

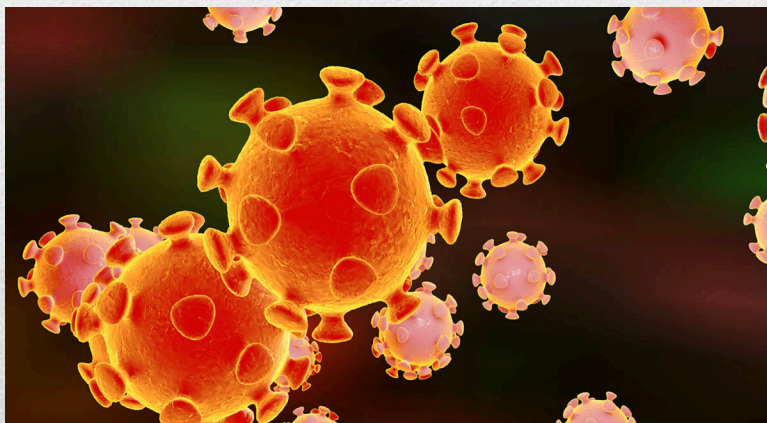


Scientific Caribbean  
Foundation

Scientific Caribbean Foundation  
Student Research Development Center

# Virtual Spring 2021 Pre-College Research Symposium

**Biological Sciences – Neurosciences - Engineering**



**Biomathematics - Computer Science - Astronomy-Physics  
Artificial Intelligence**

**Saturday, May 15, 2021**

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San Juan, Puerto Rico

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

ARE PROUD TO HOST THE

**VIRTUAL SPRING 2021 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**

May 15, 2021

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# **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). The 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 transferred to graduate school, with 75 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 2021 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 SRING 2021 PRE-COLLEGE  
RESEARCH SYMPOSIUM**

**CONFERENCE AT A GLANCE**

**SATURDAY, MAY 15, 2021**

**VIRTUAL**

**9:00–9:10 a.m.      Opening Ceremony**

**Dr. Juan F. Arratia, Research Professor and Mentor  
Dr. Angel Arcelay, Professor of Chemistry  
Dr. Elba Sepulveda, Johns Hopkins University**

**9:10–10:10 a.m.      Poster-Oral Sessions**

**Biological Sciences  
Neurosciences  
Astronomy-Physics  
Computer Science  
Artificial Intellegence  
Biomathematics**

**10:10-10:15 a.m.      Pre-College Alumni Research Experiences  
Natalia Acosta Laboy**

**10:15– 10:20 a.m.      Awards Ceremony and Closing Remarks**

**10:20 a.m.              Symposium Adjourns**



Scientific Caribbean  
Foundation

May 15, 2021

Dear Pre-College Students:

The Virtual Spring 2021 Pre-College Research Symposium is the culmination of the activities and dissemination process of the Virtual Spring 2021 Saturday Research Academy Program of the Scientific Caribbean Foundation. For a period of four months, since January 2021, 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 Spring 2021 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 Spring 2021 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 Spring 2021 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**

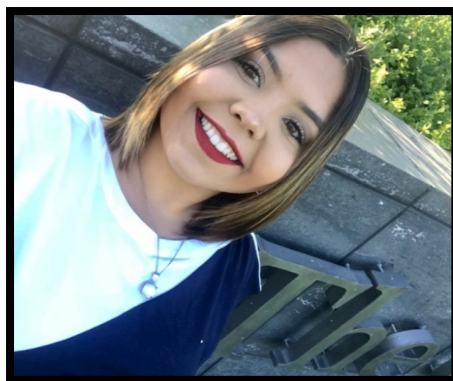
**Dr. Juan F. Arratia** was born in Pomaire, Chile. He graduated from Universidad Técnica del Estado with a BS in Electrical Engineering in 1973. He was awarded a MSc in Engineering from Louisiana Tech University, Ruston, Louisiana, in 1979 and a Ph.D. in Electrical Engineering from Washington University, 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.



**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.



**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 Development 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 was mentor 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.





