Project # 1

Gannon, Charlotte; Leao, Isabella ; Murphy,Robin

Testing Mars Global Simulant MGS-1 Enhancements including a Novel Water/Nutrient Delivery System for Growing Crops for a Mission to Mars

Completed Project, Science, Teams (Completed Project)

Determining a way to grow crops in Mars Regolith is important in terms of sustaining future life on Mars. It is hypothesized that enhancing Mars Regolith with a polyacrylamide super-absorbent polymer (PAM SAP) and organic nutrients will enable crops to grow more successfully. The experiment covered three planting stages. In stage I, triplicate planting of eight radish seeds were grown in seven different groups. Two control groups with Earth soil (C1) and Mars Regolith (C2), and five Mars Regolith experimental variable groups with enhancements: fertilizer (V1), organic nutrients (V2), PAM SAP (V3), fertilizer PAM SAP (V4), and organic nutrient PAM SAP (V5). Stage II kept all groups constant while adding 25% volume of matured compost to enhance growth. In planting stage III, arugula, radish, chard, lettuce, and kale were grown in the most successful variable from Stage II (V5). The most significant finding in this study was that V5, PAM SAP enhanced with organic nutrients, produced the most radish plants compared to other groups. While the V5 plants did not have the greatest average height at 2.8 cm compared to V3 at 3.7 cm, it had the most plants grown in total (12), 42% more than the Earth soil control. In stage III, the radish plants experienced the most growth (8 plants), 37.5% more than the next successful crop, arugula. The implications of this study include the development of a novel nutrient and water delivery system for a reliable food source to help sustain life on Mars.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 2

Crowley, Isabella; McGrath, Regan

The Effect of Exercise on the Mood of Adolescents: A survey of High School Athletes

Completed Project, Science, Teams (Completed Project)

The focus of this study will be to find what effect participation in high school athletics will have on one's immediate mood after exercise. Once consent is given by a parent/guardian a baseline form will be distributed to participants. This form will consist of a modified version of the Profile of Mood States (POMS), the International Physical Activity Questionnaire (IPAQ), and other questions specific to participation in high school athletics. Participants will then be sent emails with a second post-exercise form containing the modified version of the POMS and questions specific to the exercise done that day. This form will be filled out each day following exercise for a week. Identifying information such as name and email address will be collected for the purpose of permission identification only and will be de-identified before being given to Isabella Crowley and Regan McGrath. The data will be stored on a Ridgefield Public School secured drive and upon completion data will be deleted or stored forever on a secure drive. This research will further the understanding of the impact of exercise on mood. Managing anxiety symptoms and inducing the correct duration and intensity of exercise can create an environment best suited to the wellbeing of student athletes. By creating these environments, athletes' mental health will be positively influenced and future participation in athletic activities will be induced.

Ridgefield High School

Teacher: Patrick Hughes

Project # 3

Ahmed, Aiden

Designing an Anti-Draft Climate Controlled Coop for Baby Chicks

Completed Project, Engineering, Physical Science

Chicks need special coops, or brooders, to be reared in. These brooders must facilitate stable temperatures and shelter from drafts. This is because baby chicks are susceptible to sudden or drastic temperature changes, which are also perpetuated by drafts. The purpose of this project was to design a brooder to rear baby chicks from newborn to 1-month old. The brooder should have had enough space for chicks to roam relatively freely inside, be insulated to maintain stable temperatures, allow for manual temperature adjustments, and mitigate drafts. It was required to comfortably support multiple baby chicks. Current solutions were custom brooders made from household materials. For design, the behavior of baby chicks was observed in a lab. These observations were used to design the brooder in 3D modeling software. The brooder was then assembled to the specifications of the model. The temperature control circuit and draft mitigation were evaluated. For temperature, a sensor, circuit, and readout display were installed, and temperature readouts were logged over a three-day, continuous testing period via video recording of the readout. The difference between its reading and the set temperature indicated the system's effectiveness/accuracy. For draft mitigation, a commercial anemometer was placed in the center of the brooder and data collected in a test within a wind tunnel at the University of New Haven. The findings from this project could have helped with further advances in care for baby chicks. Additionally, it served as a potential candidate for the commercial manufacturing of baby chick brooders.

Amity High School

Teacher: Catherine Piscitelli

Project # 4

Akbar, Manaal

Stimulating An attack on a Virtual Machine to Develop Countermeasures in order to Prevent Future Cyberattacks on Virtual Machines

Completed Project, Engineering, Physical Science

A virtual machine is a representation of a computer system. For example, it can be an image or computer file that behaves like an actual computer. An example of an attack is hyperjacking where the hypervisor of a virtual machine is taken over. The point of this attack is so the attacker can run programs and manipulate victims using virtualization software. In some cases, people have lost their entire virtual software and could not get it back. Some countermeasures exist however, this project will go more in depth with it by analyzing the existing ones and improving them too. The purpose of this project was to develop countermeasures to prevent future cyberattacks on virtual machines. For this project to be completed, there were multiple steps. There was a virtual lab that my mentor provided for me. This virtual lab includes a machine which runs the cyber attack on the software the user tells it to. From stimulating the attack on the virtual machine it was then monitored and vulnerabilities/issues were shown. Analysis and clarification of each countermeasure were proposed. My mentor provided me with direction and feedback on my deliverables while I was the one in charge of the experiment and simulations. Countermeasures were compared to previous ones to see what else is missing from the old countermeasures. Results thus far show that the victim laptop has produced effects from being attacked giving more data to be analyzed. From finding and improving countermeasures, future attacks can then be prevented.

Amity High School

Teacher: Catherine Piscitelli

Project # 5

Chang, Luke

Incorporating Aluminum to Electroless Nickel Gold Immersion Surface Finish to Prevent the Corrosion and Oxidation of Electroless Nickel in Printed Circuit Boards

Completed Project, Engineering, Physical Science

Printed circuit boards, (PCBs), are a medium used in electric engineering to connect electrical components to one another. One of the most important steps of making PCBs is surface finishing. The purpose of surface finish is to protect the exposed copper from oxidation and prepare the PCB for soldering. There are a multitude of surface finishes, each with their own respective advantages and disadvantages. One of these surface finishes is Electroless Nickel Immersion Gold (ENIG). ENIG is a multi-layer of surface finish which includes nickel and gold. Nickel serves its purpose as the protector of copper, and the gold is placed over the nickel through displacement to protect the nickel from oxidation. ENIG is known for its long shelf life and its ability to provide a highly solderable finish, however, the main problem when utilizing ENIG is the development of "black pads." Black pads caused by ENIG are when the electroless nickel on the PCB corrodes and oxidizes, leaving a black patch on the PCB. And this often goes unnoticed until the whole process is finished, leading to the whole PCB to get scrapped. The purpose of this project is to determine a solution for black pads in ENIG surface finishes. The criteria for this project includes the phosphorus level of the PCB to stay between 7-10% and for there to be no oxidation or corrosion of the nickel. This project will be done through software simulation. The role of the mentor of this project is to assist the mentee with information about surface finishes and chemical reactions and to guide them through difficulties when encountered. First, through the simulation software, the standard reaction of ENIG will be tested to determine the standard parameters to be compared to. The simulation will then be designed to test aluminum as an oxidizing agent for nickel, and it is to be placed in between the nickel and gold. The simulator will be used to analyze the reactions between nickel, aluminum and gold, aluminum to determine if it will prevent black pads. Simulation data will be analyzed through comparison with the parameters collected from both ENIG and the ENIG with aluminum. The implications of this experiment provides the PCB industry with a more effective and efficient manufacturing process, leading to less failed PCBs.

Amity High School

Teacher: Catherine Piscitelli

Project # 6

Daly, Maura

Development of Soft Robotic Arms Which Mimic Biological Systems and Structures

Completed Project, Engineering, Physical Science

The development of new robotics has largely been dominated by rigid robotics from the assembling of machines to surgery to the deactivation of explosive devices.While industrial arms, surgical robots, or vehicles can perform specific tasks with remarkable precision, speed and reliability, they are not capable of adapting to other tasks such as from precision manipulation or operating in fully unstructured environments like a flat paved road to a rocky mountainside. However, within the field of soft robotics, bioinspired robots have abilities that are not only high performing universal and customizable, with features such as the abilities to fit into tight spaces, change color or surface texture, and manipulate objects. Methods to design and fabricate soft robots are much less developed than rigid robotics. By applying nature's solutions and rich sources of inspiration to problems that we are still struggling to solve using existing engineering methods. Soft robotics aims to create machines, electronics, and robotic systems out of fluids, elastomers, gels, and other soft material. Features of natural organisms, especially soft organisms or soft biological tissue, are often not present in rigid robotic systems and therefore lack the ability to complete certain tasks or skills. There are several issues in bio inspired robotic systems that can only be addressed by using soft materials: design considerations, impact resistance, and ability to move in confined spaces. By using designs that mimic biological systems and structures abilities to exert force, change shape, and do work it is more efficient. The objective of creating arms is to provide a range of behaviors such as handling fragile objects, moving across irregular, shifting, and unknown terrain, applying single sources of pressure, etc. The objective of the soft robotic arms is to create multiple arms that are interchangeable that can accomplish three critical issues that can only be addressed using soft materials: mobility in confined spaces, impact resistance, and design complexity. Mobility in Confined Spaces Semi Rigid robots will be able to collapse their shape through folding or bending. Soft robots can deform in order to adapt to the shape of their environment Impact Resistance- soft materialsare better at absorbing dynamical loads and shock. Soft materials such as silicone, fabrics, and elastomers will be used because they are suitable for manipulating objects. Design - the stiffness and dimensions of a material will determine its load capacity, deformation, and how stress is distributed. There will be 4 separate arms constructed, each made with soft materials and for different functions, such as lifting a delicate object or navigating terrain. The arms will be battery powered and testing will be on specific delicate or fragile objects and irregular terrains.

Newtown High School

Teacher: Timothy DeJulio

Project # 7

Gopal, Alesandro

Creating Optimized and Customizable Coordination Algorithms for Swarm-Robotics in Simulation

Completed Project, Engineering, Physical Science

Swarm robotics is an approach to solving complex problems using a coordinated system of multiple physical robots. One of the primary challenges in creating these swarms was a lack of flexible software to program the robots. People have worked to solve this problem by developing a programming language called Buzz. The language features a similar structure to existing languages and built-in variables/functions to facilitate whole swarm communication and behaviors. The purpose of this project was to create optimized and customizable algorithms to coordinate swarm-robots using Buzz. The algorithms were first created with a single robot in mind. This implementation was used to optimize the execution of individual tasks. From there, the algorithms expanded to incorporate more and more robots. This step aimed to optimize the way the algorithms divided tasks between the robots and added options to easily customize the algorithms. Multiple data points were recorded and analyzed to benchmark each implementation of the algorithms. The data recorded includes the time each bot spent idle/moving and the total task completion time. Findings thus far show that the implemented algorithms decrease overall execution time as a result of a bigger/more sophisticated swarm. The algorithms designed in this project will aid in the development of Buzz and create configurable and easy-to-use functions for other swarm robot programmers to use. This will help speed up the research in swarm robotics and ultimately optimize various projects, ranging from search and rescue missions to construction.

Amity High School

Teacher: Catherine Piscitelli

Project # 8

Guido, Nicole

American Sign Language (ASL) Resin Printed Prosthetic Hand

Completed Project, Engineering, Physical Science

My goal is to create a working finger and then progress to all five fingers and begin to build a hand, with Arduino coding Servos, screws, and fishing line wire. I intend to make a fully functioning, realistic prosthetic hand prototype that can perform human-like tasks such as bending a finger, signing words using American Sign Language (ASL) such as the word "wow" or picking up a tissue. Eventually, I want the prosthetic hand to control all five fingers and incorporate wrist movements. Once I have those tasks accomplished and have a fully functioning hand, I would like to discover advantages and disadvantages of a prosthetic hand and find places for improvements and make those changes. Then, I can utilize its capabilities to improve sensitivity and perform more fluid movements. My proposed experiment will include the ability for the prosthetic hand to: 1. Perform human-like tasks such as bending a finger 2. Sign simple words such as "wow" using American Sign Language Fingerspelling 3. Pull a tissue from a tissue box 4. Control all five fingers to hold a paper cup 5. Incorporating wrist movements In starting to build the experiment, I will first assess if I can make a functioning finger. Once I have a full functioning finger, I can build upon that progress and use the same system to make the remaining fingers for a complete full functioning hand to perform sign language.

