STILES
NICHOLSON
FOUNDATION

M.A.D. SCIENTIST AWARDS

MAKING A DIFFERENCE

March 11, 2021

SOUTH FLORIDA SCIENCE CENTER AND AQUARIUM

MARTIN COUNTY SCHOOL DISTRICT

THE SCHOOL DISTRICT PALM BEACH COUNTY

“Imagination is the highest form of research”

Albert Einstein

MAKING A DIFFERENCE

MAD Scientists is the result of a shared vision between the Stiles-Nicholson Foundation, the School District of Palm Beach County, the Martin County School District and the South Florida Science Center and Aquarium. The goal is to bring together bright young minds in STEM research and provide them opportunities to network with each other and with professionals in their fields. Our MAD Scientists have gone on to excel in their research fields at esteemed higher learning institutions around the US, and they maintain the relationships formed as they continue their work in STEM careers.

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The Stiles-Nicholson Foundation

The Stiles-Nicholson Foundation was formed in 1992 as a private family foundation in memory of William John Stiles and William Nicholson, the father and step-father of David John Stiles Nicholson. The Foundation's original mission was to improve and enhance the education of citizens, to better understand the benefits of the free enterprise system and how best to cope and succeed in the real world.

The mission presently includes 4 major initiatives, and the Foundation utilizes its rapid growth to help create a better, more opportunistic America, with equal opportunity for all to be the best that they can be:

· Free Enterprise & Entrepreneurship
· Financial Literacy
· STEM
· Education Outcomes

David John Stiles Nicholson; BSc., LLD, CFA

BUSINESS AND ACADEMICS

Following graduation from Queen's University, Canada in Electrical Engineering with a BSc. Cum Laude, he pioneered various computerized process optimization applications at IBM, Weyerhaeuser and MacKay-Shields Financial Company. Dr. Nicholson formed York Management & Research, LLC in 1978 as a private independent investment advisor catering to a small group of high net worth individuals and a few selected institutions such as Harvard University Endowment fund to forward his computerized models. From 1981, he created and managed three quantitatively driven long-short equity hedge funds.

After relocating to Jupiter, Florida in 1990 and 20 years of successful performance, Dr. Nicholson closed his hedge funds in 2000 to focus on philanthropy. Dr. Nicholson received his honorary doctorate from Northwood in 2005 as recognition for his long term active support of education and the American Free Enterprise System.

PHILANTHROPIC ACTIVITIES

Chairman & Founder - Stiles-Nicholson Foundation
Board Advisor – Junior Achievement of the Palm Beaches
Physics & Astronomy Advisory Council – Johns Hopkins University
STEM Council - Palm Beach County School District
Vice-Chair Board of Directors - South Florida Science Center and Aquarium
Board of Directors - Tax Foundation
Chairman & Trustee, Investment Committee - Jupiter Medical Center Foundation
Advisory Council - ASCEND Project, Brain Institute, Florida Atlantic University

What Is Science Fair?

Every year, millions of students worldwide compete in local and school-sponsored science fairs. The winners of these events go on to participate in SSP-affiliated regional and state fairs from which the best win the opportunity to enter the Broadcom Masters competition at the middle school level or attend Intel ISEF at the high school level. Intel ISEF unites these top young scientific minds, showcasing their talents on an international stage, where doctoral-level scientists review and judge their work.

How Does Science Fair Work?

It all begins with an idea! At the school level, students begin their projects with a research plan, which must include all the details of their intended project, including safety considerations, environmental considerations, and impacts on research participants. Once the plan is approved, experimentation begins. School fair competitions were held in October, and the selected winners competed in December at the regional fair. Teachers, parents, friends, and mentors from local organizations often guide the student in their investigations, but it's all up to the researcher on judging day.

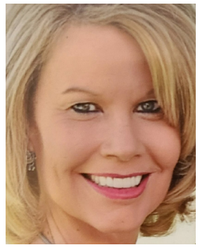
Tonight, in addition to community partner awards and special sponsor awards, the top forty students from the regional competition will be recognized and nominated to attend the State Science and Engineering Fair in Lakeland, Florida. We are very proud of every student who participates in the Science Fair. We also want to thank all the teachers, parents and mentors who devote so much time to guiding these amazing young scientists in their work.

For updates on our State and ISEF finalists, please visit
https://sites.google.com/palmbeachschools.org/pbrsef/home

Coordinator recognition

Mangai Neelavannan
Martin County School District

Mangai Neelavannan, with a 14-year service to Martin County School District, is a District Instructional Coach supporting K – 12 educators. She continuously strives to seek research-based and evidenced-based practices by networking globally with educators. She strives for rigor, scaffolding techniques and making learning visible in classroom. As an instructional leader, she coordinates the STEM Fair for Martin County and keeps all stakeholders connected with up to date relevant information. She provides supports to students, parents, teachers and admin by effectively planning and coordinating the meetings.

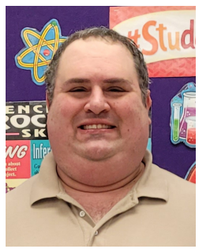


Mary Fish
Spanish River High School | Palm Beach County

Mary Fish has taught science for 31 years, 14 of those years as the Biotechnology and Honors Biology at Spanish River High School in Boca Raton, Florida. Nine years ago she took over as the Science Fair Coordinator at her school. In her Biotechnology Academy she has the ability to work one on one with her students on their research projects. She has been awarded over $50,000 in the past 11 years in order to give her students the ability to do real scientific research with model organisms and sophisticated instrumentation. Mary Fish will continue her goal to facilitate success in her students for years to come.

Andrea Kennedy
Congress Middle School | Palm Beach County

Andrea Kennedy has been teaching 8th grade science and physical science honors at Congress Middle for 4 years. Ms. Kennedy has served as the science fair coordinator, SECME coordinator and science department chairperson for the past 3 years. Ms. Kennedy has a background in environmental science and invasive plant research and earned a teaching degree in biological sciences from Florida Atlantic University.



Shaun Stabler
Polo Park Middle School | Palm Beach County

Shaun Stabler believes that there is nothing more exciting than encouraging students to use their knowledge and creativity. He exchanged the research setting as a once-doctoral candidate in molecular genetics, for the classroom setting of hands-on learning, critical thought and peer sharing. Teaching has been the perfect way to apply his skills, generate excitement, promote high standards and ensure effective learning.

South Florida Science Center and Aquarium

Serving Palm Beach County since 1961, the Science Center revolves around a simple premise: science is exciting! Science means adventure and exploration and we are delivering on this promise by providing schools, visitors and campers an entirely new set of in-person and virtual science programming and tech ventures based on computer coding, robotics, and other leading-edge educational programs. This has allowed us to educate more young minds than ever before, now serving over 350,000 students, teachers and visitors annually, including 130,000 through field trips and educational outreach into schools and classrooms.

Within the last 8 years, we've dramatically renovated our facility. Updates included a complete reconstruction of our Hall of Discovery, containing 100 hands-on exhibits, upgraded planetarium, new early childhood education room, modernized theater, and new science laboratory. In 2016, we completed the Conservation Course, a brand new 18-hole miniature golf course developed as a green space to provide recreational and environmental benefits to visitors while educating them about Florida's native habitats. In 2018 we completed the quarter-mile-long Fisher Family Science Trail which connects 15 new exhibits, including a Physics Forest, FPL SolarScape, interactive splash pad, gem panning station, dinosaur walk, and more! A $2.5 million dollar permanent human brain exhibit opened in March, 2019. Journey Through the Human Brain has since been dubbed the most advanced exhibit on the human brain in the world. We have not stopped there. Just last summer, we added the beautiful new Cox Amphitheater to our Science Trail which features daily live science shows, trivia sessions, laser concerts and more.

The South Florida Science Center and Aquarium is located at 4801 Dreher Trail North, West Palm Beach and is open Monday-Friday from 9am-5pm, and on Saturday and Sunday from 10am-6pm. For more information, call (561) 832-1988. "Like" the South Florida Science Center and Aquarium on Facebook and follow us on Twitter & Instagram @SFScienceCenter!

MARTIN COUNTY
- REGIONAL -
SCIENCE &
ENGINEERING
FAIR

Martin County Students

Aahan Asthana
Arnav Vivek
Isabella Calhoun
Kathryn Rogers
Nina Goyal
Nira Goyal
Samarvir Panwar
Steven Vokoun
Varun Singh
Viraj Singh

Aahan Asthana

Stuart Middle School

Rainfall Test

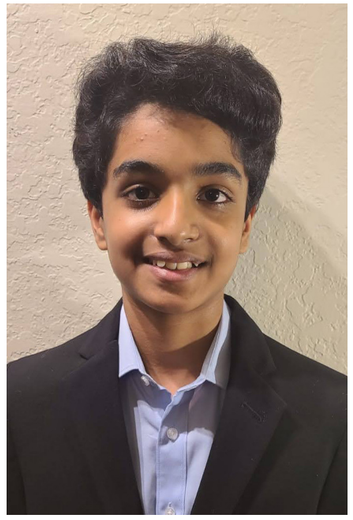
My experiment was I wanted to check if the rainwater is as purified as the ocean because most of the rainwater comes from the ocean through evaporation and then condensation which causes perception, which is rain.

Get 2 buckets
Get 2 test tubes
Get 2 syringes
Get some Ph paper

I collected the rainwater in a bucket that I left outside overnight . Using a syringe, I pulled the rainwater from the bucket and transferred it into the test tube and then placed the Ph paper into the test tube. I also went to the beach to collect some ocean water in another bucket and used another syringe to pull the ocean water in another test tube then placed a sheet of Ph paper into the test tube. Then after 2 minutes, I removed the Ph paper to see the results. I repeated the test tube process twice. To see the constant result of both the rainwater and the ocean water.

Rain Water trials- 1. 5.5 ph 2. 6 ph 3. 6 ph
Ocean water trials- 1. 8 ph 2. 8 ph 3. 8 ph

Though the rainwater is on the acidic side and the ocean water on the alkaline side.t I can determine that the rainwater and the ocean water are not as pure when you compare the two. So my hypothesis was correct.



Arnav Vivek

Anderson Middle School

A.C.D Atmospheric carbon detector

Carbon dioxide is a waste product that is very harmful to the human body and to the body of all animals. Human activities are causing carbon dioxide to be released into the atmosphere without knowing that they are harming themselves and all living things on the earth which can have disastrous consequences. The goal of this project was to create an airborne device that is drone compatible and can detect how much carbon is in the atmosphere in parts per million (ppm). To create this project a 433mhz receiver and transmitter module was used to send data to each other using amplitude shift keying or ASK. The receiver module was paired with an OLED display to display the data and results that were being sent to the receiver from the transmitter.