**Ángel M. Márquez Otero** is currently in his last year as an undergraduate student pursuing studies in Biology at Interamerican University of Puerto Rico in Bayamón. He has always wanted to pursue a STEM career since he was young. He participated in the Saturday Research Academy Program (SRAP) since 2014. Furthermore, he's been trained and has conducted projects in Biology, Biostatistics, Bioinformatics, Ecology and Evolution in the academy and two internships in United States. The first internship was at University of Vermont (Summer 2015) conducting research with *Drosophila melanogaster* and see how exercise may had an effect on them. The second internship was at the University of Kansas (Summer 2017) where he conducted research with Geographic Information Systems to determine if climate change may have an effect on the species on the genus *Lynx* based on prediction models to 50 and 70 years from now. This is his third as mentor. Also, he had under his mentorship a Summer group in the two weeks intensive program from SRAP. He wants to empower young students to pursue studies in STEM fields and to become researchers. As a future scientist Ángel wants to pursue a Master's in Educational Neuroscience and a Ph.D. in Geology or Evolutionary Biology to pursue a career as a Vertebrate Paleontologist. Through mentorship and research experience Ángel wants to be an example of perseverance for future generations of scientists and enable these the capacity to find the answers to the most pressing problems in our modern world.



**Mariana Vargas Castillo** is a Marketer with 3 years of experience in Digital Marketing with a bachelor's degree in Marketing and Advertising from Universidad Católica Redemptoris Mater, Managua, Nicaragua. She participated in the Summer Research UNICA-Puerto Rico Alliance 2016 at Universidad Metropolitana and conducted the scientific research "(R) or (S)-2, 6-Diamino-5-Hydroxy-1, 2-Dihydrophenanthren-3(4H)-One Derivates: In Silico Drug Discovery of a New Family of Potentially Biologically Active Compounds," under the mentoring of Dr. Osvaldo Cox, Professor of Chemistry at Universidad Metropolitana, San Juan, Puerto Rico. In 2016, 2019, and 2021 she became an assistant mentor along with Dr. Juan Arratia helping Nicaraguan students develop their scientific research in their preferred field.

## SCHEDULE OF EVENTS

SATURDAY, MAY 15, 2021

VIRTUAL

9:10 – 10:10 a.m.

POSTER-ORAL SESSION

VIRTUAL

Chairperson: Dr. Angel Arcelay

### BIOLOGICAL SCIENCES

9:10 – 9:15 a.m.

**Rodolfo Acosta Laboy**, San Jose School, San Juan, Puerto Rico

The Extinction of Oligocene Biodiversity of Puerto Rico

9:15 – 9:20 a.m.

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

Catalyst Application as an Improvement in SGP Thermal Desalination Pprocess Via Hydrogen Production

9:20 – 9:25 a.m.

**Edgar A. Maldonado Ortiz**, Centro Residencial de Oportunidades Educativas, Villalba, Puerto Rico

COVID-19 Pandemic Influencer in the Sleep Paralysis Episodes on Puerto Rico Population

9:25 – 9:30 a.m.

**Mariana Beatriz Gutiérrez Pagan**, Maria Reina Academy, Guaynabo, Puerto Rico

Electrochemical Impedance Spectroscopy as a Potential Biomarker in Early Psychopath Development Diagnosis

9:30 – 9:35 a.m.

**Carolina I. Ferrer Angulo**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA

Gene Manipulation on Zaire Ebola Virus Using Crispr-Cas9

9:35 – 9:40 a.m.

**Beatriz I. de Leon Gomez**, Academia Maria Reina, San Juan, Puerto Rico. 00921 USA

Effects of Microplastic on the Human Health

9:40 – 9:45 a.m.

**Janelle Bachman Rodriguez**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA

Effects of Excessive Screen Time on Social-Emotional Development in School-Age Children with Attention Deficit Hyperactivity Disorder (ADHD)

### NEUROSCIENCES

9:45 – 9:50 a.m.

**Yamilet Nieves Vega**, Academia Maria Reina, San Juan, Puerto Rico

Replacing Damaged Glial Cells: Addressing Schizophrenia in a Different Way

9:50 – 9:55 a.m.

**María Fernanda Vázquez-Rivera**, Academia María Reina, San Juan, Puerto Rico

The Psychopathic Brain: Making Connections

### ASTRONOMY AND PHYSICS

9:55 – 10:00 a.m.

**Marc A. Thys Charneco**, Colegio La Piedad, Carolina, Puerto Rico

Measurement of Celestial Bodies: Eratosthenes and Aristarchus' Methodology vs Modern Day Figures

### COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE

10:00– 10:05 a.m.

**Mariandrea Camila Urcuyo Mena**, Centro Educacional Mantica Berio, Chinandega, Nicaragua.

Design and implementation of an AI application, using SCRATCH for Children with ASD

### BIOMATHEMATICS

10:05 – 10:10 a.m.