King School

Teacher: Victoria Schulman

Project # 9

Huber, Alejandro

Developing and Testing a Laminar Airfoil Utilizing CFD to Implement Into General Aviation

Completed Project, Science, Physical Science

Laminar flow is when the air around an object is smooth and uninterrupted. When applied to aircraft, it is highly efficient, reducing skin friction by 90%. This increases aircraft efficiency significantly, as skin friction accounts for 50% of the drag on an aircraft. Unfortunately, most airfoils in general aviation are not optimized for laminar flow. This is a problem because fuel prices have consistently increased in recent years, making up a significant portion of the gross aircraft operating costs and expenses. Energy used in air transportation has increased by 43%, resulting in aircraft contributing 3% of global anthropogenic carbon emissions. This is predicted to increase to 15% by 2050. The project aims to design a laminar airfoil to implement into general aviation. This was done by first designing the CFD model with Ansys Fluent. Next, a Transition SST model was used while the airfoil was at an AOA of 0° and a chord length of 1000 mm. Finally, a NACA 4421 was used to confirm that the model was working correctly at an AOA of 0° chord length of 1000 mm, Re of 3000000. The designed airfoil was tested in this model, creating graphs of Lift and Drag coefficients. Iterations depended on when these two values converged. The final result was then compared to the original NACA 2412 to evaluate the difference in performance. Creating a laminar airfoil to implement in General Aviation could improve the fuel economy and the aircraft's overall carbon footprint.

Amity High School

Teacher: Catherine Piscitelli

Project # 10

Jerfy, Aadit

AI Based Skin Cancer Detection System

Completed Project, Science, Physical Science

I propose a simpler detection method of melanoma than currently available that would effectively be accessible to anyone with a phone, computer, or similar device. A user interface will be made using Anaconda, and code written by Sasank Chilamkurthy - co-author of PyTorch- in which Python will be utilized to identify whether or not an image submitted shows melanoma. If it does, the form of melanoma will also be identified. The Python-Based AI will be trained using the HAM10000 database from harvard.edu, which consists of 10,000 images of melanoma. It will train the neural network for detection of cancerous lesions. The various required variables and databases will be imported. The code will be trained to focus on variance in skin tone. The images will be cropped so as to limit the computing power needed. The AI will iterate through the database, comparing it to the submitted image and picking up on similarities. If there are enough characteristics of melanoma in the submitted image, it will be characterized as melanoma. The user will be notified of the results of the search along with a comparison to similar images that the code has marked. They will be advised on further treatment. Ultimately, the code will be converted into an application, available for a low cost on phones, computers, and various other electronic devices.

Newtown High School

Teacher: Timothy DeJulio

Project # 11

Krueger, Max

Effects Of Heating & Radiation Exposure On Quartz Crystals

Completed Project, Science, Physical Science

1. The coloration of amethyst has been shown to result from gamma irradiation of quartz containing traces of iron, and also be reduced by exposure to intense heat sources. In this project, I intend to determine whether irradiation of bleached quartz can serve to restore some part of the crystal's original color. 2. 3 different types of quartz were broken into pieces to examine, the three variants being rose quartz, citrine and amethyst. 3 shards from each crystal were placed into a kiln and heated for 12 hours at 450 Celsius. Afterwards, one bleached shard of citrine and one of amethyst were placed into a lead gamma radiation storage container with buttons approximating 3.5 microcuries of radiation. Roughly every week for four weeks afterwards the shards would have their radiation absorbance measured via geiger counter. Control counts would also be taken from clean samples. 3. Unfortunately, while significant color change was exhibited by the quartz samples during heating, no visible difference was seen as a result of radiation exposure. However, measurement of the radiation released by the irradiated crystals demonstrated that they were retaining a non-insignificant amount of radiation. 4. Although color change was not observed, the absorbance of radiation by the crystals demonstrates they are at least able to retain radiation long-term. Given that radiation has been proven to affect quartz coloration in prior research, we can conclude the coloration would likely have been affected by radiation exposure if not for the miniscule quantity of it available.

King School

Teacher: Victoria Schulman

Project # 12

Li, Emily

Line Follower Car

Completed Project, Engineering, Physical Science

1. To make cars easier to use, we can use a simple idea of a car with sensors that can follow a line in front of it. 2. Creation of basic car structure using plastic, with four wheels and two sensors attached. The car will include four small motors that will move the car when necessary. An Arduino board will be mounted to code what the car will be doing. On a computer, the code will be made so that the Arduino will know what to do. The Arduino will connect to the sensors and when the sensors detect a line, the Arduino will tell it to move forward. 3. An ideal result would be a model car that can follow various line patterns

Newtown High School

Teacher: Timothy DeJulio

Project # 13

Mathew, Daniel

Measuring the Effect of Hydrogen Exposure Temperatures on the Embrittlement of Pure Palladium

Completed Project, Science, Physical Science

Palladium allows for hydrogen storage under nonflammable conditions and almost exclusively permeability to hydrogen. However, there are flaws with palladium, as it is known to suffer from embrittlement (loss of flexibility and increase in hardness) during hydrogen exposures. While research is being done on the effect of temperature when exposure occurs on the embrittlement of palladium-cooper, a baseline for the effect of temperature needs to be established for pure palladium as well. The purpose of this project is measuring the effect of hydrogen exposure temperatures on the embrittlement of pure palladium. The independent variable being tested is varying temperature of exposure and the recorded effects are yield strength, ultimate strength, hardness, and ductility. The experiment was conducted at the manual hydrogen absorption/desorption apparatus using five trials of varying temperatures and compared to the already completed 50°C trial. Temperatures under 100°C were established using a regulated water bath, while temperatures over 100°C were fixed using an all-stainless-steel system of calibrated volumes. Palladium was prepared through resizing and physical/chemical cleaning. The process of hydrogen absorption/desorption was then completed at the aforementioned apparatus. These steps were all completed in the Chemistry Department at Hartford University under mentor supervision. From here, specimens were sent to Pennsylvania for measurements of hardness. Conclusions deducted from trends of increased or decreased effect on ductility support the hypothesis thus far. These findings can then be implemented as a baseline, or control, for effects of temperature when hydrogen exposure occurs on palladium-copper.

Amity High School

Teacher: Catherine Piscitelli

Project # 14

Wallace, Heather

Engineering a Methodology to Efficiently and Effectively Discover and Classify Micrometeorites

Completed Project, Engineering, Physical Science

Micrometeorites (MMs) are minuscule (150-400μm) geologic forms originating from asteroids in our solar system. They reach Earth's surface after traveling through interplanetary space, and they provide small insights into the story of our solar system, our planet, and ourselves. There has not yet been a study comparing different methods of micrometeorite collection. My study compares the ratio of micrometeorites to debris (material other than micrometeorites) in samples collected in different conditions (dry vs. wet) from rain gutters on residential homes. I will collect the samples using a ladder and proper safety equipment, take them back to a lab room at my school for processing, and observe the processed samples under a stereomicroscope to find micrometeorites. I will match possible micrometeorite contenders with a photo guide/micrometeorite encyclopedia I received from an expert collector and further verify my findings with my mentor. I have not yet completed all the steps necessary to analyze my data, but my results will be ready to present at the fair in February. The truth is often more interesting than anything fiction can create. When it comes to the history of human development, this adage is true: the story of our solar system and our pale blue dot is one of the most incredible stories ever told. Micrometeorites provide a clue to the details of that story. With a tested collection method, professional researchers and citizens can discover fundamental truths about our incredible story.

Ridgefield High School

Teacher: Patrick Hughes

Project # 15

Wempen, Ryan

Designing a Simulation for Aerothermodynamic Performance of Transatmospheric Vehicles and Ablative Heat Shield Designs for Space Exploration Reentry and Hypersonic Missile Defense

Completed Project, Engineering, Physical Science

Since the advent of the Mercury, Gemini, and Apollo missions, the National Aeronautics and Space Administration (NASA) and its contractors have used computer simulations to design next generation space and reentry vehicles. The complexity of designing spacecrafts to travel to distant planetary bodies and reenter earth's atmosphere at hypersonic speeds is a complex undertaking, and simulations permit engineers to test novel designs and new materials. Since no unclassified simulations were available with the capacity to assess all relevant spacecraft specifications and flight parameters, one was developed to fulfill this need. Utilizing hypersonic computational fluid dynamics and simulation (MATLAB) software, this project integrated primary vehicle parameters with a complete atmospheric reentry profile that included aerothermodynamic heating, hypersonic shock waves, and reentry aerodynamics to determine optimal vehicle design and reentry trajectory. Two missions were designed to illustrate the simulation's ability to develop optimized solutions across the spectrum of existing scientific exploration and defense missions: 1) a SpaceX International Space Station (ISS) return mission and 2) a Missile Defense silo attack mission. The simulation supported the novel idea of using an ablative reentry heat shield that ejects to reveal a slender body. In the manned space capsule role, this solution solved the current gap between using a blunt thermodynamic vehicle to minimize heating impacts and a slender aerodynamic vehicle able to make precise runway landings for immediate reuse of the vehicle. In the missile defense role, this solution provided a window of non-detection by enemy satellite-based sensor platforms and exhibited national security applications.

King School

Teacher: Victoria Schulman

Project # 16

Yang, Henry

Developing a Minesweeper Solver to Analyze the Efficacy of Training Algorithms with Imperfect Information

Completed Project, Science, Physical Science

Reinforcement learning (RL) is a subset of machine learning (ML) that learns almost entirely from experience by rewarding progress and punishing hindrances. Because RL requires minimal pre-training compared to other ML algorithms, it's commonly applied to games as their dynamic environments are filled with decisions. Namely, chess exhibits perfect information where all pieces are visible on the board. In contrast, minesweeper more accurately simulates the imperfect real-world environment where players start with no knowledge and progressively reveal more information. The purpose of this project was to develop a minesweeper solver to analyze the efficacy of training algorithms with imperfect information relative to human performance. The game environment was created using Python programming to train and evaluate the solver (agent). The agent was developed using Python's robust RL libraries like Keras to implement deep-q-learning and epsilon-greedy techniques to predict future rewards based on the current game state while balancing exploration and exploitation. While existing studies have used RL in minesweeper, they've shown common declining reliability as game difficulty increases. Thus, the agent was deemed successful if it reliably completed standard beginner or intermediate boards at reasonable speeds relative to a human player. Given the game's randomness, the agent was tested for numerous trials. Results thus far indicated success in training the agent; however, no evaluation or comparison to human players has been made. From predicting consumer behaviors to automation, the implications of this project can improve how AI is trained and enhanced using imperfect, human-supplied data to solve increasingly complex problems.

Amity High School

Teacher: Catherine Piscitelli

Project # 17

Acharya, Anushka

Comparing the Efficacy of Various Types of Neural Networks in Predicting the RNA Sequences of Splice Isoforms

Completed Project, Science, Health & Medical

Messenger-RNA must be transformed before synthesizing with proteins through splicing, where non-expressive portions, introns, are removed and the rest, exons, are recombined. containing portions that will not be expressed, introns, and portions that will, exons. However, it is difficult to predict the RNA sequences of splice isoforms because all introns are not always spliced out and exons can end up being spliced out. The purpose of this project was to test which combination of data, when fed into a neural network, can best predict whether exons will be spliced out or included in the splice isoform. It is hypothesized that a combination of all datasets will best perform since the model can work off more information. The independent variable is the data combination fed into the model and the dependent variable is the classification metric of each model, which shows how well the model performs in areas such as accuracy and precision. There is no control since this is a comparison project. First the datasets were processed, so all data was converted into numbers to make it easier to work with. Then the model was coded, tested, and trained on different data combinations. After the classification metrics were recorded and compared. Data thus far support the hypothesis.Abnormal splicing may result in abnormal mRNA, leading to mutated protein functions. Predicting the sequences of splice isoforms makes it easier to identify potentially harmful spliced sequences and create targeted therapies to treat diseases caused by such isoforms, such as cancer.

Amity High School

Teacher: Catherine Piscitelli

Project # 18

Anwer, Eshal

Determining if the Functioning of the Brain During Rest Impacts its Function During the Succeeding Tasks in Individuals with OCD

Completed Project, Science, Health & Medical

The human brain has a default mode network interference (DMN-i), a three way model network that assists in organizing information, engagement of the external environment, and change between rest and when a task is performed. It's been researched that individuals with obsessive-compulsive disorder (OCD) have impaired DMN-i coordination, affecting their performance from rest to task. The purpose of this project was to determine if the functioning of the brain during rest impacts its function during the succeeding tasks in OCD patients. It was hypothesized that if impaired DMN-i is documented in people with OCD, it would explain difficulties with executive functioning in OCD because of their correlation. The independent variable was the brain functioning during rest and the dependent variable was the performance of the succeeding tasks. 22 healthy controls (individuals without OCD) and 20 individuals with OCD were tested. All participants had fMRI imaging before and after they performed a task from the Risk and Ambiguity test. After data collection, a software called QuNex preprocessed it and a neuroimaging tool called HPC workbench mapped neuroimaging data. The mentor previously collected the data and fMRI imaging while the student was responsible for data analyzing and modeling. Data from the experimental group was compared to the control group of individuals without OCD. Data thus far supports the hypothesis that individuals with OCD have impairment and less connectivity in their DMN-i. Findings of this project could assist in informing about the impaired rest to task process in individuals with OCD.

