift circulation of the virus or other factors, like proteins. Dendritic cells (DCs) are usually the first cells from the innate immune system that the Ebola virus infects. Furthermore, DCs are in charge of sending out signals to other cells of the adaptive immune system in the presence of glycoprotein (GP). After the virus infects the DCs, they send out signals to the T cells, a cell from the adaptive immune system. The virus uses this mechanism because it spreads quickly across the body due to the engulfing method (micropinocytosis) used to infect the rest of the cells. Typically, the T cell would annihilate the infected cells, but EBOV infects T cells before functioning correctly. However, when the T cells are infected, the cytokine is released, the last resort of our immune system to combat the virus. The system uses all of its defenses to try and defeat the virus. Therefore, by observing the effects on the infection rate with a virus-like Ebola glycoprotein, the results expected were that the dendritic cell would carry out the signals to the T cells. The T cells will then annihilate the infected cells before they get infected themselves, and the immune system will not release cytokine. This occurrence means that GP is not the only protein contributing to all the body cells' fast infection. This method lets us have a more defined glycoprotein function and wonder which other protein contributes to this process. With these findings, the project's primary purpose is to provide data to create immunotherapy for the Ebola virus because if we know the cause of the fast infection across the body, we can genetically engineer a virus that presents a specific antigen that antibodies can bind to when infecting the body, before it infects the adaptive immune system.

## **STUDY OF SCHIZOPHRENIA TREATMENTS IMPACT ON THE EMOTIONAL HEALTH**

**Atrim Giselle Rodríguez Santiago**, University Gardens School, San Juan, Puerto Rico  
Research Mentor: Diego E. Garcia Ortiz, Ana G. Méndez University, Gurabo Campus, Puerto Rico

Schizophrenia (SD) is a disease that has been studied for many years, but research progress began until recently. It is a chronic disease of which not much is known and therefore there is no treatment. Just a few antipsychotics to keep symptoms under control, such as *clozapine*, *olanzapine*, *haloperidol*, *quetiapine*, *aripiprazole*, and others. The problem is the side effects which causes a person with schizophrenia to lose his motivation to do things in their daily life due to negative symptoms like weight gain, suffer diabetes or develop heart problems because of the demotivation. To improve this situation, the theoretical creation of a new drug was carried out to avoid such harmful side effects. Research analysis and reading was performed to study how each drug was carried out in our body, in addition to observing how the disease develops within the brain. In the analysis performed by Cell Profiler, it was observed the changes that occurred in the morphology of the brain of the person with schizophrenia and the areas these drugs react to produce its effects, the dopamine receptors. The analysis shown that in the healthy brain, the number of accepted primary objects was 40, 32.5% of the accepted objects were most of them were detected in the central zone of the brain, the hypothalamus. In contrast, with the brain with schizophrenia, 62 primary objects were identified, involving 39.9% of the accepted objects were most of them were detected from the corners, revealing a kind of void in the Hypothalamus or even part of the Thalamus section of the brain. It is concluded that the development of a new drug were the receptors of dopamine do not be so highly affected is necessary. It is still more research needed to perform a correct medicine to this disease but, if we develop a better treatment, we could be able to help patients in their Schizophrenia episodes without this side effects.

## **CORRELATION BETWEEN THE DEVELOPMENT OF GLIOBLASTOMA MULTIFORME AND A MUTATION OF THE NF1 GENE**

**Mariana Sofía Toro Cruz**, Academia María Reina, San Juan, Puerto Rico

Research Mentor: Diego E. García Ortiz, Ana G. Méndez University, Gurabo, Puerto Rico