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

The Effectiveness of the SIR Model Predicting Covid 19 Herd Immunity Using Vaccines in Puerto Rico

**ABSTRACTS**  
**BIOLOGICAL SCIENCES**

**THE EXTINCTION OF OLIGOCENE BIODIVERSITY OF PUERTO RICO**

**Rodolfo Acosta Laboy**, San José School, San Juan, Puerto Rico

Research Mentor: Ángel M. Márquez Otero, Interamerican University of Puerto Rico, Bayamón, Puerto Rico

The Oligocene epoch served as a transition period for both flora and fauna across the world. As temperatures cooled from the previous, the weather became more seasonal, and flora adapted to a drier and cooler environment. Similar to how flora began to develop and evolve, fauna quickly followed, with the birth of early canids, amphicyonids, and other types of birds and mammals quickly filling in the niches that were left vacant after the last major extinction. Oceanic islands like the Major and Minor Antilles were no exception to all these major biodiversity developments. This work will be focusing on specific species of Oligocene fauna native to the island of Puerto Rico, the likes of which include extinct species of gharials and ground sloths. Furthermore, the work will be directly relating to finding possible reasons as for why these animals went extinct even with a lack of any hyper carnivorous apex predators present within the prehistoric ecosystem.

**COVID-19 PANDEMIC INFLUENCE IN THE SLEEP PARALYSIS EPISODES ON PUERTO RICO POPULATION**

**Edgar A. Maldonado Ortiz**, Centro Residencial de Oportunidades Educativas, Villalba, Puerto Rico

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

Sleep paralysis is a state of rest where your brain is conscious of his surroundings, but your body is still in a sleep causing a paralysis. During this stage the brain still processes information in the form of dreams, because of this the person suffering from sleep paralysis develops symptoms like hallucinations, pressure, sense of choking and anxiety caused by the inhibition of serotonin 2A receptors as certain studies suggests. Factors like stress, sleep apnea, narcolepsy and unstable sleeping patterns are highly contributing to the appearance of this event. During the Covid- 19 pandemic which affected Puerto Rico on March 2020 stress level arose like never, affecting people's mental and emotional health. In addition, many people had to work in their homes and instead of associating their house with relaxation and sleep, it becomes another stressful workplace. This change of scenario caused a percent of the population to change their routine and their sleep habits turning this a potential factor to the sleep paralysis condition frequency. To study if there is a correlation in the pandemic experience and sleep paralysis appearance a survey was developed and distributed to several groups of people to get data of their daily routine, workspace, stress and anxiety behavior and changes in sleep habits. In addition, questions like gender, approximated age, pandemic effect, if it is a student or not and if it has a full-time or part time job to observe if this situation is a contributive factor to the sleep paralysis development.

## **CATALYST APPLICATION AS AN IMPROVEMENT IN SGP THERMAL DESALINATION PROCESS VIA HYDROGEN PRODUCTION**

**Alexander Rey Zambrano Tapia**, CIMATEC School, Caguas, Puerto Rico  
Research Mentor: Diego E. Garcia Ortiz, Ana G. Méndez University, Gurabo Campus, Puerto Rico

On Earth, 96.4 percent of water is saltwater meaning there are fewer sources of fresh water. A popular way of extract fresh water is via thermal desalination. This process, however, requires massive amounts of energy and leaves behind brine. This investigation suggests a solution to both issues by using the leftover brine as an energy source in a process called Salinity Gradient Power (SGP) and then using a catalyst to augment the energy output. It does so by separating certain components to then use such variables for energy production. Hydrogen has had important interest in the bioenergy research thanks to its concentration, energy properties and no greenhouse emission during its usage. By using these mediums as an energy source, thermal desalination gives the SGP its brine and with catalyst capable of producing hydrogen via water splicing it contributes to the production of energy for it to be able to produce more fresh water. The investigation has already been theoretically proven by using an online software simulator called Multisim. The original model did not include the catalyst so to document the change the new model will have to include. The result was shown to be less efficient compared to that of a gas-powered energy source, however it keeps its purpose on being self-efficient while not producing any kind of pollution making it eco-friendly. Furthermore, all that would be needed is use a miniature version of the SGP and the thermal desalination to test the already established idea in a real-world scenario with a catalyst helping the SGP create energy for the thermal desalination using hydrogen liberation. Once connected via an electrical circuit, both systems can provide each other the resources they need to function on an industrial scale.