The transmitter was paired with a MQ135 gas sensor which was programmed to send data in the form of carbon dioxide measurements to the transmitter which then was sent to the receiver. The transmitter and the gas sensor were soldered onto to a PCB circuit board and connected to an arduino which was the base of both the receiver and the transmitter. The receiver and display was connected to the arduino via a breadboard for the receiver would not be going into the air. The PCB board holding an arduino, the transmitter, and the gas sensor was taped onto a 4x3.5” balsa wood piece. The pcb holding the transmitter and the sensor was then tied to the legs of a 220g drone via wire twist ties. The orduinos were then powered by a 9v battery. The transmitter was then flight tested to see how high it would go with a regular 9v battery, three 3v lithium ion batteries, and then tested with no batteries. According to results, when a regular 9v battery was used the drone barely took off the ground for very long while with the ion batteries it went much higher but not for a sustainable amount of time. The device was also taken to a wooded area, a busy intersection, and indoors to measure the carbon.

In conclusion, the goal of the project, the device worked and did its job but the drone was not able to carry the weight of the device with or without the battery. Most likely, if lighter materials were used, and a heavier, larger drone was used it would be able to Ily and do its job.

Isabella Calhoun

St. Joseph Catholic School

Compost: Nature’s Fertilizer

The purpose of this experiment was to determine if compost tea could be used as a more environmentally friendly alternative to liquid fertilizer. I became interested in this experiment in researching the blue-green algae blooms in the Indian River Lagoon. As fertilizer runoff is cited as a major contributor to algae growth, this experiment investigated if the use of compost is a comparable alternative to commercially available fertilizers. This project hypothesized that if home-made compost tea is compared to three different types of fertilizers used for lettuce seed growth, the compost tea growth would be equal to that of one, or more, of the fertilizers. Embryonic root growth was measured daily for fifteen days, and the data was compared. The controlled variables for this experiment included the environment the seeds were growing in, the types of seeds, fertilizers, Petri dishes, and filter paper, the time that the seeds were measured, and the time that the seeds were watered. The independent variable was the type of nutrient supplement added to the seeds. The dependent variable was the length of the embryonic roots. Seed growth began slowly, however, in the end, the hypothesis was supported. Root growth in the compost tea was the greatest of all seed growth. This proved that homeowners could use compost to remain environmentally friendly; not only are they helping their plants flourish, but they are also recycling their kitchen scraps and potentially saving our waterways.

Kathryn Rogers

Anderson Middle School

Saving With Solar

The problem was which type of recycled solar oven design;Box, Fresnel lens, or satellite dish produces the highest temperatures and is the most efficient? The hypothesis was the box oven would be the most efficient solar oven and reach the highest temperatures because the design permits the user to easily adjust the angle and would be the easiest to replicate. The box oven was the most efficient solar oven and reached the highest temperatures. The testing was done by recording the weather and atmospheric conditions. Placing the ovens on an unshaded sidewalk. The focal point of each oven was adjusted , then a thermometer was placed in an oven cooking bag. Once the thermometer was in the focal point the starting temperature was taken, and recorded every 30 minutes, each testing cycle lasted five hours. The testing cycle was repeated 4 times. The results of the testing showed a consistent pattern, regardless of weather and atmospheric conditions. The control oven's average temperature was 63.65 degrees celsius. The box oven's average temperature was 54.93 degrees celsius. The Fresnel oven's average temperature was 36.40 and the satellite oven's average temperature was 41 degrees celsius. The data showed that the recycled box oven consistently reached the highest temperatures in the testing group. The hypothesis that the box oven would reach the highest temperatures and would be the most efficient to create and use was supported. The temperatures reached could be used to make water safe for drinking and cooking.

Nina Goyal

Hidden Oaks Middle School

Greenhouse Gases Showdown

Many human activities such as burning of the fossil fuels, use of fertilizers for agriculture, and deforestation has resulted in an increased level of greenhouse gases such as carbon dioxide, methane, and nitrous oxide in our atmosphere. This greenhouse gas effect contributes to global warming.

This experiment is focused on identifying which greenhouse gas out of carbon dioxide, methane, and nitrous oxide is the greatest offender. Four boxes were made. The box with soil was the control. The second one had soil and plants. The third one had soil, banana and cabbage peels, which produces methane. The fourth one with soil and fertilizer, which produces nitrous oxide. A thermometer was placed inside each box. Each box was covered with plexiglass. A thermometer was placed outside the boxes to record the outside temperature. The temperature inside and outside each box was recorded at IOAM, 2PM, and 6PM for seven days to see which greenhouse gas produced the highest temperature.

The temperature was found to be highest in the box which had the fertilizer, supporting my hypothesis. This was followed by the box with the cabbage and banana peel followed by the control followed by the box with the plants in it.

This experiment showed that nitrous oxide has the highest global warming potential. The largest source of nitrous oxide is agriculture, especially the fertilized soil. Future research will concentrate on how we can reduce the emission of greenhouse gases and how we can prevent the disastrous outcomes of these greenhouse gases.

Nira Goyal

Martin County High School

Stability Testing of CBD and Hemp Creams With and Without Silk Protein at Different Temperatures

During the COVID- 19 pandemic, people need to be able to receive effective medicines in order to minimize contact with others. Due to the temperature conditions in transportation and storage, medicines have separated and become ineffective. A possible method of increasing the stability of medicines is adding silk protein, CBD Oil, or Hemp Oil.

This experiment will determine whether silk protein, CBD Oil, and Hemp Oil in certain combinations are effective at the stability of creams under different temperatures. Four creams were made: CBD Oil Cream, Hemp Oil Cream, CBD Oil with Silk Protein Cream, and Hemp Oil with Silk Protein Cream. The creams were separated into three vials for three different temperatures: 37 degrees Fahrenheit (2.78 degrees Celsius), 77 degrees Fahrenheit (25 degrees Celsius), and the temperature of a cardboard box kept outside (approximately 100 degrees Fahrenheit or 37.78 degrees Celsius). The control was a vial of plain cream base. All of the creams and the controls were centrifuged at the end of each week and the amount of oil separated was measured.

None of the creams in the experiment separated. This did not support my hypothesis because all of the creams performed equally well.

This experiment demonstrated that CBD Oil, Hemp Oil, and silk protein are effective at improving the stability of creams because none of the creams in the experiment separated at any temperature. These oils and silk protein can help keep medicines stable, saving money and allowing access to effective medicine during a global pandemic.

Samarvir Panwar

Hidden Oaks Middle School

Prepare for Perpetual

In this project I tried to make a perpetual motion machine. In my Design the machine was supposed to generate and use its own energy to keep itself running forever. The machine created static charge by rubbing plastic and a PVC pipe and then transferred the charge back to the motor to be used again. In the end this didn't work out because the charge that was being made was all either positively charged or negatively charged and none of both. To get a motor to work you need both positive and negative charges but the machine could only produce on or the other. Even if I could get around that, the zap of static electricity would lose charge every time it zaps.

Steven Vokoun

South Fork High School

Creation of a Highly Efficient Surface ROV Invoking Cylindrical Solar Panels Year 5

Solar energy is a source of energy that is readily available and is much needed in our world today. Sadly, due to the high land cost and low panel efficiency, it is not more widespread on a small scale in our world today. Through this project can a fully autonomous efficient surface ROV be created for the purpose of chemical stirring in pools and circulation of water in a lake or another body of water be created that utilizes solar energy as a power source. Through this year's experimentation the efficiency of motors and propellers utilized for thrust for the Rov was focused upon. In order to test this a structure was built to test the thrust of motors at varying motor Kv ratings, Propeller design, and input powers to analyze the optimal conditions for the most efficient cost-effective design for the Rov. Through this experimentation it was found that the 1400Kv motor produces on average 2.3x more thrust than the 2500Kv motor. It was also found that the 1400Kv motor was 3.6 times more efficient than last year's thruster design. The predictions that a 1400Kv motor prefers a higher blade pitch than the 2500Kv motor was confirmed through experimentation. By making these changes and others to the input voltage and control electronics a much more efficient Rov for the dispersion of dissolved oxygen into bodies of water can be made. This allows the Rov to function more hours from the cylindrical solar panels and optimize its power consumption.

Varun Singh

Anderson Middle School

Busted! Monitoring Hand Hygiene with Smart RFID Technology: Part 2

Hand hygiene is an important factor in the spread of germs, and controlling this spread is very important because of diseases such as COVID-19. Places such as hospitals and restaurants want to contain the spread of germs because of the possibility of contaminating medical tools, foods, and other items. If hand hygiene would be implemented globally, the spread of germs would be a lot less than it is right now. Currently, there is no efficient method to track hand washing habits. A method was designed previously, however there were a few flaws that stood out, one being that it was not portable. The goal for this project was to improve upon the prototype by making the design more cost-effective, as well as more portable. To do this, several improvements were made. To increase the project's portability and decrease cost, the laptops were replaced by a smaller, lighter Raspberry Pi. The data that was recorded was stored in a database instead of Microsoft Excel, so the program and read and write at the same time, as well as store more data. Also, the data gathered was reported in Microsoft Power BI instead of Microsoft Excel, so the results could be visualized and interpreted easier. The final improvement that was made was a 20-second music sound that played when someone washes their hands. This encourages not only washing hands regularly, but washing correctly.

After analyzing the data, every scan that took place was recorded successfully and every violation that took place was calculated without any errors. Also, when the music was playing while washing hands, everyone washed their hands for 20 seconds or longer. The performance of Raspberry Pi's met expectations and system requirements to run the project. In conclusion, the improvements that were added on to the prototype were successful. These improvements, such as using a Raspberry Pi, using Microsoft Power BI, and using a database instead of Excel, were successful in making the prototype more cost effective and portable. Reminding people to wash hands for 20 seconds with music, helped in increasing efficiency of hand washing. The next step for this project would be to test it in a real world application and improve based on the results.

Viraj Singh

South Fork High School

See with NFC - A Novel Solution to Assist The Blind and Visually Impaired - A Continuation

A widespread problem in today's day and age is the struggle visually impaired people have while attempting to read or interpret a text. At the moment, there is no practical solution to assist people with this problem effectively. After researching the benefits of NFC tags, I applied this technology to a mobile device to create a solution to this problem through a mobile application. However, there were still many flaws with the project such as not being able to write to NFC tags and not being able to assist the colorblind effectively. The goal of this project is to improve upon a mobile, easy-to-use cellphone application that pronounces text based on the product being read using an NFC scanner programmed on the cellphone as well as identify and pronounce colors.