The exact causes of glioblastoma multiforme (GBM), the most common and most malignant brain tumor in adults, remain unknown. This contributes to today's resistance to therapeutic intervention and very poor prognosis of GBM patients, both of which can be addressed by investigating the possible correlation between GBM and a genetic predisposition known as Neurofibromatosis Type 1, a mutation of the neurofibromin 1 gene (NF1). Most of the mutations in this gene result in the inactivation of a tumor suppressor protein known as neurofibromin. This project focuses on analyzing how the deficiency of neurofibromin in a person's brain may lead to the rapid development of GBM. Using a program called CellProfiler, an MRI image of a healthy brain is analyzed, as well as an MRI image of a brain with a highly developed GBM. After all, the analysis of the image of the healthy brain shows that 39.0% of the area is covered by its objects, while the analysis of the image of the brain with a developed tumor shows that 27.0% of the area is covered by its objects. This means that the tumor displaced parts of the brain, making it smaller. It is evident that, as the brain tumor evolves, the neurofibromin protein is no longer activated, causing the tumor cells to grow and divide rapidly in the brain. Understanding the causes of GBM through future research is the key to being able to provide patients with more effective treatments and a better prognosis.

**ABSTRACTS**  
**NEUROSCIENCE**

**DOPAMINERGIC PROJECTIONS LINKED TO TOURETTE'S SYNDROME: BASAL GANGLIA ABNORMALITIES**

**Yamilet Nieves Vega**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Pedro R. Trinidad-Pérez, University of Puerto Rico, Rio Piedras

Studies suggest an imbalance in the Basal Ganglia's inhibitory function could interfere with its ability to suppress unwanted movements and vocalizations and thus lead to Tourette's syndrome (TS). Tourette's Syndrome can significantly interfere with the person's activities and social interactions. The emergence of unwelcome motor and vocal tics in social situations can lead to not only embarrassment, social isolation, physical pain, but can even end up in suicide. Due to the fact, patients with TS are 4 times more likely to die by suicide compared to patients without TS. By understanding the neural activity of TS, we could create new treatment plans to help minimize the symptoms, improving the lives of the patient diagnosed with TS. A model was made to represent abnormalities in the Basal Ganglia pathways and the dopaminergic projections associated with the involuntary urges or uncontrolled movements experienced by TS patients. Using Simbrain, a visually oriented framework for building and analyzing neural networks, the basal ganglia were modeled and then analyzed the effect of altering the dopamine projections in the basal ganglia's direct and indirect pathways. Dopamine excites the direct pathway and inhibits the indirect pathway, with a net effect to increase facilitatory inputs to the motor regions. Most of the output from the basal ganglia goes through the thalamus to the cerebral cortex, affecting movement by influencing motor cortex activity. It was found that higher levels of dopamine cause the brain activity to be constant, allowing the brain to exhibit unwanted moves. Therefore, regular doses of dopamine in the Basal Ganglia can continuously suppress the involuntary tics caused by Tourette's Syndrome.

## **INTERMITTENT EXPLOSIVE DISORDER: FLUCTUATING SEROTONERGIC LEVELS**

**María Fernanda Vázquez-Rivera**, Academia María Reina, San Juan, Puerto Rico 00921  
Research Mentor: Pedro R. Trinidad-Pérez, University of Puerto Rico, Rio Piedras

Intermittent Explosive Disorder (IED) is an impulse control disorder that causes a diagnosed person to have sporadic explosive outbursts. These outbursts occur suddenly with little or no warning resulting in repeated episodes of impulsive, aggressive, violent behavior, or angry verbal outbursts. The unexpected outbreaks can cause distress on the patient, negatively impacting his or her relationships, work, school, and they can even have legal and financial consequences. There is no current exact known cause for IED, but studies suggest that it may be related to the neurotransmitter serotonin's abnormal activity, like its fluctuating levels, which affect the brain's ability to control impulse aggression. The abnormal activity also includes low levels of the neurotransmitter, which also leads to trigger anger and aggression. Four brain regions were identified that are linked to emotions, including anger, and are believed to have a connection with serotonin. These regions are the prefrontal cortex (PFC), the amygdala, the anterior cingulate cortex (ACC), and the insular cortex. A circuit was created in Simbrain that was then manipulated by varying serotonin levels in each region, and recorded the plots' results with normal, high, and low levels of serotonin. After running the different circuits with the varying levels of serotonin, it was found that the circuit with the low serotonin levels had a continuous neural activity, and suddenly it flatlined. The previous suggests that when the selected brain regions have low serotonergic levels, the person diagnosed with IED may be suddenly experiencing an anger outburst from IED. Suggesting that IED may be triggered and caused by low levels of the neurotransmitter in the modeled brain regions.