Amity High School

Teacher: Catherine Piscitelli

Project # 19

Bahel, Piyush

Optimizing an Inductive Stent to Determine Optimal Dimensions for Detecting Restenosis

Completed Project, Science, Health & Medical

One in four people who undergo angioplasty, the unblocking of a vessel such as a coronary artery, have restenosis, a condition where the stented artery from stent implantation narrows again. Treatment is only possible after discovery which typically happens when patients experience severe symptoms To tackle this problem, a stent that can relay to the doctor the condition of the stented area is needed to detect restenosis before the condition worsens. Therefore, the purpose of this project is to optimize an inductive stent to determine the best dimensions for an inductive stent in blood at body temperature. To do this, the final stent design, developed in last year's project which focused on developing the inductive stent and verifying its structural integrity was optimized. The mentor continued to provide guidance throughout the project. The inductive stent was optimized using SOLIDWORKS, by evaluating all ring connector combinations, to find the strongest combination for the inductive stent. Also, the optimization procedures in SOLIDWORKS determined the strongest dimensions for the stent. Finally, the optimized model was simulated and a FOS plot was defined. Results thus far support the creation of a fully optimized inductive stent. The implications of this project are that it develops an optimized inductive stent, which helps patients post stent implantation know if the stented area is narrowing again and it provides confidence to doctors when keeping track of their patients health since this is a fully optimized device.

Amity High School

Teacher: Catherine Piscitelli

Project # 20

Cardamone, Beatrice

Transmissible Spongiform Encephalopathies: A Possible Treatment

Research Proposal, Science, Health Research Proposal

Transmissible Spongiform Encephalopathies (TSE's), or Prion Diseases, are neurodegenerative diseases, about which we know very little. They seem to be associated with a type of protein, called the prion protein (PrP) and its malformation, the scrapie prion protein (PrPsc). These diseases are always fatal, and there are, in essence, no treatments available. Within the last decade, we have, however, made significant strides in understanding their pathology. Based on this, several things have been tested as possible treatments, but none have produced considerable results. These previous ideas have all revolved around what is called the Prion Only Hypothesis, which states that the malformed prion protein is the infectious particle in TSE's, and there is therefore no genetic component. Over the years, there have been mounting studies seeming to contradict this idea. My goal is to, by analyzing available data, propose a new kind of treatment, which may, in the future, help TSE patients live longer.

Newtown High School

Teacher: Timothy DeJulio

Project # 21

Cavallaro, Grace

Determining the Effect of Umbilical Cord Size and the Time it Takes to Process Each Cord on Usability and Number of Hematopoietic Stem Cells Available for Transplantation

Completed Project, Science, Health & Medical

Hematopoietic Stem Cells (HSCs) are immature cells that will eventually turn into blood cells. To repopulate these cells in cancer patients, physicians turn to bone marrow transplants, or, as a result of more recent research, umbilical cord blood, which contains HSCs. The purpose of this project is to determine the criteria for whether or not umbilical cord samples can be used for hematopoietic stem cell transplantations. The hypothesis is that if one umbilical cord sample is larger than another, then it will be more likely to be usable, and there will be more HSCs available for use. Also, if an umbilical cord sample takes less time to process than another, then it will be more likely to be usable. The independent variable is the various data regarding each of the samples, including mass, volume, date collected, and date processed. The dependent variables are both the usability of the samples and the number of HSCs collected from each sample. The methods began with compiling many years' worth of data into spreadsheets specific to each topic being analyzed (mass, volume, etc.) and running it through statistical analysis in order to explain its significance. Data thus far supports the hypothesis. This project creates criteria for whether or not an umbilical cord is a good candidate for further use after the sample is taken, which could make the process of saving the cords more efficient not only for scientists conducting research but potentially also for patients who may need a transplant.

Amity High School

Teacher: Catherine Piscitelli

Project # 22

Withdrawn

Project # 23

Dalle Mule, Angelina

Efficacy of BeCare MS Virtual Tracking System in Quantifying Symptoms of Multiple Sclerosis

Completed Project, Science, Health & Medical

Multiple Sclerosis (MS) is an autoimmune disorder of the central nervous system (CNS) that currently impacts an estimated 2.3 million people worldwide. MS can be relapsing-remitting or steadily progressing, with symptoms such as fatigue, muscle spasms, and memory problems. While there is currently no cure for MS, telehealth is a recent option for the tracking of symptoms that can aid in treatment regimes. BeCare MS, a remote patient monitoring platform, aims to facilitate symptom tracking and communication for patients by using self-led games to quantify symptoms. These games each correlate with a different aspect of the current standard for MS symptom quantification, the Expanded Disability Status Scale (EDSS). Participants were asked to complete the activities in BeCare MS and then rate how they performed within each game on a scale of 1-10. The purpose of this study was to compare the accuracy of BeCare MS against how participants felt they performed. The results (n=120) were analyzed using KDE plots and regression through Python and Excel. There was no correlation between in-app results and survey responses (r=0.0632). Survey responses showed participants rated themselves higher than in-app results indicated. The outcomes suggest a cognitive bias may have been involved in the disparity between survey responses and in-app results. It remains to be determined if cognitive bias such as the overconfidence effect influences self-rating scores.

Darien High School

Teacher: David Lewis

Project # 24

Dillon, Avery

Determining Whether or Not Using Certain Exercises in Physical Therapy will be More Effective

Completed Project, Science, Health & Medical

Physical therapists use a variety of exercises to try to encourage a normal range of motion and strength gain after an injury. The purpose of this project was to determine whether or not using certain exercises in physical therapy would be more effective. The independent variable in this study was the type of exercise. The quantitative dependent variable was the recovery time of the patient and the qualitative dependent variable was the pain and soreness levels after and during activity. The mentor, Michael Dow, allowed the student to shadow physical therapists in order to collect the data that the student needs. This data consisted of patients from the age ranges of 30-65 years old, including both genders, for lower extremity injuries. He also assisted the student through data analysis to make sure the data was processed correctly. The student put the data into different rows for each exercise. Then the student put different weeks of recovery (out of 6 weeks) in columns and also wrote down within these columns the progress being made (slower than normal, quicker, regular). The data was analyzed in order to determine the differences in recovery time based on different exercises. This project could help make advancements in physical therapy by determining if using exercises differently could help patients. The data thus far shows a correlation between the types of exercises used and the length of recovery time.

Amity High School

Teacher: Catherine Piscitelli

Project # 25

Fitzgerald, Cora

Comparing Lipid Nanoparticle Delivery with Electroporation for Crispr Delivery

Completed Project, Science, Health & Medical

CRISPR-Cas9 is a new tool to treat incurable diseases. But, its application in cancer treatment has been hindered by low editing efficiency in the tumors, and the potential toxicity of delivery systems. The PCSK9, Apolipoprotein C3, and PLK1 genes are all present in the liver and are considered oncogenes. Finding the most targetable oncogene to use CRISPR, and the right delivery system will increase editing efficiency, and help treat diseases. Electroporation is a delivery method that uses an electrical pulse to pass nucleic acids into cells. It is the most common delivery system for CRISPR but has shown low editing efficiency in the liver. I propose an analysis of various delivery systems to multiple genes involved in the growth of liver cancer. The first step I would take is to collect data on experiments using Electroportation, Lipid Nanoparticles, and Polymeric nanoparticles on Hepatic genes. I would conslidate the data, and come to a conclusion about the best combination for CRISPR. I would do further research on the genes and delivery systems' functions to back up my conclusions. I would expect Lipid nanoparticles delivering to the PLK1 gene to have the highest editing efficiency. This is due to LNPs nontoxic and potent transfection. The PLK1 will be the best gene to target. Its vital role in mitosis makes it common for overexpression and will have the greatest impact if made curable. The implications of successful use of CRISPR in the liver could treat, and even cure liver cancers.

Ridgefield High School

Teacher: Patrick Hughes

Project # 26

Garg, Adi

Using Neural Networks to Predict Effects of Genetic Mutation

Completed Project, Science, Health & Medical

In order to increase the efficiency of genome sequencing projects, accurate methods to predict damaging genetic variants are necessary. With the widespread availability of human genome datasets involving large populations and advancements in the fields of machine learning and neural network development, the creation of such computational models has become much simpler. However, despite this progress, most models fail to produce accurate predictions, as based on comparisons with data from cell experiments, where genetic missense variants are labeled with scores based on cell fluorescence when exposed to certain chemical agents. Additionally, while some models exist whose predictions achieve greater accuracy, their consistency across different genomes is limited. The thresholds of output scores for damaging versus benign variants remain wildly different from gene to gene. Thus, an important task is to develop 1) A model which outputs scores with consistent 'cutoff' thresholds across different genes, and 2) A method to evaluate consistency across genes. Due to its simplicity and efficiency in Big Data projects, the Python programming language will be used to perform statistical analysis on existing models' predictions, as well as to develop a new model. With a new model to display consistent results across different genes, genetic disease analysis will become significantly easier, since broad spectrum approaches can be taken to analyze various genes and their contribution to certain diseases, without wasting time to look at a model's individual outputs for each gene.

Weston High School

Teacher: Christopher Gamble

Project # 27

Gupta, Aditi

Assessing the Impact of Synthetic Sweeteners on Hunger Perception in Drosophila Melanogaster

Completed Project, Science, Health & Medical

The consumption of natural sugars leads to the stimulation of neurological reward pathways in the mesolimbic dopamine system. The chemical composition of natural sugars allows these pathways to be fully activated. Artificial sugars, a modern alternative to natural sugars, are unable to fully activate reward pathways like real sugars are. Because of this, consuming artificial could prevent one from recognizing fullness, leading to an increase in consumption in an attempt to activate the reward pathway fully. Prior research has demonstrated a correlation between the consumption of synthetic sweeteners and weight gain. This research will determine whether there is a connection between consuming three different synthetic sweeteners and increased consumption of food when compared to sucrose, a natural sweetener. Four groups of eight Drosophila Melanogaster were fed either a control 3M sucrose solution, a 5% sucralose solution, a 5% aspartame solution, or a 5% acesulfame-potassium solution. Flies were monitored over a period of either 1 or 3 days, and their food consumption was measured using the Capillary Feeder Assay. Based on the preliminary analysis, Drosophila Melanogaster are consuming up to three times as much of the synthetic sweeteners as they are the pure sucrose solution. The final statistical analysis has not been completed. Synthetic sweeteners are currently implemented into weight loss plans and diets. Viewed as "healthy alternatives" to sugars by many, they are prevalent in commonly consumed foods. This research aims to shed more light on the harmful impact of artificial sweeteners on the brain and body.

Ridgefield High School

Teacher: Patrick Hughes

Project # 28

Horn, Avery

Utilization of Decellularized Spinach as a Vascular Perfusion System for Organoid Development

Completed Project, Science, Health & Medical

Organoids are powerful tools of research that can accurately replicate a human organ or tissue in a 3D in vitro form. However, organoids can only reach a certain size before the center becomes necrotic, causing the cells to undergo apoptosis. Therefore, a method is needed to vascularize organoids, allowing sufficient nutrients and oxygen to reach the cells. Previous methods have been time consuming and expensive. This study used decellularized spinach, seeded with endothelial cells to create a viable vascular perfusion system for future studies to maintain organoids. This study sought to examine how endothelial cell lines survive and behave when seeded on the surface and perfused through the vasculature of decellularized spinach leaves. To determine whether endothelial cells could survive on decellularized spinach, endothelial cell lines were seeded on spinach in a well plate and were monitored using a live cell dye. Human microvascular endothelial cells were perfused through the vasculature of the decellularized spinach, and were imaged using immunohistochemistry. The results demonstrated that endothelial cells were able to survive and become confluent both on top of the decellularized spinach, and inside the microvasculature. This result is important because it affirms the potential for ornate vasculature development once the organoids are seeded, allowing them to be maintained for research. Utilizing spinach leaves for organoid maintenance is efficient, eco-friendly, and accessible. Optimizing organoid models are important for therapeutic development and may eliminate some of the need for animal testing, creating a more ethical, accurate and viable option for biological research.