To improve on this project, the mobile application was designed to have an easy-to-use interface and be simple to operate. The audio of the text-to-speech element of the application is at an appropriate volume and is clear to understand. The audio is also capable of being translated to different types of languages, allowing for global accessibility. The application consistently reads and writes text to and from the desired NFC tag. The color detector is also a new feature that allows the colorblind to identify colors that they would originally not be able to interpret. Throughout my trials and attempts, many errors occurred throughout the development of the application. After resolving these problems, the application began to run smoothly, with all variables working. When the mobile application scans the NFC tag, the text written on the tag is displayed. When the application writes to the NFC tag, the text is accurate and writes instantly. While using the application over the course of a week, no problems came up and the application is very efficient. The speech-to-text aspect of the application is at a comfortable noise and is spoken. In all, the app is very reliable and flexible.

Palm Beach Regional

Science & **Engineering** Fair

Palm Beach County Students

Rima Alsheikh
Diane Altidor
Ashesh Amatya
Michael Brouse
Caeden Dooner
Katie East
Colin Gallogly
Sarah Garfield
Bhav Jain
Tejasvi Kari
Aditya Kumar
Sophia Lo Bello
Isabella Maldur
Eoghan McIvor
Michael Pitts
Dana Sapir
Estasha Shah
Daria Sokolova
Victoria Stern
Emily Weimer
Bari Weiner
Catherine Zhao
Catherine Lee
Ramsey Alsheikh
Aishwarya Ayyanathan
Bianca Bernard
Samer Elhoushy
Mandy Feuerman
Sarah Habona
Maryam Imran
Yara Ismail
Jimmy Joseph
Deeksha Kumaresh
Julianna Lian
Brianna Marturano
Natasha Mayorga
Michael Mikati
Kasey Moore
Angelina Ning
Su O'Brien
Patrick O'Leary
Ashwin Parthasarathy
Grace Phelps
Liam Schnur
Lucja Stawikowska
Nolan Wen
Ben Kessler

Rima Alsheikh

Eagles Landing Middle School

SPF Longevity of Natural Oils in an Oxybenzone and Octinoxate-Free Base

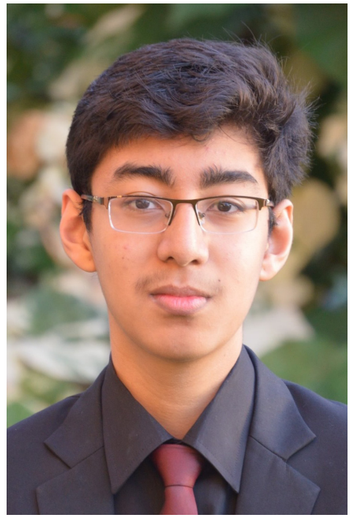
The prolonged exposure of skin to UV radiation has harmful effects on our health. Sunscreen provides protection for our skin from the damage caused by ultraviolet radiation; however, the sunscreens we rely on to protect us from the dangers of the sun usually contain one or more chemical ingredients that are detrimental to our health. Chemicals, such as octinoxate, and oxybenzone can cause skin and lung tissue irritation, hormonal disruption, and even potential cell damage that may lead to skin cancer. Recent studies show that sunscreens leach up to 360 times more toxic chemicals into the blood than the FDA permits. On other hand, carrot seed oil, red raspberry seed oil, and wheatgerm oil are natural ingredients that have inherent SPF properties that block UV rays. The purpose of this experiment was to test the SPF longevity of natural oils in an oxybenzone and octinoxate-free base. The researcher hypothesized that if the SPF longevity of the natural oils in an oxybenzone and octinoxate-free base are compared to a commercial sunblock, then the SPF of natural oils will protect against the Sun's Ultraviolet radiation for a longer period of time. The SPF longevity of the natural oils was tested by combining the oils with a homemade-oxybenzone-octinoxate-free base and covering the surface of a plastic bag with this mixture. Every half-hour, the radiation level inside the bag was measured. The hypothesis was supported as in each trial some natural oils provided longer-lasting protection than the commercial sunblock.

Diane Altidor

Palm Beach Central High School

Determining the Effect of a Disulfiram Copper Complex on Drug Resistance Through Deletion of ALDH1 in Metastatic Breast Cancer Cells (A Three Year Study)

Cancer is one of the leading causes of death in the U.S., with about 1 in 8 women developing invasive breast cancer in her lifetime. Drug repurposing, an underused treatment, is crucial for faster cancer treatments via drugs because the drugs have already gone through all the needed steps to safely be out in the market and available to people, while also greatly reducing the estimated $1.3 billion it cost to develop a new cancer drug. This experiment was designed to study whether CRISPR, a cost-effective way to knockdown ALDH1 in the cancer cells, can reduce drug resistance so that Disulfiram (a drug commonly used to treat alcoholism) combined with a copper supplement (to enhance the effect of disulfiram) will effectively decrease the metastatic properties of the cells. After the cells were put through an extracellular matrix invasion chamber to test their ability to metastasize, it was shown that the knocked-down cells were unable to metastasize in both experimental groups. ANOVA tests were performed to test the significance and at p-value < 0.05, the results were significant meaning that after knocking down ALDH1 expression in metastatic breast cancer cells through CRISPR, the drug resistance in the cells was reduced, and the Disulfiram combined with a copper supplement was able to significantly decrease the metastatic properties of the cell line. This shows that CRISPR has a future in cancer research. It can stop drug resistance which allows drugs to keep their effectiveness in targeting and eliminating tumors



Ashesh Amatya

Alexander W. Dreyfoos School of the Arts

Artificial Neural Network Modeling of Harmful Algal Blooms in Lake Okeechobee

Harmful algal blooms (HABs) have been recognized as an increasingly serious threat to many communities with far-ranging consequences for environmental conditions, economic prosperity, and human health and well-being. This is particularly so in south Florida where the frequency of HABs in Lake Okeechobee has increased over the past few years with impacts spreading to coastal ecosystems including the St. Lucie Estuary in the east and Caloosahatchee Estuary in the west. Much is still unknown regarding the specific alignment of environmental drivers over varied spatial and temporal scales of blooms. My research aims to predict this occurrence of harmful algal blooms using Artificial Neural Networks (ANN). Water quality monitoring data in Lake Okeechobee was downloaded from a public domain database (www.sfmwd.gov). Statistical analyses were performed to examine the relationship of various environmental variables with chlorophyll a, which is considered the surrogate parameter of algal blooms. Dissolved inorganic nitrogen, dissolved inorganic phosphorus, and temperature were identified the most relevant environmental factors related to HABs occurrence. Two sets of monthly time series data consisting of these input variables and the output variable (chlorophyll a concentration) were developed for training and testing of ANN. The platform of Keras was used to code the ANN model. The result showed robustness of the ANN model in quantifying the non-linear relationships between environmental variables and chlorophyll a concentration in Lake Okeechobee (MAE= 4.6, and R2=0.72). With this ability to predict, this tool can be used as a management tool to mitigate HAB's adverse socioeconomic and health effects.

Michael Brouse

Spanish River High School

Behavioral Responses to Acute Caffeine Exposure in *Danio rerio*

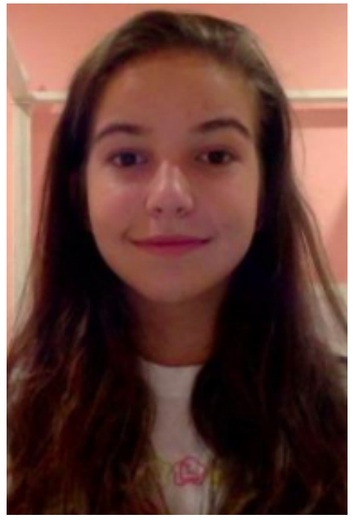
According to a comprehensive research study from the Kantar Worldpanel Beverage Consumption Panel, 85% of the United States population consumes a mean average of 165 mg of caffeine per day. Despite diets becoming exceedingly saturated in cyclic caffeine consumption, little research has been completed to determine the behavioral effects that recurrent caffeine intake can have in humans and in wastewater. By exposing five populations (n=3) of randomly selected zebrafish to varying concentrations of the central nervous system stimulant for an interval of 40 minutes, their subsequent behavior has been recorded and statistical relationships between caffeine dose and abnormal, anxious behavior have been established. Fish tanks of similar size, pH, nutrient content, and dissolved oxygen content were placed side-by-side and recorded for 40 minutes via video camera. Instances of dormancy (remaining still for periods >2 seconds) and low-lying behavior (defined as fish diving to the bottom 3 cm of the tanks) were analyzed using tracking software. After completion of the experiment, data suggests that a dose-dependent relationship between caffeine and anxiogenic behavior (dormancy and low-lying swimming) exists in zebrafish. In concentrations upwards of 10 mg/L of caffeine, zebrafish began to appear less motile with dormancy and low-lying behavior exacerbated. In this manner, it appears that lower concentrations of caffeine increase mobility while higher concentrations reduce locomotion. This prompts the need for future research into acute and chronic caffeine exposure in humans and in marine organisms who may be more susceptible to the stimulant through bioaccumulation and biomagnification.

Caeden Dooner

William T. Dwyer High School

Lunar Dust Mitigation on Low Gravity FreeFal Environment

The Wolverine CubeSat Development Team (WCDT) program remains the only middle school in the United States to develop, build, test, and launch a cube-sized nanosatellite (also known as a CubeSat). Aside from satellites, the WCDT program is also focused on future lunar exploration and is developing the AMARIS lunar rover based on CubeSat technology. The goal of the AMARIS mission is to evaluate techniques for reducing the negative impacts of dust accumulation on rover solar panels and frames. Lunar dust is believed to have toxic properties that can affect people and machines. This dust adhesion problem was widely reported during the Apollo era missions and still exists today. The experiment from which this paper is based investigates how electric and magnetic fields may be used to mitigate this problem. A vacuum dust-box was designed, composed of 5 mm thick Lexan sheets in which flight-grade photovoltaic panels and anodized aluminum chassis components were subjected to regolith simulant. The goal is to determine if there is a feasible solution to mitigate the dust buildup that occurs in space. The knowledge gained from this experiment will be used in designing a team lunar rover in the near future, which will utilize CubeSat technology. Overall, this proposal uses electromagnetic and vacuum theories as a framework and seeks to further advance student understanding of the lunar environment as well as prepare the future aerospace workforce through Problem-Based Learning (PBL) and the real-world application of Physics.



Katie East

Spanish River High School

Can Cortisol Excretion in Zebrafish be Measured Using Tank Water?

Almost all of the methodologies currently employed to measure zebrafish stress, such as mucus, blood, and fecal samples, are invasive and stressing for the fish. The most commonly used methodology, the use of blood samples, requires the euthanization of the fish in order to perform an ELISA assay. A new, non-invasive method of measuring stress in zebrafish, measuring cortisol levels in tank water, would provide a better way of measuring zebrafish stress in a lab setting.