**ABSTRACT**  
**COMPUTER SCIENCE**

**MOBILE APP DEVELOPMENT TO TREAT ANXIETY**

Vashty A. González Ramkhelawan, Radians School, Cayey, Puerto Rico.

Research Mentor: Karina Martínez, Interamerican University of Puerto Rico, Bayamón Campus

Difficult times in which we become desperate, moods change because and treatment in relationships can be difficult could be a result of our environment or a certain situation. Feeling angry, nervous and sometimes even sad is an uncomfortable feeling which is known as anxiety. This is our body's natural response to stress it is a reaction to stressful, dangerous, or unfamiliar situations. Anxiety is caused by genetic and environmental factors, as well as brain chemistry. The areas of the brain responsible for controlling fear, such as the amygdala, may be impacted by anxiety. Therapy with a professional help to deal with this disorder, and to help in between sessions a mental health app is being developed. This app will help to confront, dissolve or embrace anxious thoughts and feelings in between therapy sessions. Mental health apps can be effective by making therapy more accessible, efficient and portable. The app will be directed to children that are between 6 to 8 years old. By creating lists, a worry box, identifying feelings and motivate them to exercise can help the child to feel better and help them deal with anxiety.

***ABSTRACT***  
**ARTIFICIAL INTELLIGENCE**

**UNDERSTANDING ENGENIUS SOFTWARE AND ITS APPLICATION IN THE AEROSPACE INDUSTRY**

**Daniel J. Purcell Wiltz**, Colegio San Ignacio de Loyola, San Juan, Puerto Rico.  
Research Mentor: Martín E. Fuentes-Quñonez, Scientific Caribbean Foundation, San Juan, Puerto Rico

The evolution of technology has changed us as a society. New and incorporated software designs and technology have been arriving at a fast pace. Less effective and unreliable programming in the past such as mathematics and logic-based methods have only one single optimization method, which is not good to solve all problems. In today's tech, different approaches are needed in different parts of a problem as well as at different stages of the iteration process in order to succeed. That's when Engineous comes in. This software combines artificial intelligence and numerical methods for the design and optimization of complex aerospace systems. Engineous combines the advanced computational techniques of genetic algorithms, expert systems, and object-oriented programming with the conventional methods of numerical optimization and simulated annealing to create a design optimization environment that can be applied to computational models in various disciplines. Engineous's hybrid approach is based in many commonly used generic optimization and design automation utilities as well as utilities that can capture any known properties of the problem. The use and application of Engineous combined with Artificial Intelligence will solve major challenges such as labor costs, human errors, and health and safety concerns that the aerospace sector faces daily. Nevertheless, fuel efficiency, operational efficiency, Air traffic management are all favorable to the usage of Artificial Intelligence with the help of Engineous.

***ABSTRACT***  
**BIOMATHEMATICS**

**THE EFFECTIVENESS OF THE USE OF THE SIR MODEL IN THE SPREAD OF COVID-19 IN PUERTO RICO.**

**Danilka I. Santos Morales**, University Gardens High School, San Juan, Puerto Rico.

Research Mentor: Dr. Luis de la Torres, Washington State University, USA

The viruses are microorganisms that cause diseases. Some of these diseases are mild and last very little time. In those cases, epidemics don't happen. However, there are viruses that are more resistant and highly contagious, these are the ones that cause epidemics. In this case is when it is necessary to look for ways to study them. The study of their viruses and their propagation is done using mathematical models. One of the simplest and most used is the SIR model. This model uses the number of susceptible, infected and recovered people to predict the number of people that will be infected as well in the duration of an epidemic. Covid-19 is a new virus that caused a worldwide pandemic everywhere including Puerto Rico. What we want to know is the effectiveness of the SIR model applied to Covid-19 so we can be able to theoretically predict the spread of the virus in Puerto Rico. We also want to know how the spread of the virus can be reduced by changing conditions within the community. To do this, we used a simulation made with data obtained from the Puerto Rico health department. We demonstrated the importance of using mathematical models such as the SIR model to help us obtain important information to be able to predict their behavior. The SIR model provided us with insights and predictions of the spread of the virus in Puerto Rico that the recorded data alone did not.