Darien High School

Teacher: David Lewis

Project # 29

Krauss, Rachel

Effects of Evolution on Protein CCR5 From Ancient to Modern Humans

Completed Project, Science, Health & Medical

How can patterns of mutations from ancient Homosapien DNA to modern human DNA help identify a new potential avenue to use gene therapy to less or eliminate the effects of the HIV-1 virus in modern day humans. Genes will be collected from the Maxwell Planck Institut Neanderthal genome project and the human genes from the Human genome workbench program. The Neanderthal genome that is being used is the Vindija Neanderthal genome. Both of these are public information and can be used by anyone. This will be the first chance to look for the alignment between the two gene sequences for the optimal ailment between the two sequences. Then the two sequences will be put into the BLAST program to find the best optimal alignment based on the score produced. This process will inform whether or not the two sequences of the Neanderthal and Modern Human DNA are evolutionary or functionally related to each other based on their similarity. There can be more than one optimal alignment they will then be compared. This will be to see if any patterns in what parts of the gene sequence continually stayed the same or what parts were the ones that changed in each best alignment. These patterns will then be analyzed more deeply, finding the septic purpose of that single section along with possible reasons that they continued through the evolution of the human genome of mutants, giving rise to the possibility of better or worse adaptive abilities.

Newtown High School

Teacher: Timothy DeJulio

Project # 30

Levine, Emma

The Effect of Pet Allergens on Asthma

Completed Project, Science, Health & Medical

Millions of people around the world are effected by asthma and allergens. Some of most potent of these allergens are given off my domestic animals, and are proven to cause respiratory problems in pet owners. The following research consists of a survey sent out to ENT patients with asthma and possibly other medication conditions. After patients answer they survey, the data is graphed and assessed to see if there is a significant correlation between the severity of asthma and the severity of allergens. If the connection holds true, further research will be conducted to see if there is a way to limit pets from producing and releasing potent allergens. For example, the feline protein Fel d 1, mostly responsible for the potency of cat allergens, could be removed from cats' DNA using CRISPR technology.

Ridgefield High School

Teacher: Ryan Gleason

Project # 31

Liu, Sophia

Determining the Effectiveness of Replica Exchange Molecular Dynamics in Predicting Protein Stability for Villin HP-35 Mutants

Completed Project, Science, Health & Medical

Protein mutations can lead to changes in stability and cause illnesses such as Alzheimer's disease. Computer simulations/models are in the process of being developed to replace costly experimental methods as a more efficient way of studying protein stability. Replica Exchange Molecular Dynamics (REMD) is one computational model that is particularly cutting-edge. The purpose of this project is to determine how accurately REMD can predict changes in protein stability after mutation. The hypothesis is that REMD can predict changes in protein stability accurately. The independent variable is the method used to predict protein stability. The dependent variable is accuracy of stability predictions. There is no control because this is a comparison study. The model proteins used in this study were four Villin HP-35 mutants. For each mutant, melting temperature—a measure of protein stability—was determined using experimental and computational methods. For the experimental method, melting temperatures were found online in previously done studies; for the simulations, new data was collected. REMD was run through Yale's high performance computer using the GROMACS software. REMD outputs a list of protein structures for a range of temperatures, which were used to calculate the melting temperature of the protein. Statistical tests were performed to examine how experimental and computational measures of protein stability compare. Preliminary conclusions support the hypothesis. This study helps to gain a better understanding of the accuracy of REMD, allowing scientists to better study diseases related to the misfolding of proteins and bolstering our knowledge of how organisms function.

Amity High School

Teacher: Catherine Piscitelli

Project # 32

Nair, Shreya

Determining whether Age and the Ki-67 Proliferation Level of ER-positive, HER2-negative Breast Cancer Patients are Predictors of Future Adjuvant Chemotherapeutic Intervention

Completed Project, Science, Health & Medical

Breast cancer is the second leading cause of death from cancer in women. One type, ER-positive, HER2-negative breast cancer,occurs due to a somatic gene mutation. The Ki-67 Proliferation Index (PI) level demonstrates diagnostic and prognostic functions, by quantifying the cancer's proliferative activity. The purpose of this research was to determine whether the ER-positive, HER2-negative breast cancer patient's Ki-67 PI level (%) and age is a predictor for the need for future chemotherapeutic intervention. It was hypothesized that if the ER-positive, HER2-negative breast cancer patient's Ki-67 PI (%) is ≥ 14%, then the patient will need future chemotherapeutic intervention. The independent variable was whether the patients received chemotherapy or not. The dependent variable was the Ki-67 PI level (%) of each patient and their age. Out of 120 patients, the patients who met the criteria were divided into two groups: patients who did receive chemotherapy (Group C) and patients who did not receive chemotherapy (XC). Each patient's surgical pathology report was analyzed and Ki-67 PI level (%) was recorded as well as patient age. The patients with a Ki-67 PI (%) of ≥ 14% were labeled as "high proliferation rate" (HPR) and patients with < 14% were labeled as "low proliferation rate" (LPR) Then, the average Ki-67 PI level (%) of both groups; C (HPR & LPR) and XC (HPR and LPR) was determined. The data trends thus far support the hypothesis. These findings can be used by surgical oncologists to construct and provide a more complete consultation, including if chemotherapy will be required for patient treatment.

Amity High School

Teacher: Catherine Piscitelli

Project # 33

Noujaim, Sophie

Determining a Correlation Between Oral Contraceptive Use and Development of Different Types of Leukemia

Completed Project, Science, Health & Medical

Determining a Correlation Between Oral Contraceptive Use and Development of Different Types of Leukemia There are four main types of Leukemia; AML, ALL, CLL, and CML. In females, studies have shown that increased androgens cause a lower chance of being diagnosed with CLL, and an increased survival rate if a patient develops CLL. The purpose of this study is to determine the relationship between oral contraceptive use and diagnosis of different types of Leukemia. It is hypothesized that if the subject has taken combination oral hormonal contraceptives, they will have a higher chance of being diagnosed with CLL and AML because combination oral hormonal contraceptives have the highest potency of both estrogen and progesterone. The independent variable of this study is what type of oral hormonal contraceptives the patients have utilized, the time period in which they used the contraceptive, and the time between the contraceptive use and their diagnosis of Leukemia. The dependent variable of this study is the development and type of leukemia within Leukemia patients. The control of this study is Leukemia patients that have not taken oral hormonal contraceptives. Data will be collected using a database. The data between the control and experimental groups will be compared to observe if there is a relationship between certain oral hormonal contraceptives and certain types of leukemia. If the conclusion of this study supports the original hypothesis, it can help females that are looking to start taking oral hormonal contraceptives know which is safest to take and what the possible side effects of them are.

Amity High School

Teacher: Catherine Piscitelli

Project # 34

Persily, Benjamin

High G/C Content at the 3' End of the Spacer of Prime Editing Guide RNAs Results in Increased Editing Efficiencies

Completed Project, Science, Health & Medical

Prime editing is an extremely powerful and versatile gene-editing tool that is safer than the well known CRISPR/Cas9 system. This increased safety is due to the employment of single-stranded breaks of the DNA, as opposed to double stranded breaks, resulting in fewer off-target mutations, and thus, increased safety. Using prime editing, I targeted SOX2, an essential marker of pluripotency that is highly expressed in stem cells, to optimize the design of the prime editing guide RNAs (pegRNAs), an essential component of prime editing. Using a fluorescent SOX2 tdTomato-TGA insert as a readout through flow cytometry, we saw high editing efficiency in two of the targets, and we were able to identify a pattern among the spacers that led to increased efficiency, namely high G/C content at the 3' end of the spacers was present in the two highest performing pegRNAs, while high G/C content at the 5' end of the spacer was present in the poorest performing pegRNA. Interestingly, the addition of a single guide RNA did not result in an increase of editing efficiency. The optimization of prime editing in stem cells holds incredible potential for correcting almost any genetic disorder, as prime editing provides a safe method for correcting nearly any deleterious mutations, and stem cells provide an easy, controllable method for obtaining any, patient-specific, cell type. Thus, by combining and perfecting these technologies, patient stem cells could be corrected and reintroduced into the patient to treat - and hopefully ameliorate - almost any genetic condition.

King School

Teacher: Victoria Schulman

Project # 35

Podila, Kavya

Examining the Characteristics of Residual Pancreatic Cells and Islets in Type 1 Diabetes

Completed Project, Science, Health & Medical

Type 1 Diabetes (T1D) is characterized by the autoimmune destruction of pancreatic beta cells. There is a lack of knowledge on the progression of beta cell destruction in diabetics and the impacts of the disease on other pancreatic cells. The purpose of this experiment is to assess the distribution and hormonal composition of pancreatic cells and multicellular islets in Type 1 Diabetes. Slide images were digitally accessed through nPOD, a digital biorepository of pancreatic tissue. 15 images total were analyzed from Non-diabetic, Autoantibody+, and Diabetic, de-identified donors. Using the bioimage analysis software QuPath, cells were manually quantified for insulin, glucagon, somatostatin, and pancreatic-polypeptide positivity. Islets were manually quantified and categorized by insulin+/glucagon-, insulin+/glucagon+, and insulin-. Results from the experiment will broaden the field's understanding of the survival of pancreatic endocrine cells through the progression of T1D. One possible outcome is beta cell count will be greater in pancreatic samples from autoantibody+ donors than in samples from T1D-positive donors. This is predicted because the autoantibodies serve as a biomarker of T1D progression and may have been actively destroying beta cells but may not destroy enough for the patient to be diagnosed with diabetes. Data collected from donors who are autoantibody+ will reveal "at-risk" qualities of the pancreas and help in the early identification of Type 1 diabetics. Furthermore, glucagon+ and somatostatin+ cells have been known to transdifferentiate into beta cells; if the data shows those cells are surviving in large quantities, T1D treatments could focus on encouraging transdifferentiation.

Ridgefield High School

Teacher: Patrick Hughes

Project # 36

Raissi, Dariush

Determining Which Mutation in the Amino Acid Sequence of Papain-Like Protease Proteins of the SARS-CoV-2 Virus Leads to Changes in the Protein's Structure and Function

Completed Project, Science, Health & Medical

COVID-19, or SARS-CoV-2, is a worldwide pandemic that can mutate, leading to many different variants. A protein found in the COVID-19 virus is the Papain-Like Proteinase (PLpro). PLpro breaks the peptide bonds between the amino acid's viral polyproteins (smaller proteins conjoined with covalent bonds). By cutting off specific portions of other proteins, PLpro can activate and inactivate them. I focused on the Np3 The purpose of this project was to find which mutations (insertion, deletion, and substitution) in the gene encoding Papain-Like Protease affect the protein's structure and the consequences of those mutations. The independent variable was the different mutations found in the proteins. The dependent variables were the changes in protein structure and changes in the function of the protein. Newly identified genome mutation sequences were compared to the reference sequence using multiple sequence alignment tools such as CLUSTAL X or SnapGene. The sequences of genes encoding the Papain-Like Proteinase of different COVID-19 variants were put into a program that shows insertions, deletions, and substitutions. After comparing the amino-acid sequences, the sequences were inserted into another website which created a 3D representation of the protein and mapped out changes in the protein structure. Then, along with the mentor’s help, the visual representations of the protein were assessed to determine what consequences come from mutations. Data trends thus far have been inconclusive. This project showed what mutations that occur in the PLpro have the greatest consequence on the protein's function.

Amity High School

Teacher: Catherine Piscitelli

Project # 37

Rubio, Maya

What are The Effects of Heavy Metals in Tattoo Inks on The Human Body?

Completed Project, Science, Health & Medical

Problem: The high consistency of heavy metals seen in tattoo inks and how they have been connected back to certain diseases in the body. Method: 1. Dissect a highly toxic tattoo brand looking into the components (a non FDA or EDA approved ink) 2. See what is in the tattoo ink that is not listed on the bottle 3. Compare this ink to others and different colors seeing if they have any similarities 4. Look into the effects that it has on the body and what might cause these effects. 5. Find an alternative to the toxic ink. Metals that are so far found in tattoo inks which are not FDA or EPA approved are Bornium(Br), Silicon(Si), Sulfur(S), Chlorine(Cl), Calcium(Ca), Titanium(Ti), Chromium(Cr), Iron(Fe), Nickel(Ni), Copper(Cu), Zinc(Zn). These metals have been proven and linked to skin cancer, hepatitis B and C, MRSA, Bacterial infections and much more. Findings and results: N/A Implications: Look into alternative inks for example: Organic inks and Temporary inks Look into the care and upkeep of tattoos in order to avoid infections/diseases.

Ridgefield High School

Teacher: Ryan Gleason

Project # 38

Sandhu, Gurshaan

How the Intensity of an Exercise Affects Cell-Mediated Immunity Through the Release of Anti-Inflammatory Cytokines

Completed Project, Science, Health & Medical

I believe that medium-intensity exercise would be the most beneficial in releasing anti-inflammatory cytokines and helping out the immune system because it releases more IL-6 proteins which boosts immunity to prevent diseases by building antibodies and sending out interleukin proteins. My methodology used was to research about the cytokines of IL-6, and how much they get released in different intensities of exercises. Then I collected data and compiled it to compare the amounts of IL-6 released in those different intensities of exercise. Then, the part comes to write the meta analysis and publish. The findings and results lead to medium intensity exercise being the most beneficial in releasing the most amount of cytokines. Implications are to find out which exercise impacts immunity most in the most beneficial way through the release of anti-inflammatory cytokines, and help medical fields on making medications and research.