## **ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY AS A POTENTIAL BIOMARKER IN EARLY PSYCHOPATH DEVELOPMENT DIAGNOSIS**

**Mariana Beatriz Gutiérrez Pagan**, Maria Reina Academy, Guaynabo, Puerto Rico  
Research Mentor: Diego E. Garcia Ortiz, Ana G. Méndez University, Gurabo Campus, Puerto Rico

A psychopath is a person who has an antisocial personality disorder (ASPD) and portrays abnormal behavior, has a lack of sentiments, tends to be egocentric, and does not seem to learn from past events. The premise of this investigation is to discover how the vmPFC and amygdala are disconnected contributing to the appearance of this symptoms being one of the main objectives the improvement of ASPD diagnosis, which is difficult to detect on early ages were there is still time to help the patient with therapies. In this project, we will explain the activity of the brain when having this disorder using the simulation, Simbrain, to show the neuronal activity in the parts of the brain affected. Certain studies had concluded that people who have this disorder are thought to have some genes, which cause them to have ASPD and alters the amount of certain protein concentrations. The technique of Electrochemical Impedance Spectroscopy (EIS) is used to measure the impedance of a system with the dependence of the alternating current potential frequencies. This method helped us determine if the protein concentration was high enough to have a negative effect in the neural circuits by receiving an interference in the current's potential of the EIS. This technique can help us determine the concentration on any age, improving the ASPD diagnosis and being able to detect these anomalies to know if a patient has a high probability to develop ASPD on the future becoming an important tool in other protein-associated diseases detection.



## **GENE MANIPULATION ON ZAIRE EBOLA VIRUS USING CRISPR-Cas9**

**Carolina I. Ferrer Argulo**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Fabiola D. Pagán Torres, Universidad de Puerto Rico en Bayamón, Puerto Rico, 00959

Ebola virus is not a common disease; however, it's responsible for the deaths of 11,000 people during the West Africa epidemic. Unfortunately, there is no official treatment for the disease. An effective way to combat it is through an immunotherapeutic treatment which knocks out the genetic sequencing of nucleoprotein, polymerase L, and VP35 or VP24, NP, and VP35. We propose to use CRISPR-Cas9, where Cas9 will cut the viral RNA in the ribosomes. For this to happen, the CRISPR RNA (crRNA) has to match the sequence of the proteins. Then the Cas9 gene will create the proteins helicase, to unwind the RNA, and nuclease, to cut the RNA. Finally, crRNA and viral RNA arrive at the ribosome, and instead of completing the process of translation, the genomes break apart and infection ends. Fortunately, spacers of the CRISPR gene will contain the genes from the viral RNA to prevent future infections. Additionally, through this process the immune system will adapt to the methods used by CRISPR-Cas9. This can result in the creation of a treatment. In fact, this mechanism worked for editing the Vaccinia virus genome to create a vaccine and to correct disease mutations in mice, resulting in alteration of their phenotype. Moreover, our immune system does not get a chance to fight this pathogen, due to the quick budding, and this gene gives the body a chance to enhance immune response. Furthermore, other areas we could explore are using CRISPR-Cas9 to mediate gene expression; an innovative method for treating many conditions and diseases.

## **EFFECTS OF MICROPLASTIC ON THE HUMAN HEALTH**

**Beatriz I. de León Gómez**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Fabiola D. Pagán Torres, Universidad de Puerto Rico en Bayamón, Puerto Rico, 00959

Plastic has recently become more than an environmental problem; it has evolved into a health problem, and that just the beginning. Humans use plastic every day, from our soap to our toothbrush, and our consumption grows every day and worst. A small portion of the plastic that we humans use is recycled; another portion is either in the landfill or the ocean. As we all know, matter cannot be created or destroyed. So, the plastic in the ocean later, through time they gradually erode, decompose under the effect of sunlight, and are eaten by bacteria, breaking up into many very small particles, resulting in 5 millimeters of plastic particles, called microplastics. For this reason, the purpose of this investigation is to study the effects of microplastics on the human health. To understand this topic on how is affecting our health, papers were gathered and analyzed. Recent studies have shown that these microplastics have been present in aquatic species, food, beverages, water, etc. This ingestion of these microplastic can be very hazardous to us humans and other species. Hence, Endocrine dysfunction, weight gain, insulin tolerance, reduced reproductive performance, and cancer have all been attributed to the effects of microplastics. More investigation on how microplastics affect our health can be conducted, such as how it affects women's fertility and how to bring awareness of laws that control or eradicate the use of plastic.