## ***ABSTRACTS*** **ENGINEERING**

### **QUEUEING THEORY**

**Gustavo Carrion Rodriguez**, CIMATEC, Caguas, Puerto Rico

Research Mentor: Kenneth Jose Martinez Torres, Montana State University, Bozeman, Montana

This research will analyze and model traffic congestion using the Queueing theory or the mathematical study of the congestion, flow, and delays of waiting in line (Kenton, 2019). In essence, queues occur every time instantaneous demand exceeds the capacity to provide a service. Therefore, if there is no efficient approach, traffic can get very congested and it can cause poor quality of life throughout the world by making people lose time, spend more money in fuel, and even contaminate the environment, but by treating it in the same way as a queue, it can be evaluated to find a better solution. That is why in this research, the queueing theory will be applied to model these traffic congestions. The data retrieved for this study will be from the surveillance cameras installed in 5060 Stephanie / Warm Springs intersection in Nevada, USA (Nevada Department of Transportation). After gathering the data from the camera livestream in Nevada, the researchers will do a Fit test to determine the distribution with the “Minitab” application. Then, the data will be inserted into the G/G/1 equation’s variables. After analyzing the data with the proper probability distribution, the results could define the status of this traffic road intersection. In the end, if the result is a very high number, we could say that this road intersection in Nevada is indeed congested. For later studies, the data recovered in this investigation with the queueing theory can help artificially determine the variables that can be adjusted in order to have traffic flowing properly and it can also be tested with different distributions. Furthermore, this same procedure could be implemented to other intersections in other parts of the world to determine if they are congested as well.

## **INNOVATIONS IN THE NEW V-280 AIR VEHICLE**

**Andres Guerra-Hernández**, Escuela Especializada en Matemáticas, Ciencias y Tecnología, San Juan Puerto Rico

Research Mentor: Natalia M. Rosado-Díaz, University of Puerto Rico, Mayagüez, Puerto Rico

The V-280 Valor is a multipurpose air vehicle, manufactured by Bell Helicopters, Lockheed Martin and part of the Future Vertical Lift. The V-280 Valor has a speed of 320 miles per hour, a range of 820 miles, a capacity of 16 people counting crew and can carry up to 57,000 pounds. This vehicle will have the power to lift military equipment or lightly armed vehicles and it has a non-rotating barrel for air support and defense. The V-280 Valor has an airframe of carbon fibre reinforced composite that helps to reduce costs and weight. The most important part of the V-280 Valor is that it is a helicopter and an airplane, known as Vertical Take Off and Landing. It has a non-rotating barrel for air support and defense. The variants will be air assault, special operations, attack, medevac, and utility. Some results in this model are: insufficient protection, insufficient range, and the change from a mounted machine gun to a remote controlled.

## **THE USE OF SGP AS ENERGY IN THE DEVELOPMENT OF A THERMAL DESALINATION PROCESS CIRCUIT MODEL.**

**Alexander Rey Zambrano Tapia**, CIMATEC School, Caguas, Puerto Rico

Research Mentor: Diego E. Garcia Ortiz, Ana G. Méndez University, Gurabo Campus, Puerto Rico