In this experiment, the researcher collected samples of tank water from a beaker in which a fish, stressed from the transfer process of its home tank to the beaker, was being held. The samples of tank water were then analyzed for cortisol concentration using a hydrocortisone indicator used to detect cortisol present in human sweat.

Confounding variables such as water temperature, water salinity, feeding schedule, and food type were all held constant throughout the collection of the tank water. A total of twenty experimental samples of tank water and two controls were measured to test the applicability of the indicator to cortisol excretions of zebrafish into tank water. Out of twenty two samples, only five had absorbances outside of the standard curves, rendering them unusable. The results indicated that this method, with refining and improvements, could prove to be a simple, viable methodology of measuring cortisol excretion in zebrafish. Improvements in the cortisol-based stress analysis of zebrafish will enable a more humane, sustainable method of measuring stress in a laboratory environment and field research.

Colin Gallogly

BAK Middle School of the Arts

Does the Viscosity of a Liquid Affect the Flight Time of a Bottle Rocket?

Does the viscosity of a liquid affect the flight time of a bottle rocket? In my experiment, I tested to see if the viscosity of a liquid affected the flight time of a bottle rocket. To complete this experiment, I used an air pump, a water rocket kit, and various sodas, such as pepsi, diet pepsi, Sprite, Lemonade, water and Orange Juice. We recorded the time of 3 trials of each liquids launch for best results. We recorded our data in a notebook and put it into a chart. In doing this, we hoped to gain a better understanding of how viscosity affects rockets. Next time we do an experiment like this, a funnel would be a useful tool, as it would be easier to get the liquid into the rocket.

Sarah Garfield

Palm Beach Central High School

The Effect of Predator-Induced Increases on CO2 Sequestration in Bromeliad-Daphnia Reservoir Ecosystems

The first species to disappear from an ecosystem are the top predators, which disappear through overfishing and human hunting/consumption. These predators play important roles, both in ecosystem dynamics and natural gas cycles. Since freshwater ecosystems have high top-down control, a freshwater Bromeliad-Reservoir Ecosystem is an accurate way to measure a top-predator's effect on an ecosystem through the amount of dissolved carbon dioxide. Ten mesocosms of Bromeliad-Reservoir Ecosystems were created with leaf litter, *Chlorella vulgaris*, and *Daphnia magna*. Damselfly nymphs were added to half of the mesocosms and the carbon dioxide levels in the cups were calculated every 3 days for 54 days using titrations. It was found that the presence of top-predators decreased in situ CO2 concentrations as compared to conditions without top-predators. A two-tailed t-test was run and it was found that the i*n situ* CO2 concentrations were statistically significant (T = 2.631 > 1.987 at 0.05). CO2 flux was also calculated using titration samples from day 54, atmospheric CO2 levels (396 ppm), and the CO2 exchange velocity coefficient (0.48 m dm -1). Predator treatments sequestered 59.92% less CO2 in situ and emitted 2.17% less CO2 gas to the atmosphere. The results provide evidence that top-predators can alter overall carbon levels of an ecosystem, showing that predator abundance and the human removal of predators may have complex consequences on biogeochemical cycling and greenhouse-gas dynamics.

Bhav Jain

Don Estridge High Tech Middle School

What is the effect of acid rain on plants?

The project is an investigation on the effect of acid rain on plants. This experiment had 4 groups of plants, each with 3 plants in them, and each plant was given a different kind of water. One would be given water with vinegar, while another would get lemon water, one would get soap water, and the last one would be the control group and get normal water. This project is important because acid rain is a real problem, and is responsible for the deaths on many crops, and the cause of famines worldwide. If we can find out the effects of acid rain in detail, then we can find out ways to counteract and combat it. This project also tested one method of doing so in the experimental portion using a plant given base water, to see its effects, and they were quite favorable.

Tejasvi Kari

Palm Beach Central High School

The Effect of Carbon Nanotubes and Oil Dispersants on the Oil Degrading Ability, Vitality, and Gene Mutations of *A. borkumensis*

Oil spills are major threats to the ocean and marine life, and they release massive amounts of oil. Oil dispersants are chemicals that break down oil into smaller droplets to make it easier for the *A. borkumensis* bacteria in the water to degrade oil. However, the project done last year showed that bacteria exposed to dispersants had a lower colony count and oil-eating ability than bacteria in the control group. This year, carbon nanotubes (CNTs) were placed in tanks and test tubes to see if they could be a safer, more effective alternative to dispersants. The four groups were nanotubes only, nanotubes and dispersant, dispersant only, and the control group. DNA purification and PCR were done on one sample per group to sequence the fdx P450-1 gene, which is responsible for production of one of the proteins responsible for oil degradation. The group with only CNTs had a significantly higher mean colony count (p-value of 0.0482 < 2.120 at 0.05) and greater mean decrease in test tube oil levels (p-value of 0.0189 < 2.228 at 0.05) than the other groups. The data supported the conclusion that the group with only CNTs would be the most effective in making bacteria eat oil and have a greater colony count. The results for the DNA sequencing are inconclusive due to the length of the nucleotide chain. These results can open up new possibilities in the field of bioremediation and help to clean up oil spills more efficiently and effectively.

Aditya Kumar

Spanish River HIgh School

Creating a Prototype Device to Monitor Preliminary Symptoms of Sepsis

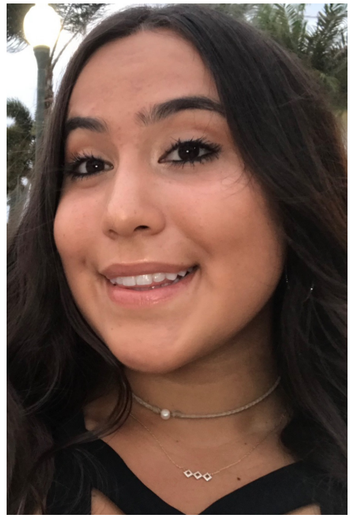
Sepsis is a potentially life-threatening condition caused by the body's overwhelming response to an infection. Sepsis is the leading cause of death in U.S. hospitals (2018) as the mortality from sepsis increases by as much as 8% for every hour the treatment is delayed (Sepsis Alliance, 2018). The purpose of my study is to create a device that will continuously monitor for preliminary symptoms of potential septic patients, which would allow a medical professional to administer proper procedures for diagnosis of septic shock. In the form of a shirt-like tunic, the invention would consist of sensors feeding data to an Android app to be monitored by a nurse or other medical professional. The sensors involved would measure beats per minute, skin temperature, and breaths per minute. First, I created the device without incorporating a wearable design and only involving the Arduino UNO, breadboards and sensors which I programmed using C++ on Arduino IDE. Then , I added the wearable design by using the Lilypad E-Textile technologies and conductive wiring. In my device, I implemented a bluetooth module which would send data to the app created with Android Studio and Java which would display the values in live time. The companion app would then use a weighted average algorithm to combine a user survey with the sensor data to create risk assessment for sepsis. The device is extremely cost effective and can be used to monitor patients continuously and notify trained medical personnel when there is a risk for sepsis.

Sophia Lo Bello

BAK Middle School of the Arts

Is My Car an Oven?

Have you ever gone grocery shopping, and when you get back into your car it feels like you just stepped into an oven? Have you heard the news stories about the countless human and animal lives lost from car-induced-heat-strokes? “Is My Car An Oven?” tests the different treatments one can put a car under to help keep the car from reaching scorching hot, life threatening temperatures. The car is put outside with either no treatment, a sun shield, or under the shade, and the before and after temperatures are taken by the researcher. In the end, the findings greatly supported that placing a car in the shade helps keep cars from becoming the most warm, with a sun shield in second, and finally, when a car is in plain sunlight, it heats up the most. Overall, however, the greenhouse effect can’t be truly prevented in cars, we can stay safe by keeping life forms out of cars when not in use, and when people or animals are in a car, to keep the air conditioner on.



Isabella Maldur

Spanish River High School

How Much Fluoride is Too Toxic?

In recent years, fluoride started to make an appearance within the water supply of cities across the nation. In these cities, especially those with a high percentage of low income families, fluoride is commonly added to the water supply because of its various beneficial impacts such as its aid in the prevention of tooth decay. However, fluoride can cause detrimental, if not, deadly effects to the growth of a plant.

The purpose of this experiment was to test the amount of sodium fluoride that is toxic to a plant. The researcher states that if the concentration of sodium fluoride on the fast plant seeds is increased, then the rate of germination will decrease and will result in a harmful effect on the plant.

Six different dilutions were made with sodium fluoride. The first dilution was distilled water which acted as the control, and the remaining five consisted of dilutions of the .13g of sodium fluoride used. The sodium fluoride was measured with 1000ml of distilled water. After calculations, the set solution (increasing by 5ml) was distributed for the five solutions. Based on the amount of stock, the remainder was filled with distilled water until it reached 50mL. The seeds were then added in petri dishes with solutions to be germinated for experimentation.

The results supported the hypothesis because as the concentration of sodium fluoride increased, as a result, the rate of germination decreased. This data can hopefully be used for preventative measures when planting, resulting in a more successful yield.

Eoghan McIvor

Polo Park Middle School

Comparing Programming Languages!

This project will compare the programming languages Rust and Java by looking at the raw performance and other differences between the two languages. This is important because the language that someone uses in a project can have a major impact on development time and performance. The first step was writing a test program in Rust and then creating an equal program in Java. In the beginning there were some issues with parity between the two programs but the issues were corrected before collecting any data.

In all of the performance tests Rust was more than two times faster than Java and in one test Rust was three times faster. This is a significant performance difference especially when writing high performance code. However, this speed boost comes at a cost. Developing code for Rust is more difficult because the programmer has to be specific about how everything should be handled. Java doesn't have this problem because it is less verbose. The main reason Rust is faster is because it compiles directly to binary code that a CPU can run. The disadvantage of Rust, is that a program needs to be compiled for each architecture that the program needs to run on. This is not a major disadvantage. Overall Rust is a better language when writing code where performance is critical. However Java is an excellent language for code that needs to run reasonably fast or needs cross platform support.

Michael Pitts

Suncoast High School

Creating Hydrogen Through Solar-Powered Electrolysis

The goal of this project is to make a hydrogen generator that converts solar power into hydrogen with an efficiency of at least 70%. A hydrogen generator works through a process called electrolysis, where a positive and negative current is applied to water to create hydrogen at the negative current and oxygen at the positive current. The purpose of this project is that solar power is currently stored using batteries, but batteries are expensive and degrade. Hydrogen can be burned using the same methods as fossil fuels, however, hydrogen burns with zero emissions. In this project, two bottles were attached and filled with a sodium hydroxide solution. Two sets of galvanized steel plates were suspended in the bottles, and negative current was put through one set of plates, and the other set had a positive current. The side with the negative current produced hydrogen, and that was collected in a bag, which was then used to calculate the mass of hydrogen produced. The efficiency is the ratio of the energy of the hydrogen to the energy produced by the solar panel. In this project, the efficiency was measured to be 80.1%. This means that the project was a success because the result is much higher than the goal of 70%.