Ridgefield High School

Teacher: Patrick Hughes

Project # 39

Sandmeier, Yuriy

Knockdown of the essential 23S rRNA methyltransferase, rv3579c, increases the susceptibility of Mycobacterium tuberculosis to macrolides

Completed Project, Science, Health & Medical

According to the Centers for Disease Control and Prevention (CDC), in 2018, roughly 1.7 billion people were infected with Mycobacterium tuberculosis (Mtb). To treat tuberculosis (TB) infections, there has been a long-standing interest in using macrolides, a family of drugs that includes clarithromycin and azithromycin (Z-pack), due to the fact that they are exceedingly safe and well-tolerated by most individuals. However, Mtb possesses intrinsic resistance to macrolides, generally rendering macrolide drugs ineffective at treating TB infections. The mechanistic basis for this resistance is little understood; thus, we aimed to determine whether there were additional factors responsible for this phenotype. Using homology-based methods, we ascertained that rv3579c was closely related to the rlmB family of methyltransferases found in E. coli. We then demonstrated the essentiality of rv3579c in M. smegmatis (a non-lethal model of Mtb) and later showed that, with genetic knockdown of rv3579c, Mtb becomes more susceptible to clarithromycin, thereby highlighting a mechanism that could potentially facilitate successful treatment and elimination of TB in affected individuals. Furthermore we determined that knockdown of rv3579c is bacteriostatic, and determined the minimum inhibitory concentration of 14 ribosome-targeting antibiotics in conjunction with knockdown of rv3579c. With these pivotal findings, we have laid the groundwork for further research to determine whether or not rv3579c can be targeted by chemical compounds to both inhibit Mtb growth and render the bacteria sensitive to macrolides. In the future, we aspire to use our findings to prevent the deaths and hospitalizations of countless millions of people.

King School

Teacher: Victoria Schulman

Project # 40

Subramanian, Mallika

Mechanism of action and effectiveness of essential oils from thyme and rosemary in combination against Escherichia coli-caused urinary tract infections

Completed Project, Science, Health & Medical

Antimicrobial resistance(AMR) is one of the largest healthcare emergencies today, with urinary tract infections(UTIs) caused by antibiotic-resistant uropathogenic Escherichia coli(E.coli) (UPEC) as a critical offender. The development of biofilms, matrices of UPEC, further complicate treatment. Antibiotics struggle to pierce the biofilm, leading to longer infections and antibiotic use, increasing AMR. Little has been done to identify UTI treatments which inhibit both bacterial and biofilm growth. Previous research demonstrates essential oils(EOs), especially T.zygis(thyme) and R.officinalis(rosemary) EOs, can combat bacterial growth as effectively as antibiotics, and inhibit biofilm growth. EO combinations have shown enhanced activity over individual EOs. T.zygis and R.officinalis EOs were previously tested on K-12 E.coli, and established a 90% T.zygis, 10% R.officinalis combination as the most effective to inhibit bacterial and biofilm activity. The antibacterial mechanism of T.zygis and R.officinalis EOs in combination has not yet been established. Agar disk diffusion evaluated antibacterial activity, a colony forming unit/mL assay measured antibiofilm activity, a membrane potential assay measured membrane polarity, and an RNA extraction assay measured levels of gene expression. 90% T.zygis, 10% R.officinalis had the highest antibacterial activity, membrane depolarization, and gene inhibition. 90% T.zygis, 10% R.officinalis and 60% T.zygis, 40% R.officinalis had the highest antibiofilm activities. 90% T.zygis, 10% R.officinalis was the most effective treatment overall. These results could indicate EO combinations for utilization in antibiotic-sparing treatments for UPEC-caused UTIs.

Staples High School

Teacher: Amy Parent

Project # 41

Verdejo, Samantha

The Effect of Music on the Growth Rate of Yeast

Completed Project, Science, Health & Medical

Yeast are single-celled microorganisms that convert sugar into energy and undergo fermentation. Fermentation occurs when yeast metabolizes starches and sugar to produce carbon dioxide and ethyl alcohol. Yeast helps to maintain digestive and immune systems in the human body. However, yeast often takes a long time to grow and produce carbon dioxide. A bacteria called bacillus carboniphilus, releases low-frequency sounds to increase the efficiency of colony formation of the yeast. Therefore, music can increase the growth rate of yeast since it replicates a similar effect as the bacteria. Using high frequency sounds and genres of music, like Indian Classical music, has shown to benefit the efficiency of yeast growth. The experiment tests the effect of low frequency sounds, high frequency sounds, Indian Classical music, and dubstep on the growth of yeast over 15 minutes. The effect of music on the yeast is measured by the height of a foam layer, representing the amount of carbon dioxide produced. The yeast should have the greatest amount of growth while either high frequency sounds or Indian Classical music is playing. Increasing the productivity of yeast growth can quicken fermentation processes in baking and alcohol industries. Beta-glucans can be retrieved from the cell walls of yeast which can be used to heal wounds and protect against invasions in the immune system. Discovering the ideal type of music or sound could quicken many fermentation processes and provide a quicker way to grow yeast so that it may be used for health benefits.

Ridgefield High School

Teacher: Ryan Gleason

Project # 42

Wijesekera, Aadya

Modifying a Talking Inhaler Device to Help Patients Improve Inhaler Technique

Completed Project, Science, Health & Medical

Asthma is a rising issue around the world, causing inflammation and narrowing of the airways. This leads to symptoms like wheezing, shortness of breath, and coughing. Oral medications, such as inhalers, are the most common type of treatment. Incorrect inhaler technique is one of the main contributors to uncontrolled asthma. The purpose of this year's project was to create a fully functional talking inhaler device and assess its impact on inhaler technique. An audio script was created by analyzing literature and was then uploaded to an MP3 module to allow the audio to play aloud. In order to create the audio script, literature was analyzed to assess the most important steps. Then, a 3D printer was used to construct a case to hold all the components. Following proof of concept, the device was tested to analyze its overall impact on inhaler technique. Subjects were introduced to inhaler technique via paper or verbal instructions and were assessed on inhaler technique before the instruction method and again after their selected instruction method. To be assessed, subjects were studied based on the number of critical steps they meet whilst demonstrating inhaler use. The results between the 2 situations will be compared. No medication will be present in the inhaler case as this project solely examines inhaler technique. In the future, this device could become a standard part of everyday and training inhalers in order to ensure better inhaler technique and could also be modified for other respiratory disorders such as COPD.

Amity High School

Teacher: Catherine Piscitelli

Project # 43

Yu, Hannah

Analysis of National Trend of Drug Overdose Deaths and Variabilities within States from 2015 to 2022 and Contributing Factors

Completed Project, Science, Health & Medical

Problem statement: The general trend of drug overdose deaths in the US shows steady increase from 2015 to 2017, stabilization between 2018 and 2019, and a sharp increase between 2020 and 2022 (CDC data). However, Massachusetts, New Hampshire, New Jersey, and Utah had significant lower increases in drug overdose deaths than the US average. This research examines differences of drug overdose deaths pre and post pandemic and factors contribute to the significant lower increase of drug overdose deaths in these four states. It also assesses correlation between investment in drug overdose prevention and drug overdose deaths and cost-benefit of drug overdose prevention. Methods: Statistics are used to examine differences of drug overdose deaths among US states. Mathematic methods are used to correlate investment in drug overdose prevention and drug overdose deaths and analyze cost-benefit of drug overdose prevention. Results: There are significant differences in % increase in drug overdose deaths between the US and Massachusetts, New Hampshire, New Jersey during the pandemic (e.g. drug overdose deaths in Massachusetts in 2020 increased only 6% vs. US average of 31%). Drug overdose prevention programs in MA, NH, NJ, and UT are key to reducing drug overdose deaths. Implications: Key factors contributing to drug overdose deaths during the pandemic can help reduce overdose deaths. Cost-benefit analysis of drug overdose prevention provides support for expanded drug overdose prevention programs.

Ridgefield High School

Teacher: Patrick Hughes

Project # 44

Zafar, Jasir

Analyzing the distribution of insertion, deletion, and substitution mutations in the gene encoding the Spike protein of COVID among the variants of concern.

Completed Project, Science, Health & Medical

COVID-19 is a CoronaVirus disease prone to genetic evolution that has caused the formation of many different variants. The Spike (S) glycoprotein is responsible for attaching to receptors in the human body and assists in virus invasion. A mutation is a change in the DNA sequence of an organism. The most common types of mutations are insertions, adding DNA, deletions, removing DNA, and substitutions, switching DNA sequences. Substitutions can be classified as synonymous, where the amino acids created, do not change and non-synonymous, where the amino acids created are different from the original. The purpose of this project was to determine the distribution of mutations in the Spike protein in COVID variants. The hypothesis was that non-synonymous mutations would be the most common type of mutation because they are a result of natural selection. Data trends thus far support the hypothesis. The independent variable was the SARS-CoV-2 strains. The dependent variables were the types and number of insertion, deletion, and substitution mutations. To complete this project newly identified genome sequences of different SARS-CoV-2 variants were collected from GenBank and aligned with a reference sequence using SnapGene. These programs identified different mutations within the variants. Statistical analysis was used to compare the frequency of mutation among the 3 different mutation groups. The student gathered and analyzed data and the mentor provided guidance. The results of this project help identify the most common types of mutations in COVID which can help future research on the virus and vaccine development.

Amity High School

Teacher: Catherine Piscitelli

Project # 45

Zhai, Scarlett

Determining the effect of the protein SAMP-1 on nuclear size in C. elegans embryos

Completed Project, Science, Health & Medical

Caenorhabditis elegans (C. elegans) is a transparent nematode that has many genes with functional counterparts in humans, making it a helpful model for human diseases. SAMP-1 is an important inner nuclear membrane protein that serves a variety of functions within the cell including formation/stabilization of the mitotic spindle and nuclear integrity maintenance. The purpose of this project was to determine how nuclear size is affected by SAMP-1. The control was the worms that do not have SAMP-1 altered. The mentor accomplished physical experimentation. N2 worms are the reference wild-type strain and are the primary worms used in labs. The phenotype of SAMP-1 depletion in the 1-cell stage embryos was characterized, i.e. how the SAMP-1 depleted embryos looked at their earliest stage of development and compared to the control. Data analysis of acquired images was conducted by the student using image analysis software ImageJ and Excel for statistical analysis of nuclear size in embryos with SAMP-1 depletion compared to normal SAMP-1 levels. Results thus far support that removing SAMP-1 from C. elegans will cause nuclei in embryos to shrink as both male and female pronuclei got smaller when SAMP-1 was removed and, compared to the control, there appeared to be minimal growth of nuclei during pronuclear migration with SAMP-1 depletion. Additionally, if control pronuclei are on average 8μm in diameter, silencing SAMP-1 caused nuclei to shrink to around 5μm in diameter. Studying how SAMP-1 contributes to nuclear size will help scientists understand how the nucleus maintains its size/physiology.

Amity High School

Teacher: Catherine Piscitelli

Project # 46

Arnold, Sadie

Determining the Effects of Air Quality in Hydropower Dams Regions on the Number and Severity of Area Asthma Cases

Completed Project, Science, Environmental

Studies have shown that hydropower dams release more C02 into the atmosphere than it saves. This is a result from it causing sediment starvation which causes trees and forests to die which release more C02 into the air. Fine airborne particulate matter, especially matter with a diameter of less than 2.5μm includes a diverse array of synthetic and naturally occurring substances, whose small size allows them to travel into the respiratory system. This particulate matter is made up of small dust, smoke particles, diesel exhaust particles, and other industrial by-products such as organic carbons, sulfate, nitrate ions, and various metals. Exposure to elevated levels of this matter can lead to both acute and chronic respiratory impairment which is known to be a link to asthma. Hydropower dams are a source of energy that use the force of water flowing in streams and rivers to produce mechanical energy. The purpose of this project was to determine the effects of air quality in hydropower dams regions on the number and severity of asthma cases. I collected data on the air quality and number of cases in these areas. After this data was acquired, I compared it and looked for correlations. It was found that hydropower dams do have a negative impact on the air quality and cause respiratory illness that worsen asthma. The finding of this project could be used to inform laws governing hydropower dam emissions as well as the informative of resistance living in communities with hydropower dams.