Out of all the water in planet Earth, 96.4 percent of that water is saltwater (USGS, 2020). This can be considered a problem as now fewer sources of fresh water can be found. And without fresh water, humans cannot survive. There are many ways to extract the salt from water, one of the most known ways being thermal desalination that uses heat to separate most of the water from salt by evaporating the water using heat to separate itself from the salt (Hisham T., 2002). This process however requires huge amounts of energy and leaves behind brine. Brine is water with higher concentrations of salt to the point where it could harm the environment if wasted irresponsibly. This investigation suggests a possible solution to both problem by using the brine as an energy source in a process called Salinity Gradient Power. Salinity Gradient Power (SGP), uses the protons in brine and in salt-water and makes energy by manipulating them using special membranes (Ettiene Brauns, 2019). This study aims to use the SGP to power the thermal desalination while the thermal desalination gives the SGP its brine for it to be able to produce more energy. The investigation decided to prove this idea is by using an online software called Multisim where it lets the researcher make a circuit model. Using this website, a model was made where the SGP powered the thermal desalination process which is shown below. This model shows a never-ending cycle in which one puts salty water on one hand where at the end the only thing left is more renewable energy and fresh water. This model uses an alternative current that represents the energy generated by the SGP, a capacitor that will store energy and help in the energy flux, and the desalination represented with a light bulb. When tested furthermore on the mutism the model showed to be efficient with 1, 10, and 20 minutes without any problems found and with good energy flux across the circuit model. The model is however less efficient compared to that of a gas-powered energy source, however it still maintains its purpose on being self-efficient while not producing any kind of pollution making it eco-friendly and suitable in the production of fresh water.

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### **Scientific Judges:**

Dr. Angel Arcelay, Ana G. Mendez University, Carolina-Campus, Puerto Rico  
Dr. Adniel Machine De Jesus, Excecutive Directoe of the Science and Visitor Center of the Arcibo Observatory, Puerto Rico  
Nydiana Benitez Mangual, University of Puerto Rico, Humacao, Puerto Rico  
Melissa Rivera Narvaez, Ana G. Mendez University, Metro Campus, Puerto Rico  
Karielys Ortiz-Rosario, Collins Aerospace Puerto Rico, Aguadilla, Puerto Rico

### **Research Mentors:**

Dr. Luis de la Torres, Washington State University, USA  
Martín E. Fuentes-Quiñonez, Scientific Caribbean Foundation, San Juan, Puerto Rico  
Diego E. García, Ana G. Méndez University, Gurabo Campus, Puerto Rico  
Kenneth Jose Martinez Torres, Montana State University, Bozeman, Montana  
Karina Martínez, Interamerican University of Puerto Rico, Bayamón Campus  
Fabiola D. Pagán, University of Puerto Rico, Bayamón, Puerto Rico  
Natalia M. Rosado-Díaz, University of Puerto Rico, Mayagüez, Puerto Rico  
Keishla M. Sánchez Ortiz, University of Puerto Rico, Mayagüez  
Pedro R. Trinidad-Pérez, University of Puerto Rico, Rio Piedras

### **Symposium Coordinator:**

Dr. Juan F. Arratia, Research Professor, Student Research Development Center, Scientific Caribbean Foundation, Inc.

## INDEX OF PRESENTERS

NAME	SCHOOL	PAGES
Natalia Acosta Laboy	Colegio Rosa-Bell, Guaynabo, Puerto Rico	15, 17
Josiel Heredia Carrero	Josefina Leon Zayas High School, Jayuya, Puerto Rico	15, 18
Carolina I. Ferrer-Angulo	Academia María Reina, San Juan, Puerto Rico	15, 19
Atrim Giselle Rodriguez Santiago	University Gardens High School, San Juan, Puerto Rico	15, 20
Mariana Sofia Toro Cruz	Academia Maria Reina, San Juan, Puerto Rico	15, 21
Yamilet Nieves Vega	Academia Maria Reina, San Juan, Puerto Rico	15, 22
María Fernanda Vázquez-Rivera	Academia María Reina, San Juan, Puerto Rico	15, 23
Vashty A. Gonzalez Ramkhelawan	Radians School, Cayey, Puerto Rico	15, 24
Daniel Purcell Wiltz	Colegio San Ignacio de Loyola, San Juan, Puerto Rico	15, 25
Danilka Santos Morales	University Gardens High School, San Juan, Puerto Rico	15, 26
Gustavo Carrion Rodriguez	Specialized School of Science, Mathematics and Technology (CIMATEC), Caguas, Puerto Rico	15, 27
Andres Guerra Hernandez	Specialized School of Science, Mathematics and Technology (CIMATEC), Caguas, Puerto Rico	15, 28
Alexander R. Zambrano Tapia	Specialized School of Science, Mathematics and Technology (CIMATEC), Caguas, Puerto Rico	15, 29

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