Dana Sapir

Spanish River High School

Fibonacci Hydropower Efficiency

Nowadays, due to the need for clean energy and sustainable electricity production, hydropower plays a central role in satisfying the energy demand. Particularly, use of low-head micro-hydropower plants spreads worldwide, due to low payback periods and good environmental sustainability. The result of more clean energy being produced consequently lessens our dependence on fossil fuels and is vital. Would flap arrangement, such as one of the Golden Ratio, on a hydropower turbine impact efficiency? If two turbines with varying flap arrangement are tested, then the Fibonacci Turbine, which exploits the pattern found in nature, would be the most efficient, compared to the Standard Turbine that is currently used. To test this hypothesis, a scaled version of the turbines are built. Connected to a generator, the turbine would spin and power an LED light. After the engineering of the first prototype, the LED would not light for either turbines. However, this allows for trial and error practice commonly found in engineering careers. For instance, the researcher then developed a design to measure the speed of the blades. To do so, in ten-second trials, the turbines, placed under a constant water source, were observed on how much water the blades collected into the bottle. In conclusion, the hypothesis was proven correct because the data deduced the high percentage of almost 10% additional efficiency in the Fibonacci Turbine compared to the control turbine, which may ultimately lead to more efficient turbines and a decline in harmful extraction of Earth's natural resources.

Estasha Shah

Palm Beach Central High School

The effect of ultraviolet radiation on the amount of lipids extracted from *Chlorella vulgaris*

The purpose of this experiment is to identify how ultraviolet radiation affects the amount of lipids extracted from *Chlorella vulgaris*.

Biofuel produces less pollution and greenhouse gas emissions than fossil fuels, but it takes a lot of energy to extract biofuels from microalgae. The energy needed to extract biofuel from algae is 1.38 times larger than the actual amount of energy extracted. This research will look into whether ultraviolet radiation can penetrate the cell walls within the cells of microalgae (*C. vulgaris*) and make it easier to extract biofuels. The hypothesis is that if *Chlorella vulgaris* is exposed to ultraviolet light and a regular grow light, then more lipids will be extracted from the *Chlorella vulgaris* is exposed to a ultraviolet light than the regular grow light. Two gallons of microalgae was grown for approximately three weeks under a regular grow light. After the three weeks, one gallon of microalgae was decanted into another tank. The tank was placed under ultraviolet light for two weeks, while the other one gallon of microalgae remained under the regular grow light. The Folch method was then used to extract lipids from the microalgae exposed to the two different lights. The average amount of lipids extracted from *Chlorella vulgaris* grown under a regular grow light was 0.06 grams, while the average amount of lipids extracted from *Chlorella vulgaris* that was grown under an ultraviolet light was 0.17 grams. The data was significant because the calculated T-value of -1.35346 is less than the critical T-value of 2.91998. Therefore, it can be concluded that UV-light does help make lipids more accessible from *Chlorella vulgaris*.

Daria Sokolova

Spanish River High School

The Effect of Phenotypic Variations on Shoaling Behavior in Zebrafish

Zebrafish share a variety of genes, structures, and social behaviors with numerous other vertebrates, including humans. Consequently, analyzing their social behaviors and developmental patterns provides answers to various questions concerning other species.

In this experiment, the tendency of zebrafish to form groups, or shoals, based on their phenotypic differences was measured. Two strains of fish, the zebra danio and the leopard danio, were observed. Initially, the behavior between fish of identical phenotype was recorded through the use of three compartments in a T-maze and EthoVision tracking software. Three fish were placed in the left compartment, and the right compartment was kept empty. Then, the movement of one fish throughout the middle compartment was recorded and analyzed throughout a 10-minute time period. This procedure was then repeated for each combination of phenotypes, where the shoaling behavior between different colorations was measured . Two trials were conducted, and the water level and amount of light in the T-maze was kept constant throughout experimentation. The trials containing differences in phenotypes exhibited an immense decrease in social behavior when compared to those containing identical phenotypes.

Victoria Stern

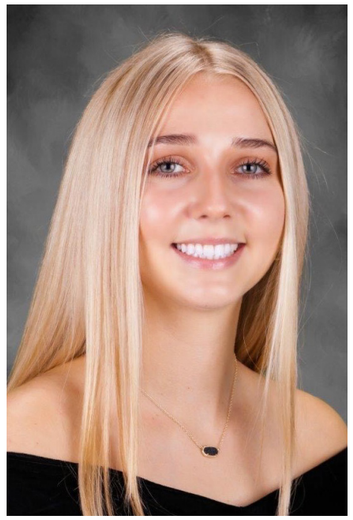
Loggers' Run Middle School

What Type Of Milk has the Highest Amount of Protein

The topic of my science project is finding the protein content in milk. The title of this project is: "What Type of Milk has the Highest Amount of Protein?" I chose this topic because the labels on the store bought milk said every type of cow's milk had the same amount of protein, so I wanted to investigate to figure out whether or not it was true. My hypothesis was: "If different types of cow's milk are tested, then they will have roughly the same amounts of protein." For my experiment I used a chemical called Biuret Reagent. It is used to test for the presence of proteins in food. If protein is present, the chemical changes color from blue to purple. I used four different types of milk: whole milk, 1% percent milk, 2% percent milk, and skimmed milk. I also tested water to show it would be neutral. I then placed 2mL of each type of milk and 2mL of Biuret Reagent into each test tube. I shook the tubes for a few seconds. I then waited 5 minutes so the milk would fully react with the Biuret agent. Lastly, I recorded the results. The experiment was repeated 3 times.

The results observed are as follows: The water did not change the color of the chemical. This indicated that there was no protein. In all of the other experiments, the reagent changed colors.The fluid colors ranged from light to dark purple. Light purple indicated a low amount of protein. Dark purple indicated a higher amount. Pink would indicate that peptides were present.

The results showed that skimmed milk had the highest protein content. Whole milk, 1 percent, and 2 percent milk had a light purple color, but skimmed milk was dark violet. I learned from this experiment that most types of milk have very similar amounts of protein. However, even though the milk containers for all the milk types indicated the same amount of protein, the skimmed milk appeared to have slightly more.



Emily Weimer

Palm Beach Central High School

The Effect of Putative Beneficial Microorganisms for Coral (pBMC) In The Prevention of Disease and Bleaching (Year Two)

This experiment is attempting to manipulate the coral associated microbiome by adding a collective amount of native putatively beneficial microorganisms for corals (pBMCs). This would be the first effort to take the common use of bacteria consortia typically used in plants and humans to corals. This process is meant to try and reduce the effect of coral bleaching and disease. Currently there is no treatment to reduce or stop coral bleaching and death. Bacterial samples were taken from Acropora coral and streaked onto marine agar plates. The plates were incubated and a catalase test was performed to determine which bacteria on the coral produced the most catalase. Catalase is an enzyme that breaks down hydrogen peroxide, a chemical that causes coral bleaching. The bacteria on the coral that produces 100% catalase bubbles was used to form the probiotic. The probiotic was then swabbed from the plate and swabbed onto the Acropora coral. Four tanks were set up labelled “1. Heat control”, “2. Heat”, “3. Disease Control” and “4. Disease”. The control groups underwent the same conditions as the experimental trials, but the control did not have the probiotic of beneficial microorganisms. After a week the coral with the probiotic performed better in the disease and heat trials as the polyps in the coral lost much less of their color. On average 42.7% of polyps were bleached on the heat trial compared to the control without the probiotic where 91.8% bleached. The disease trials had 16% bleached whereas the disease control without the probiotic was 83.3% bleached. This supports that beneficial microorganisms for coral can be used to reduce coral bleaching and disease.

Bari Weiner

William T. Dwyer High School

The Basics of Humid Nature: Does High Humidity Affect the Antacid Property of Sodium Bicarbonate?

This investigation attempts to investigate how the amount of time, in days, of exposure to high humidity (above 80% relative humidity (RH)) affects the antacid property (moles of hydrochloric acid (HCl) neutralized) of sodium bicarbonate ($NaHCO_3$). I hypothesized that increasing $NaHCO_3$’s exposure to high humidity slightly increases its antacid property because $NaHCO_3$ slowly produces hydroxide, a strong base, when decomposing in moisture. This may occur if heartburn patients store $NaHCO_3$ in a humid place. My independent variable is time exposed, in days, to high humidity. My dependent variable is HCl moles neutralized. Controlled variables are RH, $NaHCO_3$ and water amounts, $NaHCO_3$ solution and HCl concentrations, and water type. The investigation method involved titrations between HCl and $NaHCO_3$ solution of samples left in high humidity for 0, 1, 2, 3, and 4 days and distilled water, for 5 trials. The raw data collected is each $NaHCO_3$ solution’s initial pH, volume of HCl neutralized, and daily environmental RH and temperature. Data was analyzed by determining each $NaHCO_3$ set’s average volume and moles of HCl neutralized, RH, temperature, initial pH of $NaHCO_3$ solution, and percent uncertainty of HCl moles neutralized. Results revealed that increased high humidity exposure increases $NaHCO_3$’s antacid property, due to decomposition. The results showed high accuracy when compared to my predicted trend and high precision based on ±7.4%, ±6.9%, ±3.4%, ±6.5%, and ±2.9% uncertainty for the moles of HCl neutralized by $NaHCO_3$ exposed to high humidity for 0, 1, 2, 3, and 4 days, respectively.

Catherine Zhao

BAK Middle School of the Arts

Storing Strawberries to Maintain Freshness

Strawberries are known for spoiling quickly, but which method of storing strawberries keep them fresh for the longest amount of time? In this experiment, three different storage containers--clamshell, glass, and plastic airtight--were tested with and without paper towels to see how long they could keep strawberries from spoiling. The storage method (container type and whether or not paper towels are lined) is the independent variable and the amount of time the strawberries are kept fresh for is the dependent variable. My hypothesis was that if these methods of storage were tested, a clamshell container (store bought strawberry packaging) lined with a paper towel would keep strawberries fresh for the longest amount of time. The results of the experiment showed that out of the three container types, clamshell containers keep strawberries fresh for the longest amount of time.

Catherine Lee

Palm Beach Central High School

Decreasing Acoustic Footprint of Marine Propellers, using Geometric Modifications.