Amity High School

Teacher: Catherine Piscitelli

Project # 47

Bisset, Luke

Determining the Ideal Aquaculture Line Tension that Decreases Chance of Whale Entanglement

Completed Project, Science, Environmental

Aquaculture is the farming of aquatic organisms, such as fish and crustaceans, and is used throughout the world. Aquaculture gear includes the lines, nets, and buoys that aquaculture farms use. Entanglement in aquaculture gear causes the death of hundreds of thousands of marine mammals every year. One species that entanglement is severely harming is the right whale, an endangered whale native to the Atlantic. The purpose of this experiment is to determine the ideal aquaculture line tension that decreases the chance of whale entanglement. A device was made to test the effect of line tension on whale entanglement rates. A large tub of water was placed on the ground with a frame above it. This frame has a pulley on one end and a nail in the other. Line was tied to the nail and put onto the pulley so the line could move. Next, a weight was tied to the end of the fishing line, and the weight varied depending on which trial was being tested. This weight was placed into the tub until it almost touched the bottom. The end result is a line suspended in the tub of water under a specific tension. Next, a model whale attached to a stick was pushed into the line and underwent common maneuvers that a whale would do once it was entangled. For each maneuver there were 3 trials, and this was repeated for each weight. Findings thus far support the hypothesis.

Amity High School

Teacher: Catherine Piscitelli

Project # 48

Cappella, Tabitha

The Effects of Plastic Mulch Pollution on Agricultural Ecosystems

Completed Project, Science, Environmental

The pollution derived from the use of plastic mulch within terrestrial agricultural communities is increasingly relevant within the scientific community; however, intensely under-researched. Plastic mulch is a sheet of high-density polyethylene (PE), the most commonly produced plastic worldwide, with the primary purpose of increasing soil water-holding capacity and regulating soil temperature. Despite the multitude of studies on microplastic in marine ecosystems, the relationship between the parts of these ecosystems lacks understanding of their impact on the environment. Previous studies have identified a correlation between the use of plastic mulch and favorable growth conditions; however, with improper use and disposal, there is a high risk of creating macro and micro-plastic pollution, in the long-term damaging farmlands. An increase in data and knowledge in this field would allow agricultural industries to make informed decisions about their use of plastic mulching and proper disposal actions. In this study, sweet corn Zea Mays Convar, common earthworms Lumbricus Terrestris, and soil are combined in a simulated mesocosm experiment with the addition of plastic mulch on the soil and fragmented microplastics derived from plastic mulch combined with the soil in one of the two, while the other potting section is absent of plastic pollution. To measure changes in the ecosystem, soil testing is performed on the soil in these experiments, finding the changes in pH, nitrate levels, potassium levels, and phosphorus levels. As these levels change with the growth of the sweet corn, they reflect the influence of pollution the impacts on larger agricultural farmlands.

Weston High School

Teacher: Christopher Gamble

Project # 49

Chauhan, Maya

Is the Initial Therapy Session Better to Be Done Online Or In-person?

Completed Project, Science, Environmental

This project will include surveying professional therapists about the environments they provide for their patients and whether they think the initial meeting is better to be in-person or online. Online therapy is becoming more popular, especially after COViD. It is important to still have the similar patient to therapist connection, which might be better obtained if the therapist and patient meet in person for the first session.

Ridgefield High School

Teacher: Patrick Hughes

Project # 50

Chen, Rebecca

Determining The Best Chemical Nutrient Remediation To Reduce Phosphorus Levels and Algae Within Lakes

Completed Project, Science, Environmental

Nutrient pollution can be found within bodies of water and is caused by an excessive amount of phosphorus and nitrogen. This overabundance of nutrients causes eutrophication to occur, which reduces the amount of oxygen in the water, leading to dead zones and severe illness to organisms. The purpose of this experiment was determining the best chemical nutrient remediation to reduce phosphorus levels and algal blooms within fresh bodies of water. I hypothesized the combination of Phoslock, activated charcoal, and hydrogen peroxide will be the most effective in reducing phosphorus levels and reducing algae.The experiment began with collecting several samples of pond water. Each material was tested in their target concentrations, except for the control group which did not receive any treatment. The first three samples of water received a nutrient remediation of Phoslock, activated charcoal, and hydrogen peroxide tested by themselves. Three more trials were tested in the combinations of Phoslock and activated charcoal, Phoslock and hydrogen peroxide, and hydrogen peroxide and activated charcoal. The last trial had all three materials combined into one sample of water. Three trials of each experimental group were tested. Each sample of water was left for eight weeks while being tested weekly for phosphorus levels. Constants included the amount of water, water from the same pond, the environment where the water was stored, and the same phosphate test. Results thus far support the hypothesis. Determining the most effective nutrient remediation will help many aquatic organisms who suffer from deoxygenation in freshwater ecosystems.

Amity High School

Teacher: Catherine Piscitelli

Project # 51

Florio, Lia

The effect of material (Phragmites australis vs. bamboo tubes) on mason bee nesting habits

Completed Project, Science, Environmental

1. Mason bee populations have been stricken with pesticides and pests, and this fragile population requires rehabilitation. 2. This experiment will consist of 3 trials comparing the abundance of bees nesting in wooden mason bee homes versus homes made of natural phragmites reeds. The quantity of mason bee cocoons laid in each home will be counted at the end of the season. 3. If the results indicate a larger or equal abundance of mason bee cocoons in homes made of Phragmites australis, building mason bee homes can become more popular and economically efficient because people can build homes with phragmites instead of purchasing expensive nesting material from the store.

Ridgefield High School

Teacher: Ryan Gleason

Project # 52

He, Angela

Determining the Relationship between Historical Redlining and Urban Heat Protection in Connecticut Cities

Completed Project, Science, Environmental

Redlining was a practice that ranked areas based on the profitability of developing new infrastructure in them. Though no longer used, its effects can be seen through modern issues such as urban heat, which occurs in urban areas due to heat retaining surfaces such as pavement and buildings. The purpose was to create case study portraits of heavily and less heavily redlined Connecticut cities and compare them in order to determine the variability of protection against urban heat on the sub-state scale. The independent variable was the amount of historical redlining within a city, and the dependent variable was the presence and impact of urban heat. Public data was used for the quantitative analysis of six Connecticut cities, and local news sources from each of these cities was used for qualitative analysis. These cities were split into groups of heavily redlined cities (New Haven, Waterbury, and Hartford) and less heavily redlined cities (Stamford, Darien, and New Canaan). Data was collected and organized into portraits of each city using the Access model, covering human, social, physical, financial, and natural capital. Then, a keyword search was conducted on local news sources to understand and compare perceptions and discourse of heat and risk within each city. Analyzing the variability of protection against urban heat on the sub-state scale may reveal that the impacts of redlining, despite their presence across the US, are not predictable, suggesting that standardized federal policies and solutions will not have the same effectiveness in individual areas.

Amity High School

Teacher: Catherine Piscitelli

Project # 53

Hofstatter, Gregory

Examining the Effects of Urbanization on the Choruses of Spring Peepers

Completed Project, Science, Environmental

Urbanization has been shown to have an effect on the habitats in which spring peepers live (vernal pool, ponds, etc). Effects of high traffic noise and increased salinity, which are known 'symptoms' of urbanization, have also shown to have an effect on the chrouses of spring peepers. The purpose of this research was to identify the effects of urbanization on the choruses of Spring Peepers. The hypothesis of this project was that urbanization has an impact on the choruses of spring peepers, as previous research has pointed in this direction. The independent variable of this project was the level of urbanization (Rural vs Suburban vs Urban) in a given habitat. The dependent variable was call intensity. Call intensity was rated on a scale of 1-3, where 1 represents infrequent calling and a small number of individuals and 3 represents a full, constant, and overlapping chorus. Data was taken from the FrogWatch database, a collection of Spring Peeper recording data from across the Eastern United States. Data was organized into a spreadsheet, cleaned, and analyzed. Data thus far has suggested that the level of urbanization does affect the choruses of Spring Peepers. The mentor had an advisory role. This project could help us better understand how increasing levels of urbanization can affect spring peepers, which can lend insight into how other amphibians, or other animals in general, are affected.

Amity High School

Teacher: Catherine Piscitelli

Project # 54

Kemp, Charlotte

Assessing Neighborhood Layout for Wildfire Damage Prevention

Completed Project, Science, Environmental

Wildfires have become more frequent and intense in recent years. Humans are expanding into wildland, forming a vulnerable intersection called the Wildland Urban Interface. As the Wildland Urban Interface grows, more people are at risk of wildfire damage to their homes. This study assesses types of neighborhood layouts (curvilinear, radial grid, grid) for their impact on preventing wildfire damage. To do this, the study looked at neighborhoods within the perimeter of 5 wildfires in California from 2017-2019. Google Earth archives were utilized to compare satellite images before and after the wildfire to count how many homes were completely damaged. After, surrounding factors including the median age, average income, altitude, and road density were collected. For every fire, we were able to conclude that homes in more curvilinear neighborhoods had a greater risk of wildfire damage. This can be attributed to increased connectivity, greater road area, and the weakening of perpendicular winds. This research can be used for planners working in the wildland urban interface for making homes more resilient.

Ridgefield High School

Teacher: Ryan Gleason

Project # 55

Kolb, Antonia

Environmental Remediation via Photocatalysis for Partial Methane Oxidation and Oil Photodegradation

Completed Project, Science, Environmental

Methane is a highly potent greenhouse gas, and its emissions have been accelerating rapidly. Methane can be a large source of energy, but it is still challenging to harness and utilize. This project aims to improve the oxidation of methane to CO2 to aid in our understanding of photocatalytic methane oxidation. Although not ideal, converting methane to CO2 is still highly beneficial for the environment because CO2 is less potent than methane. Current methods of methane oxidation are not scalable and are energy-intensive, but this novel reactor design solves these issues by powering the reaction through blue LEDs. Utilizing a catalyst system consisting of photo absorber GaP and CdS, protective coating (Ti,Mn)4:1OX, and co-catalysts Pd Ag, there was ~2% conversion of methane to CO2. This ~2% conversion represents significant progress in removing a highly potent greenhouse gas from the atmosphere. Similarly, this photocatalytic hydrocarbon oxidation for removing environmental pollutants can be extended to an application in oil spill removal. The implementation of photocatalysis-driven hydrocarbon oxidation nanotechnology, such as CuO nanosheets functionalized with paramagnetic magnetite (Fe3O4) nanoparticles, provide a non-toxic approach to oil spill removal. This novel method is a viable alternative to current mitigation techniques because the volume of oil spills is cost-prohibitive for many removal techniques. This system is specially designed to be environmentally friendly using non-toxic nanocatalysts CuO nanosheets for oil oxidation co-functionalized with Fe3O4 nanoparticles. The incorporation of the Fe3O4 magnetic core allows for facile particle collection with a magnet post-reaction.

King School

Teacher: Victoria Schulman

Project # 56

Krishnan, Gouri

The use of NMR to identify the LOD in mixtures of organic compounds to efficiently produce environmentally friendly biomass polymers & reduce energy loss from wasted plastic

Completed Project, Science, Environmental

As greenhouse gas emissions from wasted energy continue to increase the effects of global warming and climate change, the issue of wasted energy has come to the forefront of research. Not only are buildings spending quadrillions of BTUs of energy only to use a small percentage of that energy, but also over 44 million tons of plastic end up in US landfills every year, causing extreme environmental damage and sequestering large amounts of unusable energy in plastic bonds. Attempts to mitigate this problem through the creation of environmentally friendly plastics from biomass are often slow and inefficient. We aimed to streamline this process via nuclear magnetic resonance (NMR) spectroscopy, testing a model system of organic compounds that could possibly be used as sustainable plastic polymer precursors. NMR was performed on combinations of acetophenone and 1-phenylethanol at different concentrations to identify the detection limit in these mixtures. This information will allow for successful quantification of products formed and determination of conversion rates. We identified a detection limit between 1-7 mM of acetophenone, significantly lower than the initial detection range of 1-100 mM. With further experimentation, we hope to narrow this detection limit further, obtaining an accuracy within 1 mM. As conversion rates are directly proportional to the success of sustainable polymer precursor formation, this approach aims to minimize time, cost, and energy wastage through indirectly increasing the efficiency of sustainable polymer production that, when scaled up, could potentially replace fossil fuels entirely.