## **EFFECTS OF EXCESSIVE SCREEN TIME ON SOCIAL-EMOTIONAL DEVELOPMENT IN SCHOOL-AGE CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)**

**Janelle Bachman Rodríguez**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Fabiola D. Pagán Torres, Universidad de Puerto Rico en Bayamón, Puerto Rico, 00959

Socio-emotional development is described as the process children experience when they commence to acquire abilities such as social skills, regulating emotions, forming relationships, and figuring out their identity. During this stage, some children face conflicts or challenges because of underlying illnesses like Attention Deficit Hyperactivity Disorder (ADHD), a neurodevelopmental condition characterized by its symptoms of inattention, hyperactivity, and impulsiveness. Recent studies have shown that screen time amongst school-age children has increased which can also increase the likeliness to present inattentive behaviors and develop mental disorders such as anxiety and depression. Furthermore, we created a survey that was sent to the parents of children from 6-12 years old who had been diagnosed with ADHD. This survey contained questions that examined the child's different behaviors regarding the use of electronics and possible changes in their ADHD-related symptoms. In addition, the survey contained an informed consent that stated the purpose, qualifications, expectations, and possible effects of this investigation. Moreover, we speculate that the results obtained from the survey will indicate that children who have greater screen time will show a worsening in their ADHD-related symptoms and a decline in socio-emotional skills. These effects could potentially lead to other mental conditions and produce difficulties in social interactions, creating relationships, and expressing emotions. In closing, these alterations might also be seen in adolescents which would be another interesting research project that we would like to conduct in the future.

***ABSTRACTS***  
***NEUROSCIENCE***

**REPLACING DAMAGED GLIAL CELLS: ADDRESSING SCHIZOPHRENIA IN A DIFFERENT WAY**

**Yamilet Nieves Vega**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Fabiola D. Pagán Torres, Universidad de Puerto Rico en Bayamón, Puerto Rico, 00959

Schizophrenia is a chronic mental disorder that affects the person's thought process, actions, perception of reality, and interaction with others. This mental illness can significantly interfere with the person's activities and social interactions because it makes it difficult for the person to differentiate what is real from what is imaginary. By further understanding what is affected in the brain of people diagnosed with schizophrenia, we could create new treatment plans that involve medicine with less side effects to better their lives. Recently, researchers from the University of Copenhagen uncovered a new cause for this disorder. The study shows that genetic defects may damage the glial cells and may lead to a number of brain disorders, such as schizophrenia. To further this study, it was attempted to replace defective glial cells with healthy ones to observe later outcomes. The hypothesis is that by replacing unhealthy glial cell in the simulation, it may be possible to reverse the progression of schizophrenia. However, despite trying different approaches, it was found that the techniques available for this type of study are scarce. This empathizes how limited scientists are when trying to artificially model behaviors of neurological disorders. This is a call to further the development of new methods to better understand the cognitive processes underlying these disorders. As artificial neural networks not only have the power to predict behavior, but also to modify factors that can alter such behaviors.

## **THE PSYCHOPATHIC BRAIN: MAKING CONNECTIONS**

**María F. Vázquez Rivera**, Academia Maria Reina, San Juan, Puerto Rico 00921 USA  
Research Mentor: Fabiola D. Pagán Torres, Universidad de Puerto Rico en Bayamón, Puerto Rico, 00959

Psychopathy is a disorder distinguished by atypical emotional responses and antisocial behaviors such as reduced empathic response. Psychopaths' tendencies to act in an antisocial manner and disregarding such behaviors' impact on others imply a diminished empathic response. There is no remedy, medication, vaccine, or therapy that can inflict the emotions psychopaths lack; however, understanding this disorder's cause may help find a solution. The absence of empathic response is believed to be associated with lessened activity in regions linked with emotional response, such as the ventromedial prefrontal cortex (vmPFC), responsible for the sentiments of empathy and guilt, and the amygdala, responsible for mediating fear and anxiety. Neuroimaging has shown reduced gray matter and connectivity among such regions. Regarding connectivity, long-range connections between brain regions constitute the macroscale connectome, or macro-connectome, which refers to the distribution of long-range tracts between brain regions. Since researchers believe that rewiring of neural circuits may underlie changes in behavior, we speculate that making connections at the macro-scale level between the amygdala and the vmPFC could generate empathy, guilt, anxiety, and fear in an individual with a psychopathic brain. Using the software Simbrain, we aim to design neural circuits of these two brain regions and make different directional connections to see if activity is achieved. We will also research the different central nervous system acting drugs that induce neuroplasticity and determine the most suitable medication to obtain our goal. Creating connections between the ventromedial prefrontal cortex and the amygdala could bring about the feelings linked to these areas that individuals with psychopathy lack.