The purpose of this project is to test the effects of different propeller geometric designs on the differences in noise pollution measured in decibels(dB), while maintaining the highest level of propulsion efficiency possible. This can be applied in real life as noise pollution, primarily resulting from large barge's propellers in shipping lanes, is harming the environment. A main concern for the environment is the noise pollution's effect on whales, as the noise pollution resulting from the cavitation from the propeller has such a high decibel value that it blocks the communication in the whale pods causing whales, most importantly the whale calves, to become lost. Which is jeopardizing the marine ecosystem as we know it. During this experiment three different types of three blade propellers were geometrically modified by using differing amounts of propeller blades, that were created using 3D printing technology. They were tested in a pool using a hydrophone to measure the decibel output.It was found that the decibel data for both of the two experimental groups contained significant data that when the number of blades on a propeller is altered, this indicates that noise emission decreased. The information developed from this study can be applied to various industries, and help prompt answers for worldwide marine noise pollution reduction and shipping lane noise issues. As well as maintaining a stable ecosystem for marine life.

Ramsey Alsheikh

American Heritage School of Boca/Delray

Natural Computational Entropy and Random Number Generation

Random number generation is the process of generating numbers that could not feasibly be predicted beforehand. The purpose of this experiment was to provide evidence that a computer's local processes could be used as a source of entropy for a random number generator (RNG). The hypothesis was that the generator using natural computational entropy would produce statistically random numbers. The local CPU registers of a machine running Ubuntu were used as a source of entropy for a newly coded random number generator. These CPU registers change their contents millions of times per second, so it was hypothesized that it would be impossible to predict their contents beforehand. A C program was coded on a system running Ubuntu Linux that used the contents of the EAX register every second to output a series of 10 bit numbers. The generator passed the Dieharder suite of statistical tests, and the hypothesis was supported. While the Dieharder tests do not "prove" randomness - as randomness is technically impossible to prove - passing it indicates it is very likely that the generator is reliable. Further research is needed to conduct more exhaustive statistical tests, and to examine other potential sources of entropy in a computer that could prove to be, effectively, more random. This experiment has provided evidence for the possibility of true random number generation that does not rely on expensive equipment. It has applications in cryptography and computer security, as random numbers are commonly used to make computer interactions more secure from hackers.

Aishwarya Ayyanathan

American Heritage School of Boca/Delray

Diagnosing Lung Cancer Through using a Convolutional Neural Network

Cancer is the second most common cause for death of Americans, only behind heart disease. In 2020, the number of new cancer cases is expected to exceed 1.8 million. Lung cancer is one of the leading causes of death; almost 25% of all cancer deaths were caused by lung cancer. Lung cancer is deadly primarily because it is difficult to diagnose and catch in the early stages. So, if it could be caught at an earlier stage, millions of lives could be saved. This experiment focuses on the application of machine learning to create a Convolutional Neural Network using Lung CT scans to exceed the current efficacy of 89%. The proposed hypothesis is that if an improved model is created, then it will diagnose cancer at a higher accuracy than the 89%. First, the appropriate dataset was found from the LIDC, a database of lung cancer images at various stages to train the model. Next, the data set was imported with the necessary packages in Python and was labeled. Then, the images were preprocessed for an efficient program run. Then, the model was created and trained with the remaining half of the dataset. Next, the efficacy of the run was noted and compared to the current threshold. It was found that a Convolutional Neural Network could be made that exceeds the current 89%. This has tremendous applications in the field of healthcare; if lung cancer is caught in early stages, then the number of deaths can be greatly minimized.

Bianca Bernard

The Weiss School

Comparing the Efficiencies of Different Methods of Biological and Technological Carbon Sequestration

As the Earth keeps burning more and more fossil fuels, the level of carbon dioxide in the atmosphere grows, and Global Warming is furthered. In order to prevent this, Carbon Sequestration, a method of using plants or absorbers of carbon dioxide to absorb it, must be implemented. The student used a test track equipped with a bicycle carbon dioxide injector to measure the most efficient method of carbon dioxide. The student concluded from the research that CaOH (Calcium Hydroxide) was the most efficient method of carbon sequestration overall, as it had the most carbon dioxide decrease in the shortest amount of time. However, regarding amount, the 500 grams of NaOH (Sodium Hydroxide) was the most efficient because it had greatest quantity.

Samer Elhoushy

American Heritage School of Boca/Delray

The Effects of the Naturally Produced Magnetic Field of the Moon's Lunar Regolith on Material Degradation and Data Transfer

Throughout the past decade, aerospace engineering technological advancement has significantly increased, and it has become more of a priority to expand past the atmosphere of Earth to the space environment, and to embark novel journeys from Earth's moon past the Van Allen radiation belts. While, with the advancements of NASA's Artemis program, Earth has advanced further and further into eventually colonizing both the surface of its moon and the surface of Mars, what has not been fully concluded is the potential hindrance that the moon's regolith can cause to construction, power consumption, and, ultimately, colonization. Testing an accurate simulation as to what the impacts of lunar regolith can truly bring to lunar monitoring satellites, rovers, and commonly used equipment in the lunar environment will provide insight to the future of lunar travel, and what methods of mitigation can be utilized to minimize the effects of lunar regolith in the long term of lunar exploration.

As the moon's natural lunar regolith chemically contains properties that allow it to propagate in its own magnetic field, the goal of this project is to analyze the magnetic field strength and physical properties of an accurate lunar regolith simulant, and to analyze the impacts of the lunar regolith's magnetic field on the degradation of satellite technologies, communications devices, and different lunar rover subsystems. This project utilizes Arduino C++ programming, and operates with a set of capacitors that can sense the disturbance in magnetic field strength of a given volume parameter as a direct result of lunar regolith. The project itself will additionally utilize C++ programming to measure the rate of transmission of four distinct wavelengths to conclude if the status quo of communications technology will withstand its ability in the lunar environment.

Mandy Feuerman

American Heritage School of Boca/Delray

An Examination of the Association Between Empathy as a Disposition and Adherence to Covid-19 Safety Guidelines

The purpose of this project was to find out how empathy as a stable personality relates to adherence to Covid-19 safety guidelines. Empathy is measured along the Interpersonal Reactivity Index (IRI), which consists of four sections with separate scores for each. These sections were perspective taking, empathic concern, personal distress, and fantasy. The hypothesis was that there will be a positive association between empathy as measured by the IRI and adherence to Covid-19 safety guidelines. A survey which included all the questions on the IRI as well as questions about adherence to safety guidelines was responded to by 142 students between the ages of 14 and 18. The empathy subscores and empathy average were calculated. The participants were given a guideline score based on the guidelines they indicated following and the extent to which they followed them. The data were analyzed in Microsoft Excel with the data analysis toolpak. According to the analysis, there was a moderate positive association between average empathy score and guideline score, with a correlation coefficient of .44. The r-square was 20%, indicating that 20% of the variability regarding following of safety guidelines can be accounted for by empathy average. With a p-value of .006, the data can be found to be statistically significant. The data can be applied to public health messaging, as it should be stressed to less empathetic people that the pandemic is an emergency and that safety guidelines are about self-preservation as much as they are about helping others.

Sarah Habona

Florida Atlantic University High School

Using Sargassum and Flaxseed to Create a Mucilaginous Microplastic Filter

Past research has found that jellyfish mucus could act as a microplastics filter due to its adhesion properties, allowing small particles to cling to its surface. Using this principle, it should be possible to create an artificial mucus-like substance that acts similarly. Past research demonstrates that brown seaweed extract can be used as a thickener due to the alginic acid within the seaweed's cell walls, while flaxseed gum is a gelling agent. This study seeks to investigate the effectiveness of a flaxseed-based gel as a microplastic filter. Gel solutions will be made by boiling whole flaxseed using a w/v ratio of 10g/200mL, with the liquid being composed of water and brown seaweed extract. The concentrations of sargassum extract being tested are 0%, 25%, 50%, 75%, or 100%. To test the adhesive properties of each gel solution, plastic particles up to 2mm in size (in largest dimension) will be stirred in a beaker containing both water and the gel solution. Gels will then be evaluated based on their recovery rate of plastic. This experiment concluded that gels made using 100% sargassum extract recovered the highest percentage of plastic, while gels using less than 50% of sargassum extract did not retain their shape well enough to collect plastic particles. All gels were subject to some amount of water absorption, which is not ideal. These findings suggest that the use of natural materials to create microplastic filters is possible but more research must be done regarding the gels' water solubility.

Maryam Imran

American Heritage School of Boca/Delray

Developing an Artificial Neural Network as a Novel Method for Real-Time Diagnosis and Detection of Atrial Fibrillation in Electrocardiograms

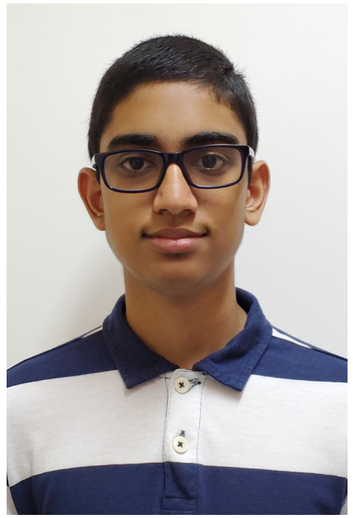
The purpose of this experiment was to develop an artificial neural network in order to accurately diagnose atrial fibrillation. Atrial fibrillation (AF or AFib) is a common type of arrhythmia that results in irregular electrical activity of the heart, in which the atria quiver due to disrupted signal transmission between the SA and AV nodes. The atria are unable to fill the ventricles with blood, and oftentimes blood pools in the heart causing various cardiac complications. Among these are strokes, heart failure, palpitations, pulmonary embolisms, and many others. Atrial fibrillation can be deadly if left untreated, and due to its episodic/asymptomatic nature, it can be difficult to diagnose. Furthermore, diagnosis requires the recordance of long electrocardiograms (EKGs), usually hours in duration, and a demanding/tedious search by doctors for AF characteristics in these recordings often yields inaccurate results. This model attempted to accurately diagnose AF with at least 80% accuracy. Data was retrieved from Physionet's MIT-BIH database. Three different types of patients were used: data from normal sinus rhythm patients, data from AFib patients, and data from non-AFib arrhythmia patients. The neural network model was trained based on Tensor Flow and Kera's libraries with Google Colab in Jupyter notebook, while Pandas libraries were used to manipulate data. Results showed a 90% accuracy in diagnosing AFib.

Yara Ismail

Garden of the Sahaba Academy

Optical Illusions

The purpose of this experiment was to examine which age range could view the most images in an optical illusion. It analyzes the following age ranges: 6-10, 13-19, 20-30, 40-50, and 60+ to see if illusions could affect the eye. Optical illusions are important because they help you see things from different perspectives. As you age, people often find it more difficult to see and focus on details and small objects. At different ages, people are not able to focus on details as well as they used to, often causing conflicting interpretations of the optical illusions. I hypothesized that if I present an optical illusion test to participants varying in ages 6-60, then ages 13-19 will be able to see the most illusions. This was completed by giving participants a test to see which illusions they saw after they looked at 2 illusions for 30 seconds each. Based on the experimental results the data supported that the age range of 20-30 was able to see the most. An average of 5.5 people saw both illusions in both images, which was the greatest average amongst the other ranges. The experimental results did not support my hypothesis as people with the age range of 20-30 had the most active mindset.