King School

Teacher: Victoria Schulman

Project # 57

Lee, Ian

Determining the Best Strength of a Magnetic Field through Magnetized Water for Enhancing Plant Growth

Completed Project, Science, Environmental

Magnetic fields affect all forms of life such as birds that sense the Earth's magnetic field to migrate, or atoms that the electrons within can be rearranged due to magnetic fields. Smaller forms of magnetic fields can also affect living organisms, such as magnetic coils or magnetized water. Magnetizing water uses water that passes through magnets, and how much the water has been affected by magnets can be determined by the strength of the magnet, volume of water, and for how long the exposure is. The purpose of this project is to use magnetic fields at different strengths on water to affect the growth and width of kale plants. If we increase the strength of magnetization on water, then the kale plants will have an increase in growth of height and width of the leaves. The independent variable is the strength(Gauss) of the magnetic field used on water. The dependent variable is the growth of the kale plants(inch). Pots were filled with mixing soil and contained five kale seeds and were watered daily. Water was in jugs with different magnetic strengths around the jugs for usage on plants. Experiments were on a detached screened-in porch, in a controlled environment. The plants were affected by magnetic fields through magnetized water. Data-wise, the results thus far support the hypothesis. Magnetic fields and magnetization can be seen as another alternative to chemicals in growing plants. It will be utilized more so the overabundant usage of chemicals will slowly lessen.

Amity High School

Teacher: Catherine Piscitelli

Project # 58

Lee, Youlmin

Determining The Most Effective Mixing Percentage of Cinnamomum zeylanicum and Paint Primer on Antifouling Freshwater Biofilms and Efficacy in Preventing Physical Deterioration

Completed Project, Science, Environmental

Previously, the most widespread method of antifouling was the usage of antifouling coatings containing hazardous additives such as tributyltin. However, additives as such have been banned for their polluting tendencies, further highlighting the need for utilizing eco-friendly antifouling methods. Cinnamomum zeylanicum, commonly known as cinnamon, has shown positive results in preventing bacteria settlements (Pseudomonas aeruginosa). The purpose of this study was to determine the most effective mixing percentage of Cinnamomum zeylanicum and paint primer by testing the durability, and antifouling abilities against freshwater biofilms. The independent variable was the different mixing percentage of cinnamon oil and paint primer ranging from 1% - 5% cinnamon content. The dependent variables were the durability and the antifouling ability of each experimental group, while the control was the acrylic panels painted with just paint primer. A total of 6 experimental groups were painted with paint mixtures ranging from 0% (control), 1%, 2%, 3%, 4%, and to 5% cinnamon oil content. There were 2 major tests grouped together; the durability test, and the antifouling test. The durability test included, 1) the tape pull off test according to ASTM D3359 standards, and 2) the “softness” test. The antifouling test included, 1) a field test according to ASTM D6990 standards, and 2) an image analysis by evaluating RGB and HEX codes. The data was analyzed by finding a correlation between the graphs of all 4 tests. This study can further expand the knowledge on the possibilities of using non-polluting additives to prevent biofouling in the water industry.

Amity High School

Teacher: Catherine Piscitelli

Project # 59

Liu, Allen

Machine-Learning Guided Design of Efficient Semi-Transparent Perovskite Solar Cells

Completed Project, Science, Environmental

Organic, perovskite-based solar cells have dramatically increased their power conversion efficiency by more than 25% in recent years. Because perovskite, also known as any ABX3 crystal structure, has unique optical and electrical properties, its usage provides benefits such as a high absorption coefficient, a direct and tunable band gap, the ability to flex and bend, and an easy deposition technique compared to the silicon based solar cells that currently dominate the photovoltaic market. These properties also allow the possibility of fabricating semitransparent solar cells where parts of light are harvested, leaving the rest to pass through the cell. The objective of the project was to create a novel semitransparent solar cell that are more efficient than current prototypes in the market. Literature review will be done in order to generate a data set for organic perovskite machine learning techniques. Upon proper processing and sampling, simulation results will be used to identify the most promising perovskite compositions. Although the rest of the perovskite characteristics were assumed, characteristics of flexibility, power conversion efficiency (PCE), and tunable band gap were tested in order to properly gauge the materials' capabilities. The data was be analyzed based on the materials used, fabrication/deposition method, and its PCE. Results thus far support the hypothesis. Further research through this project intends to increase the practicality of green energy, with the aspiration of improving green architecture and introducing machine learning techniques to the semitransparent photovoltaic research.

Amity High School

Teacher: Catherine Piscitelli

Project # 60

Narang, Anusha

Accurate prediction of vegetation dynamics in wetlands through the use of LSTMs with supplemental climate data

Completed Project, Science, Environmental

Wetlands are vital ecosystems to the environment because they can act as carbon sinks, filter water, control erosion, and are centers of biodiversity. Impacts from human activities such as rising sea levels have caused a decline in wetlands. In Louisiana, which hosts 40% of America's wetlands, wetlands are disappearing at a rate of 75 square kilometers annually. Accurate modeling of vegetation dynamics in wetlands will help inform environmental laws and guide restoration efforts. The objective of this study is to determine if LSTMs with supplemental climate data can be used to more accurately predict vegetation dynamics in wetlands. To monitor changes in vegetation the Normalized Difference Vegetation Index (NDVI) was used. This data was collected on a monthly basis at 10 locations in Louisiana's Plaquemines Parish from January 2001 to December 2021. Satellite images were found through Google Earth Engine's publicly available dataset. Supplementary climate data was obtained from the National Oceanic and Atmospheric Administration (NOAA). Three machine learning models were built from this data, Seasonal Autoregressive Integrated Moving Average (SARIMA), Long Short Term Memory (LSTM), and multivariate LSTM. SARIMA was built with solely NDVI data, 2 LSTM models were built, one with only NDVI data, the other with NDVI and additional climate data. Results were analyzed with root mean square error. Results indicate the multivariate LSTM model is the most accurate model. Machine learning models based on NDVI and climate data can be used to monitor vegetation trends in wetlands.

Darien High School

Teacher: Guy Pratt

Project # 61

Osowiecki, Sabrina

Determining the Effects of Prolonged Starvation on the Survival, Growth, and Development of Lymantria dispar

Completed Project, Science, Environmental

Asian spongy moths (Lymantria dispar) are an invasive insect that can defoliate forests and cause health issues. They can withstand periods of starvation, which allows them to be transported, often by boats or trains, and consequently establish new populations. The purpose of the project is to determine if a period of starvation causes measurable differences in survival, growth, and development for Asian spongy moths. The hypothesis is that Asian spongy moths starved for the longest periods of time will have the lowest survival rate, the slowest development, and the lowest weight. The independent variable is the amount of time the insects were kept away from food, and the dependent variables are the length of time they survive, the speed at which they molt, and their weight gain. First, Asian spongy moths (RM strain) were weighed and placed into three groups of 100 each: a control group that received food for 21 days, a group that was starved for 4 days and then given food for 21 days, and a group that was starved for 8 days and then given food for 21 days. After starvation, test groups were weighed then moved to cups with artificial diet. After 21 days, the amount of insects surviving, what instar each insect molted to, and approximately how much weight each insect gained since hatching were determined. Data thus far partially supports the hypothesis. This project can help determine the threats posed in the long run by Asian spongy moths that are transported.

Amity High School

Teacher: Catherine Piscitelli

Project # 62

Perkowski, Olivia

Determining the Optimal Size that Oyster Shells can be Crushed Down to While Still Being Able to Quickly Dissolve into Long Island Sound

Completed Project, Science, Environmental

Over time the pH in Long Island Sound has been drastically decreasing, from its solid level of 8.1 in 1930 to now close to 7.0. These decreasing pH levels lead to a process called ocean acidification. One way that scientists have discovered to help reverse ocean acidification is by reusing shells, crushing them, and then putting the crushed shells back into the ocean. This helps because the shells dissolve and add calcium carbonate into the ocean and act as an antacid and therefore mitigating the effects of ocean acidification. The purpose of this project is to determine what are the largest size pieces the oyster shells could be crushed to while still remaining efficient at allowing absorption of calcium carbonate into Long Island Sound in order to save time and resources. The independent variable of this experiment is the size into which the different types of oyster shells are crushed. The dependent variables are how fast the crushed shells dissolve into the water and the pH of the water afterward. The first step was collecting oyster shells from beaches along Long Island Sound. Next, the shells will be crushed down using a shell crusher available at NOAA Research Center. Water pH and alkalinity will be measured before and after experimentation. The mentor for this project is virtually providing advice and insight on the process and data collection. Results thus far show smaller grams dissolve quicker. Findings from this study should help study reversing the effects of ocean acidification.

Amity High School

Teacher: Catherine Piscitelli

Project # 63

Petrov, Nikhil

Creating a Forecasting System That Will More Accurately Predict Typhoon Paths and Potential Impacts in the Philippines

Completed Project, Science, Environmental

Out of all natural disasters, typhoons, known as hurricanes in the Western world, have the widest damage range and are most detrimental to coastal regions. While typhoon prediction systems are already implemented, these forecast systems are mostly limited to the region impacted. The purpose of this project was to create a forecasting system that more accurately predicts typhoon paths and potential impacts in the Philippines. A model was created in Python as well as in QGIS that projected typhoons within the following 30 days. This model projected the path of the typhoon and the projected fatality count and the damages caused to the region. First, a map was created using the IBTrACS hurricane/typhoon dataset, which focused on hurricanes that traveled through the Philippines within the past 40 years. The mentor provided the student with datasets needed for the map, as well as assisting with the mapping software. After the typhoons that have impacted the Philippines were isolated, data was manually collected on the temperature at the time of the typhoon, monetary and property damages from the typhoon, as well as the fatalities and injuries incurred. Using this data, the projection system was created with Python to simulate the project fatalities and economic loss. The mentor helped the student in the coding process, and answered questions. Historical data from typhoons in the Philippines was used to test this system. The data trends support the findings thus far. This project will assist and create advanced warnings for typhoons in the Philippines.

Amity High School

Teacher: Catherine Piscitelli

Project # 64

Savarese, Louis

Creating a Model for a Hybrid Energy Generation System for Open Ocean Data Buoys Using Wave Energy Converters and Photovoltaics to Increase Energy Generation

Completed Project, Engineering, Environmental

Most ocean data collecting buoys are currently powered through either solar power exclusively, or by replaceable batteries, both of which have significant flaws. Battery systems must be replaced about every year, leading to costly maintenance trips, while solar energy alone is rarely able to provide a consistent high energy source due to varying environmental conditions. A flourishing energy generation technology is wave energy, which has potential to be hybridized with solar panels on buoys to make energy levels consistently high. The purpose of this project was to create a model for a hybrid energy generation system that has high power generation, and consistent power generation using both solar and wave energy technology as a power source. The model for the system had to produce a consistent energy source, require no additional maintenance, be relatively inexpensive to produce, and provide higher levels of energy than pure solar systems. A design for a Wave Energy Conversion Device for data buoys coupled with photovoltaic solar panels was created and modeled using computer modeling software. The effectiveness of my design is determined based on consistency of power generation, extent of power generation, and cost. Results thus far show that the design is able to produce energy at a low cost, but the extent has not yet been determined. If the design is successful, it will allow for more sensors able to be placed on buoys, fewer maintenance trips, potential improvements to wave energy, and an overall decrease in cost for maintenance of data buoys.

Amity High School

Teacher: Catherine Piscitelli

Project # 65

Stoltenberg, Ian

Using a Computational Model to Determine the Cost and Effectiveness of Different Renewable Energies in New England Households

Completed Project, Engineering, Environmental

Fossil fuel reserves are depleting and sources like gas or oil are hurtful to the environment anyway. Renewable energy sources like wind, solar, and hydropower can be used as sources of energy that can not be depleted and do not harm the environment. The use of renewable energies can cut costs as well as help cut down on environmental issues like global warming. The purpose of this project was to use a computational model to determine the cost and effectiveness of different renewable energies in New England households. The hypothesis was that solar power will have the greatest effect on both cost and carbon emissions. The independent variable was the type of renewable energy, and the dependent variable was the cost effectiveness and the effect on the environment. The control was no renewable energy. A computational model was created using the Julia programming language. It replicated the average New England household, and the coding allowed the type of renewable energy to be plugged into the model. The model analyzed the difference in cost and carbon emissions compared to regular gas or oil energy sources. In this way, the different types of renewable energy, as well as the absence of it, was compared to find the one that is cheapest and has the best effect on carbon emissions. The data trends thus far support the hypothesis. This project could assist with learning about renewable energy and seeing how much more effective it is than the alternative, specifically in New England homes.

Amity High School

Teacher: Catherine Piscitelli

Project # 66

Tullo, Bowen

Examining Future Environmental Conditions' Effects on the Physical Construction of Temperate Sponges

Completed Project, Science, Environmental

Climate change and ocean acidification has been leaving marked impacts on our oceans, degrading coral reefs and causing sponges to become increasingly dominant on our seafloors. Unfortunately, there is very little research done on this specific environmental niche that temperate sponges hold, which could create a severe ecological catastrophe if the population is affected by growing climate change in lieu of increased temperature and reduced pH before we are aware of the potential damages. The purpose of this research was to analyze the effects of our potential future oceanic conditions under climate change on the growth of these temperate sponges. A variety of large Clathria prolifera samples were collected locally and acclimated to four 20 liter aquariums filled with seawater at standard LIS parameters for about 1 week, then adjusted to experimental levels over the course of 2 days. Each trial lasted 4 weeks, during which once a week, sponge growth was measured using a millimeter measuring tape and aligning it with the width of the sponge's base, and a small piece of sponge growth small enough to fit on a microscopic slide was fragmented off and observed. Analysis on fiber strength was done under microscope, and was estimated by direct human observation, with photographic evidence being provided as support. This research can provide a baseline for future experiments on this relatively underexplored subject, as well as ensuring that we are prepared for any future harm to our important temperate sponges.