**ABSTRACTS**  
**ASTRONOMY AND PHYSICS**

**MEASUREMENT OF CELESTIAL BODIES: ERATOSTHENES AND ARISTARCHUS' METHODOLOGY VS MODERN DAY FIGURES**

**Marc A. Thys Charneco**, Colegio La Piedad, Carolina, Puerto Rico

Research Mentor: Natalia M. Rosado Díaz, Universidad de Puerto Rico, Mayagüez, Puerto Rico.

Eratosthenes and Aristarchus were Greek astronomers that wanted to find the sizes and distances of the celestial bodies. With a lot of work, they were able to make extremely accurate measurements and estimations. The purpose of this project is to analyze and compare these measurements. Eratosthenes and Aristarchus were great mathematicians, but they made small mistakes throughout their calculations. Comparing their original and corrected results, with the modern figures, shows that these were extremely precise measurements for the time. Some measurements were precise to the decimal point, others were less than precise. Their equations relied on the accuracy of their older measurements, for example: to calculate the moon's distance, they used the earth's diameter as a constant. Even though they calculated Earth's Diameter very precisely, small errors can quickly lead to big problems when dealing with massive numbers. With all of that stated, these measurements have mostly stood the test of time, which is especially surprising, when you consider the lack of resources and technological advances they had.

**ABSTRACTS  
COMPUTER SCIENCE  
AND ARTIFICIAL INTELLIGENCE**

**DESIGN AND IMPLEMENTATION OF AN AI APPLICATION, USING SCRATCH FOR CHILDREN WITH ASD**

**Mariandrea Camila Urcuyo Mena**, Centro Educacional Mantica Berio, Chinandega, Nicaragua  
Research Mentors: Dr. Juan F. Arratia and Mariana Vargas Scientific Caribbean Foundation, San Juan, Puerto Rico

Autism is a condition related to brain development that affects the way a person perceives and socializes with other people, causing problems in social interaction and communication. Today it occurs in a large part of the population, 3 new cases are discovered every day, and each case has its peculiarities. This project aims to help the parents of children with autism and the children themselves to calm crises with the developing of an application that helps parents and children, with the ability to interact and instruct in any educational area that is in the interest of the parents to reinforce. In addition, it has a special classical music game for the moments that feel most frustrated. Music has been shown to have positive and calming effects for children with autism. The application contains: interactive games in Math, Science, English to aid children's education and the special musical classic game. It was intended to advance in the design and implementation of 1 game for each field.



***ABSTRACTS***  
**BIOMATHEMATICS**

**THE EFFECTIVENESS OF THE SIR MODEL PREDICTING COVID-19 HERD IMMUNITY USING VACCINES IN PUERTO RICO**

**Danilka Ianí Santos Morales**, University Gardens High School, San Juan, Puerto Rico  
Research Mentors, Dr. Juan F. Arratia, Scientific Caribbean Foundation, San Juan Puerto Rico  
and Dr. Luis de la Torre, University of Washington

Covid-19 is a new virus that caused a global pandemic. Since it is highly contagious and there are still no drugs to fight it, scientists around the world have indicated that the best way to fight it is with the use of vaccines. For this reason, several vaccines were created, the most important being that of the Moderna company and that of Pfizer (both available in Puerto Rico). Vaccinating enough people has been shown to stop epidemics by achieving community (herd) immunity. Different mathematical models are used to study the effect of vaccines on the evolution of the pandemic. Mathematical models are used to study and predict the spread of epidemics and to predict when it will end. One of the simplest and most widely used mathematical models is the SIR model. This model divides the population into susceptible (S), infected (I) and Recovered (R) and studies how people move from one state to another. What we want to know is the effectiveness of the SIR model predicting the herd immunity in Puerto Rico with the use of Covid-19 vaccines. To do this, we used data obtained from the Puerto Rico Health Department to create a simulation using MATLAB. The SIR model provided us with insights and predictions of the spread of the virus and the effects of the vaccines in Puerto Rico that the record data alone did not.

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