Jimmy Joseph

Florida Atlantic University High School

Utilizing Solar Tracking Technologies to Provide Cheap and Efficient Energy

There has been a constant search for a cost-effective, efficient method to harvest clean energy. Solar panels have been used as a method to harvest energy. Both stationary panels and solar tracking panels are utilized to harvest energy. Although solar tracking panels can provide more energy, there are not utilized residentially due to their high cost. In this project, the researcher attempted to develop a cost-effective solar tracking system that harvested energy in an efficient manner.

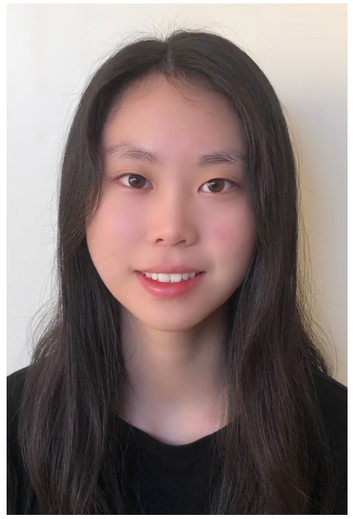
In order to test the effectiveness of the panel, the two solar panel systems were built: a stationary system, and a solar tracking system. Using photoresistors, the solar tracking system was able to directly face the sun. Each system was placed outside for a duration of 100 minutes, and the current and voltage outputted from each system was recorded in 5-minute intervals. At the end of the experiment, although the solar tracking panel system cost 102% more than the stationary panel, it harvested on average 117% more energy than the stationary panel. The researcher's solar tracking system was more cost-effective than the stationary panel system.

Deeksha Kumaresh

American Heritage School of Boca/Delray

Using Different Machine Learning Classifiers to Examine the Relationship Between Prodromal Huntington's Disease and MicroRNA Expression in Blood

Huntington's disease is a progressive neurodegenerative disease that has no treatment to cure or even slow down its progression. MicroRNAs are small non-coding RNA molecules that regulate gene expression. Since the suppression of mutant genes can cure or slow down the progression of a disease, microRNAs can be viewed in light of a treatment option. However, in order to do so, a relationship must be established. Since machine learning algorithms can uncover patterns that are hard to detect by humans, this project aimed to use different algorithms to examine the relationship between Huntington's disease and microRNA expression data in blood. It was hypothesized that if deep neural networks, random forest, gradient boosted decision trees, and support vector machine(SVM) algorithms were implemented, then each would perform better than the dummy classifier, with the deep neural network achieving the highest accuracy. Each classifier was trained and the average of the area under the receiving operating characteristic curves of 100 iterations was plotted. As hypothesized, all of the classifiers performed significantly better than the dummy classifier with a p-value less than 0.05 for each. However, the support vector machine did unexpectedly better than the other models. The results indicate the existence of a relationship between miRNAs and Huntington's disease, which can potentially be used after further research to synthesize a treatment. Furthermore, data concerning the number of patients showed that data from 600 patients would have put the SVM used in this research really close to those networks used to detect miRNA-related diseases.



Julianna Lian

Florida Atlantic University High School

Exploring ROS-mediated inflammation with polyphenol-rich *Sargassum sp.* and incredibly regenerative *D. dorotocephala*

Reactive oxygen species (ROS) is a classification of highly reactive chemical compounds of both radical and nonradical oxygen. It is naturally generated as a byproduct of cellular respiration and is essential in chemical signaling, but dangerous in excess: redox imbalance, oxidative stress, and mitochondrial dysfunction resulting in various genetic disorders. *Sargassum* is a polyphenol-rich brown seaweed that shows promise in stabilizing ROS by donating electrons, but its overabundance when beached on Floridian and Caribbean coasts is a nuisance and hazard to people and small animals; thus, it is often collected and composted. This project aims to (1) address excessive ROS by using antioxidative *Sargassum* as a capable inhibitor, (2) approximate necessary vs. excessive ROS levels for proper regeneration of planaria, and finally, (3) determine the implications of these results on inflammation; ROS mediate the opening of interendothelial junctions that allow margination and extravasation during inflammation. By selectively cutting planaria to induce ROS bursts and stimulate regeneration, varying levels of a Sargassum polyphenol extract can be applied to indirectly study its effects on ROS-signaling through planaria O2 consumption (by dO2 concentration), changes in movement/behavior, metabolic inferences, and epidermal imaging observations. It's implications can then be broadened to ROS inflammation signaling—a process that is also "bimodal": important defensively, but when ROS presence is sustained, chronic and disease-causing (tissue dysfunction and injury).

Brianna Marturano

Home School

Is *Pseudomonas fluorescens* the answer to Environmental Pollution?

Pseudomonas fluorescens can be used for bioremediation to degrade toxic compounds and hazardous waste. Approximately, 200 million gallons of contaminated oil is improperly disposed of annually. Pseudomonas fluorescens may be able to help reclaim contaminated areas.

This project increased concentration of used motor oil in nutrient agar and broth to determine the effect on *Pseudomonas fluorescens* and evaluate the reduction of oil. Concentrations of 2.0%, 1.5%, 1%, .5%, and 0% used motor oil is added to the solid and liquid media and incubated with *Pseudomonas fluorescens* for 24 hours. Results of agar plates were evaluated visually, with a light meter under natural lighting and in a dark room with a UV light box. The results show decreased growth of *Pseudomonas fluorescens* on higher concentrations of oil when measured under natural and UV light. The natural light has an R-value of .823 and UV light an R-value of .909 showing a high degree of confidence in the data. Liquid cultures were evaluated using a spectrophotometer with the full spectrum and data gathered at the 391.8nm peak. Broth cultures lacked reliability (R-value of .076 with all data and .533 with an outlier removed) due to oil interference. The depletion of oil was evaluated in a separate trial in broth. Results showed no removal of oil or change in color. Hazardous chemicals in the oil were not evaluated.

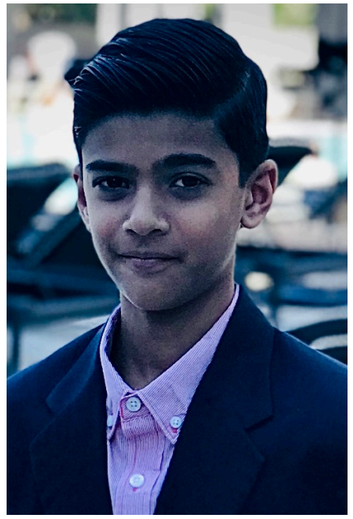
While *Pseudomonas* may remove hazardous components of oil it is ineffective at removing oil and increasing concentration of oil restricts bacterial growth.

Natasha Mayorga

Florida Atlantic University High School

Can Mycorrhizal Fungi Inhabit Mars?

Looking into the future of humanity, there are many potential dangers that threaten our species' survival on this planet, such as global warming, overpopulation, and depletion of resources. This encumbrance naturally probes our interest in the colonization of Mars, a feat which, without the cultivation of plants, is impossible. To promote extraterrestrial agricultural growth, the stimulation of mycorrhizal fungi under martian conditions should be accounted for, as a majority of plants on earth are supported by, or are even fully dependent on a symbiotic relationship with the fungi. Successful mycorrhizal growth on Mars is likely to contribute to the survival of our species on another planet. To achieve this, mycorrhizae propagules must be able to survive exposure to the martian environment. After embedding endomycorrhizal propagules in a martian soil simulant, and individually exposing this mixture to martian temperatures, ultraviolet radiation, and an atmosphere composed primarily of carbon dioxide, I subsequently quantified mycorrhizae colonization by the grid line intersection method. The propagules survived and were able to continue promoting plant growth because the spores remained dormant in soil until they came in contact with plant roots; any exposure before this contact did not have an impact on the mycorrhizae.



Michael Mikati

The Weiss School

Testing the Sensitivity of Manduca Sexta Moths to Various Light Wavelengths

This experiment aims to find an alternative streetlight in place of high sodium pressure lamps (580nm-600nm), which are the most common streetlights. All obtained materials were properly sanitized and wiped down before being used in the experiment. The student researcher frequently washed hands with soap and water and used plastic gloves to handle the pupae and moths. For the experiment, the Manduca Sexta Moth species will be utilized. This experiment will be conducted by shining different light wavelengths on the moths and examining their reactions to be recorded as data. This experiment will test UV light (200nm-400nm), fluorescent lights (480nm-570nm), and halogen lights (650nm-900nm) on the moths. Zero light will be used as the control group. Based on research it is predicted that the moths will be more attracted to the shorter wavelength light rather than longer wavelength light. To care for the moths, sugar water will be replaced every 3 days and moths will be misted with water twice per day. These tests were completed in two sets. In the end, the experiment came to the conclusion that shorter wavelength light is more attractive to moths than longer wavelength light. What this means for the streetlight dilemma, is that an alternative for high sodium pressure lamps has to be bright enough to see, and also have a wavelength greater than 600nm.

Kasey Moore

American Heritage School of Boca/Delray

Evaluation of Vitamin C amount in page oranges over elapsed shelf time

Vitamin C is a potent antioxidant present in oranges. Sources referred that its concentration decreases with shelf time. I performed a longitudinal study to compare vitamin C amount in ripe and unripe page oranges over time. Hypothesis: The amount of vitamin C in page oranges (ripe and unripe) decreases with shelf time.

Methods: The amount of vitamin C from ripe and unripe page oranges was calculated using the titration procedure. Results: The mean amount of vitamin C per 20 cc of fresh squeezed juice from ripe oranges was 8.23, 8.46, 8.14, 7.64, 7.73 milligrams at days 0,3,7,14 and 28 representing a reduction in vitamin C over time. Similarly, the mean amount of vitamin C per 20 cc of fresh squeezed juice was 7.57, 8.67, 7.14, 7.51, 7.07 milligrams at days 0, 3,7,14 and 28, representing a reduction in vitamin C over time. The vitamin C amount at day 3 was higher in unripe than ripe oranges (8.67 vs 8.46 mg/20mL of juice), however this was not noticed at day 0, 7, 14 and 28.

Conclusions: The amount of vitamin C present in ripe and unripe page oranges decreases over time. It is not clear whether the amount of vitamin C present in unripe oranges is higher than the amount in the ripe ones. Applications: People should buy the right number of oranges planned to be consumed in order to avoid shelf time, therefore maximizing the amount of vitamin C intake in their diet which translates in better health.

Angelina Ning

American Heritage School of Boca/Delray

Testing the extent of synergistic anti-biofilm activity of *Galla chinensis* and potentially adjuvant chemicals on *Escherichia coli* biofilm formation and preformed biofilm

This experiment investigated the effectiveness of using cinnamaldehyde (CAD) and zinc in conjunction with *G. chinensis* to inhibit *E. coli* biofilm formation and to disperse preformed *E. coli* biofilm. It was hypothesized that if biofilms were cultivated in the presence of treatment or exposed to treatment after cultivation, then in both cases, the combination of *G. chinensis* and CAD would exhibit stronger antimicrobial properties. To test this hypothesis, *E. coli* biofilms were cultivated in the presence of treatments constituted of 0.16 mg/mL *G. chinensis* water extract (GWE) and varying concentrations of either CAD or ZnCl2, or were exposed to these treatments after cultivation. Both the combined treatments of GWE and CAD, and GWE and ZnCl2 were more effective at inhibiting biofilm formation than GWE alone, showing that using CAD and ZnCl2 in conjunction with GWE produced synergistic antimicrobial effects. A two-tailed t-test further showed that the CAD treatment was more effective than the ZnCl2 treatment, thus supporting the hypothesis that the CAD treatment would inhibit biofilm formation more. Both combined treatments were also effective at dispersing preformed biofilm, and a two-tailed t-test showed that the ZnCl2 treatment was more effective than the CAD treatment, rejecting the hypothesis that the CAD treatment would be more effective at dispersing preformed biofilm. This experiment demonstrated that using chemicals in conjunction with Chinese herbal medicines (CHMs), such as *G. chinensis*, can produce synergistic effects on inhibiting and dispersing bacterial biofilm, demonstrating the potential of CHMs to replace antibiotics as treatments for bacterial infections in the future.

Su O'Brien

The Ideal School

Water Power

This project was conducted to help the future of hydraulics and engineering. My goal was to explore the relationship between different sized cylinders in a closed hydraulic system. I conducted this experiment by attaching a constant size input piston to four different size output pistons. This project works by applying an equal force to the input piston and measuring the force applied to the output piston.

Pascal's law states that the pressure applied to any part of the enclosed liquid will be transmitted equally in all directions throughout the liquid. My experiment proved that a larger piston can lift more mass due to its larger surface area that the pressure is acting upon. Smaller pistons cannot carry as much weight due to their smaller surface area. I measured the volume that each output piston could lift. Although the main hypothesis of my experiment was carrying weight, I also learned that the distance that the plunger moved was different based on the size and shape of the piston. The volume change in each piston stayed constant; for example a 20ml movement in the input resulted in a 20ml movement on the output.

Patrick O'Leary

A.D. Henderson University School

Can an Underwater Camera be Attached to a Buoy to Identify Sharks Using a Monorail System That Can Alert People at Local Beaches When a Shark is Approaching?

This project assesses whether an underwater camera can be attached to a buoy to identify sharks using a monorail system that can alert people at local beaches when a shark is approaching. The purpose of this research is to prevent shark attacks from occurring at beaches. The project will use an EV3, a programmable LEGO robot, and a Pixy Camera 2 to create a buoy that can move along the ocean. In reality, there would be numerous buoys to cover all of the water. The buoys would be in pairs of two that could move towards and away from each other depending on the clarity of the water. When the water is not so clear, the buoys would reduce the space between each other so they are closer together. This will make sure that no shark would be able to swim by without being identified. Under these buoys, there will be a Google Coral, which is an electronic device with machine learning properties. The Coral will be trained on images of sharks that are generated in Blender, a 3D creation software, and then tested on real images of sharks. Since the Coral was able to identify the sharks accurately if this was implemented into public beaches it should function properly with some minor adjustments. This project was mainly proof of concept the EV3 would most likely be replaced with a different robot more suitable for the water but would have the same function as the Ev3.

Ashwin Parthasarathy

American Heritage School of Boca/Delray

Classification and Prediction of Head and Neck Squamous Cell Carcinomas Using a Generative Adversarial Network Model

Head and neck squamous cell carcinoma (HNSCC) is a cancer that arises from squamous cells in the head and neck region, a type of cell found in the outer layer of skin and lining various mucous membranes. Diagnosis of HNSCC is primarily done through radiographic imaging tests, which is utilized for comprehensive diagnosis of the disease. In order to properly diagnose the carcinoma, deep learning could be utilized to recognize intricate structures within radiographic images. A generative adversarial network (GAN) is a deep learning architecture that implements two sub-models, a generator and a discriminator, that can be used in a variety of applications, including image synthesis and classification. The purpose of this experiment was to develop a GAN model that could take an input of radiographic images of HNSCC and both diagnose the stage of cancer and predict progression of the carcinoma with high accuracy. HNSCC CT scans were downloaded from an image dataset and separated to first train and then validate the accuracy of the GAN model. When radiographic images were used to validate the GAN model over a sufficient number of epochs and a large enough sample size from the validation set, the distribution of model accuracy had a median of approximately 93.95% and an IQR of approximately 0.9%. This demonstrates that the GAN model was able to recurrently achieve an accuracy of at least 93%, an accuracy that is higher than the 90% achieved by state-of-the-art machine learning architectures that do not utilize multiple sub-models.

Grace Phelps

A.D. Henderson University School

At What Concentration of Zinc Oxide are *Anthelia glauca* Exposed to Coral Bleaching?

The purpose of this project is to determine the zinc oxide concentration at which *Anthelia glauca* coral become exposed to coral bleaching. This is important because every year 30 million tons of sunscreen enter coral reefs resulting in mass coral bleaching events. By determining the concentration of zinc oxide that results in coral bleaching, the destructive effects of sunscreen can be minimized or eliminated. The scientist's hypothesis is if 20 *Anthelia glauca* coral fragments become exposed to different concentrations of zinc oxide, then the coral will experience coral bleaching at exactly 4 grams of zinc oxide because the zinc oxide enters the phytoplankton and therefore the coral because it is the coral's main food source. The scientist conducted this experiment by setting up 3 aquariums: Aquarium 1 (Control) - 0 Grams of Zinc Oxide, Aquarium 2 - 1 Gram of Zinc Oxide, and Aquarium 3 - 2 Grams of Zinc Oxide. The scientist measured the coral fragments' length in centimeters every day and added the appropriate amount of zinc oxide into each aquarium for 14 days. Throughout the experiment, the scientist observed that the coral fragments in aquariums 2 and 3 became a paler pink, began to droop, and did not pulse for light. These observations led to the conclusion that the coral in aquariums 2 and 3 began to experience coral bleaching at an average of approximately 5.59 grams of zinc oxide. In conclusion the scientist's hypothesis was rejected, the coral experienced coral bleaching at 5.59 grams of zinc oxide.

Liam Schnur

The Weiss School

Evaluation of Hydrocarbon Absorption of Various Textiles for use in Oil Spill Mitigation

Oil spills are and have been a large problem worldwide for many years. A low-cost material to absorb the oil after it is gathered by skimmers is necessary. The test studied which of five fabrics was the most absorbent. Each was placed in the oil for thirty seconds per piece of fabric in which there were four of each. The oil was measured in milliliters and disposed of after the amount was written down. The testing proved that wool fabric was the best in absorbing lots of oil and no water. This info may help in future incidents where tons of oil are spilled into the sea.

Lucja Stawikowska

Florida Atlantic University High School

Determination of the Parameters Influencing Fan Efficiency

Despite their use in everyday machinery, devices, and systems, there is limited research regarding parameters that influence cooling fan efficiency. To determine the optimal parameters that are responsible for the most efficient cooling fan, eighteen unique fans were designed and based on two parameters: number of blades and angle of attack. The number of blades tested were three, six, and nine blades and the angles of attack ranged from fifteen to sixty-five degrees in ten degree increments. Each fan design was 3D printed and tested. The voltages applied to the motor ranged from 4.5 to 12 volts in 0.5 volt increments. For each voltage value, the wind speed, rotations per minute, and current were recorded. The fan with nine blades and a forty-five degree angle produced the fastest wind speed (33.8 km/h). Interestingly, measuring current drawn by the motor allows for the use of a power efficiency calculation that is derived from the ratio between power intake and wind speed output. Therefore, the six blade, forty-five degree fan was the most efficient fan because it had the highest power efficiency ratio. Additionally, to confirm results, CFD (computational fluid dynamics) simulations were used to expand the understanding of tested parameters.

Nolan Wen

American Heritage School of Boca/Delray

The Effect of Cyanoacrylate on the Setting Time and Adhesive Strength of a Nitrocellulose Based Liquid Bandage: A Proof of Principle Study

Liquid bandages are more advantageous than traditional band-aids because they maintain good moisture balance, keep bacteria and debris out, and reduce pain. However, the long setting time and low adhesive strength need to be improved. The purpose of this study was to evaluate the effects of cyanoacrylate glue (Starbond) concentration on setting time and adhesive strength of a nitrocellulose-based liquid bandage (CVS). The hypothesis was: if cyanoacrylate could be mixed with liquid bandage, then the mixture would have a faster setting time and a higher adhesive strength than the liquid bandage alone. The setting time experiments were conducted with the following volume percent concentrations of cyanoacrylate: 0%, 25%, 33.33%, 50%, 66.67%, and 100%, on four different substrates, i.e., porcelain surface, aluminum foil, porcine skin, and bovine skin. Three different methods (eye strap, hex nut, wound closure) were employed for evaluating adhesive strength of the following formulations: 0%, 33.33%, 50%, and 100% cyanoacrylate. Each formulation was applied between an eye strap and porcelain surface, in between two hex nuts, and within an artificial wound on bovine skin, and the breaking force was measured after twelve hours of curing. Results showed that the mixtures of cyanoacrylate glue and liquid bandage set significantly faster than pure cyanoacrylate glue or liquid bandage regardless of the substrates used, and had a significantly higher adhesive strength than that of the liquid bandage alone. These preliminary findings indicated that a faster setting, more adhesive liquid bandage could be further developed for clinical use.

Ben Kessler

The Weiss School

Comparison of Programming Methods for Computer Solutions to Sudoku Puzzles

The purpose of this project is to see if more logical programming can increase the speed of a brute force program to solve a sudoku puzzle. The hypothesis is that logical programming can help speed up a brute force program to solve a sudoku puzzle. The procedures are to find a group of sudoku puzzles 10 test, write a program that solves a puzzle through the brute force method of solving sudoku puzzles, then run the program to see how long it takes to solve the puzzle using the brute force program, write a human logic program, then run the human logic to solve some of the puzzle then run the brute force program and time it, and compare the times. The data concludes that between the brute force solving the sudoku puzzles on its own and the human logic and the brute force working together the human logic solved the puzzles faster than the brute force alone.

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