Amity High School

Teacher: Catherine Piscitelli

Project # 67

Whiteley, Guinevere

The Effect of Fragment Size and Substrate Type on the Growth of Outplanted Staghorn Coral

Completed Project, Science, Environmental

Coral reefs are one of nature's most diverse, beautiful and complex ecosystems, providing many ecosystem services including coastal protection, job opportunities, sustaining local fisheries, and attracting tourism. Unfortunately, coral reefs have been declining due to a variety of factors including coastal development, pressures of climate change, and overfishing. Staghorn coral (Acropora cervicornis) is an important reef building coral species, and has suffered a decline, resulting in the critical endangerment of the species. Their decline has been caused by White Band disease, which specifically affects Acroporid species. Recent studies have looked into ways to decrease the mortality of the staghorn coral in the outplanting stage. This study will look at two genotypes, orange and blue, to determine whether the size of the staghorn coral fragment (5, 10, or 15 cm) at out-planting affects the growth rate. In addition, the substrate type (rebar, glass and conch shells) will be studied to determine its effect on the regeneration of new tissue and survival of the coral. It is expected that the 15 cm fragment will have the best performance with the highest survival, growth rates, and fastest tissue regeneration. It is also expected that glass will be the best performing substrate due to the flat surface providing a larger surface area for the fragment to adhere. The orange phenotype will likely grow better than blue since past studies have shown that the blue is more susceptible to White Band disease.The results of this study will aid the restoration of the staghorn coral.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 68

Bahel, Anchal

Determining the Availability of Telehealth Consults for Musculoskeletal Surgical Patients with Differing Insurance Plans

Completed Project, Science, Behavioral

Telehealth appointments are a practical alternative for those who cannot afford taking days off work, encouraging people to consult their medical provider when needed. There is a crucial need to understand how patients can balance their finances while prioritizing their health. The purpose of this project is to determine the availability for Telehealth consults, in a timely manner, for musculoskeletal (MSK) patients with differing insurance plans. It's hypothesized that when a patient requests a Telehealth consult with an MSK surgeon they will accommodate the patients' needs due to their financial obstacles of in-person appointments. The IV in the study is the availability for Telehealth consults, and the DV is the breakdown if there are Telehealth consults for different insurances, along with the wait time for these appointments. A list of surgeons from the American Association of Hips and Knee surgeons was compiled for 25 states. The following data were collected using the secret shopper methodology: offers Telehealth consult, Telehealth consult wait time, offers Telehealth for follow up visits, Telehealth follow-up visit wait time, offers in-person consults, in-person consult wait time. Call one was made with a medicaid patient and after at least two weeks a second call was made for a patient who has Anthem. Chi squared tests were used to determine the statistical significance of the differing groups. Current data trends support the hypothesis. This study will encourage surgeons to present patients with accommodations in order to reduce the numerous obstacles when a patient is seeking a medical consult.

Amity High School

Teacher: Catherine Piscitelli

Project # 69

Barczak, Alyson

The Effect of Robotic Architecture on the Perception of Trustability in Social Robots

Completed Project, Science, Behavioral

Robots are becoming prevalent in society, in homes, on television, fulfilling a companionship role, and forming personal relationships with owners. The perception of trustability, defined by the article Trust in Robots: Challenges and Opportunities, as a belief, an attitude, an affective response, a sense of willingness, a form of mutual understanding, and as an act of reliance, requires further research. How does the exterior, or architecture, of the robot impact the way they are perceived and trusted by a global audience? My methodology follows. 1. Choose four photos of two social robots 1a. One that looks extremely robotic (Jibo) 1b. One that falls within the Uncanny Valley (Moxie) 2. The first two photos will include 2a. Jibo pictured alone in front of a white background 2b. Moxie pictured alone in front of a white background 3. The last two photos 3a. Jibo pictured interacting with a child 3b. Moxie pictured interacting with a child 4. Survey created on google forms that will have a total of four questions based on the four images and will not record any identifying information 5. The two questions at the beginning feature images of the two robots on their own with a white background 6. The question asks “How comfortable would you [the test taker] be trusting this robot to interact with a child?” 6a. The answers are based on a Likert scale on a range from extremely comfortable to extremely uncomfortable. 7. The two final questions feature images of the two robots above interacting with children. 8. The questions as if “I [the test taker] would trust this robot with a child” The answers are based on a Likert scale and range from strongly agree to strongly disagree 8a. The survey will be posted to various social media platforms such as Reddit and Instagram. Compile information and organize information through google sheets 9. Analyze data and assess if people view the robots are more trustable pictured on their own vs when they are pictured with children 10. Formulate a conclusion based on the effect of robotic architecture on the perception of the trustability of social robots The implications of this research will lead to a deeper understanding of the way different exteriors of social robots are perceived by their audience. This understanding will influence the effectiveness of the various aspects of the robot's functioning, such as social skills, social-emotional learning, and companionship, due to the level at which the robot is deemed trustable. The results of this research will help increase the effectiveness of future social robots by presenting the architecture in a more trustable way.

Ridgefield High School

Teacher: Patrick Hughes

Project # 70

Bernal, Martina

Investigating the Role of Bilingualism in Enhancing Adolescents' Selective Attention Using Grammatical Illusions

Completed Project, Science, Behavioral

The purpose of this study is to identify the relationship between bilingualism and executive control, specifically control of the cognitive parser in the face of grammatical illusions, in adolescents. Fifty participants were recruited through convenience sampling. 34 were monolingual and 16 were bilingual. The bilingual participants' ages ranged from 14-18. However, the 14-15 year olds were sent a separate copy of the form that was sent to the 16-18 year olds for comparison of results. The language all participants had in common was English. The second language of the bilingual participants was not asked or recorded. All participants were given 10 sentences on Google Forms that are in the form of a Grammatical Illusion (a sentence that has the peculiar ability to manipulate the cognitive parser into treating it as well-formed while it is not). Five sentences were grammatically correct and five were incorrect. Participants were asked to self-record the time they took taking the survey. It was found that the 11th and 12th grade bilinguals outperformed monolinguals in detecting illusions, but were slower in judging the stimuli, illusory or not. In contrast, the younger students (11th and 10th) did not exhibit the same trend. My study will fill the gap relating to research on the cognitive parser correlated with bilingualism in adolescents, a group that is often overlooked in linguistic studies. It will provide additional findings on the brain's ability to suppress interferences when completing tasks in general, which is a recurring topic in cognitive research. 4) My study will fill the hole relating to research on the cognitive parser correlated with bilingualism in adolescents, a group that is often overlooked in linguistic studies. It will provide additional findings on the brain's ability to suppress interferences when completing tasks in general, which is a recurring topic in cognitive research.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 71

Biolsi, George

Effects of Discrete Exercise on Stress and Anxiety in Sedentary Adult Workers. A Feasibility Study.

Completed Project, Science, Behavioral

Sedentarism increases the risk of obesity, cardiometabolic diseases, and mental health illnesses. Working adults frequently accumulate the most hours sitting daily, which has increased during COVID-19. Low-cost, discrete exercise programming that requires minimal equipment in an office setting must be considered. This research aimed to determine the feasibility of a 4-week, bodyweight (BW)/isometric (ISO) exercise program on sedentary working adults and the effects of discrete exercise on stress and anxiety. 10 participants met inclusion criteria. Participants visited the lab for pre and post-testing, and completed a 4-week virtual exercise program (3 sessions·wk-1). During testing, resting measures, questionnaires (Hospital Anxiety and Depression Scale [HADS], Perceived Stress Scale [PSS]), and physical testing (Hand Grip Test [HGT], Timed-Up-and-Go [TUG]) were performed. The program included 6 BW and 5 ISO exercises. Intensity increased in sets and reps for BW and in OMNI-RES for ISO exercises. Participants completed the Visual Analogue Scale (VAS) before exercise, and noted completion. Descriptive statistics assessed demographic variables and resting measures. One-tailed, Dependent T-tests compared pre and post-means for blood pressure, HADS, PSS, HGT, and TUG. Seven participants completed 91% of sessions and 97% of repititions programmed. Participants exhibited significantly lower diastolic blood pressure, decreased PSS, and improved TUG and righthand HGT scores. There was a trend toward significance for HADS-anxiety. Discrete BW and ISO virtual exercise programs are feasible for sedentary working adults and may improve blood pressure, perceived stress, and possibly anxiety.

Darien High School

Teacher: Guy Pratt

Project # 72

Crist, Molly

Analyzing the impact of COVID-19 on the amount of happiness found in nature as shown on social media

Completed Project, Science, Behavioral

Covid-19 has greatly changed how people find happiness because many people are not able to see friends and family, travel, or go to school or work. These are things people would normally find happiness in but are not able to with the restrictions of Covid-19. The purpose of this study is to help determine how the amount of happiness found in nature has been impacted by Covid-19. A social media analysis was conducted to assess how the amount of happiness found in nature may have changed because of Covid-19. Code was used to determine the percentage of posts with happy of the amount of posts in #nature, and to determine the average sentiment of posts in #nature from both before and during Covid-19. The outcome of this experiment is that people found more happiness in nature during Covid-19 because there was a higher percentage of tweets with happy of the amount of posts in #nature and there was a higher level of sentiment of tweets in #nature at the start of the Covid-19 pandemic. This research furthers our understanding of the impacts of Covid-19 on social-emotional wellbeing. Much is still not known about how Covid-19 has affected the world and the lives of individual people. This research also gives us a better understanding of how important nature is to well-being.

Ridgefield High School

Teacher: Patrick Hughes

Project # 73

Darby, Lindsey

Analysis of Comprehension Scores of Middle School Students Using Different Forms of Reading (Assisted Reading and Digital Texts)

Completed Project, Science, Behavioral

As reading technologies, assisted reading and digital texts, become more popular, it's important to understand the differences and effects each type can have on learning. Recently, studies have shown nearly 50% of students use at least one audiobook throughout a year. Audiobooks are professionally taped recordings of texts. Text-to-Speech (TTS), however, uses a computer automated voice to translate a digital text into audio. Despite confusion between these technologies, inconsistencies in students' comprehension scores have been found. Furthermore, how do these technologies compare to paper and digital reading? The goal of the study is to determine if a correlation between comprehension and specific combinations of reading assistance present. Four methods will be used in this study: aloud print text, adult reader (audiobook simulation) on paper, aloud digital text, and TTS digital text. The readings and comprehension tests are provided by UPAR, making the difficulty and content standardized. Graphing methods of UPAR for individual participants and separate statistical analysis on average comprehension scores will be used to analyze the data. It's expected that paper texts, then assisted reading methods (read-aloud or audiobooks), and finally independent digital texts will have a descending order of average grade level comprehension. A possible explanation being, emphasis put on learning to read off paper, rather than digital texts or with assisted reading methods. Results will provide understanding to educators on how students learn and what should be updated or kept in place to increase digital literacy, the ability to successfully carry out tasks and learn digitally.

Darien High School

Teacher: David Lewis

Project # 74

Di Capua, Jennifer

Facilitating Healthcare Access for Latinx Immigrants Using a Novel Smartphone App, Salud por Todos

Completed Project, Science, Behavioral

There are 62 million Hispanics in the United States as of 2020; 22 million are foreign-born, and 8 million are undocumented. This population has limited choices when seeking healthcare, resulting in higher morbidity and mortality than US-born White non-Hipsanics. I created a smartphone app, Salud por Todos (SpT), to help connect the Latinx community with healthcare providers. Thirty-four Latinx immigrants, of which 82% are undocumented, and forty White non-Hispanics completed a survey to identify healthcare barriers. The most common barriers include cost, lack of insurance, and language. Over 82% of Latinx immigrants responded that they use a smartphone to search for information, making SpT an attractive tool for this population. Over two-thirds of the Latinx participants indicated they would like the following information in a smartphone app: languages spoken by the physician, specialty, type of facility, average visit cost, distance from home, ability to pay in cash, available payment plans, access to social workers, address, identification requirements, and accepted insurances. The survey information was used to build the SpT smartphone application in English and Spanish. The SpT application was published on the iOS and Google Play app stores and tested by thirty-four Latinx immigrants and forty White non-Hispanics. Using a Likert scale of 1-5, all respondents rated the SpT app better in overall satisfaction, ease of use, likelihood to recommend, privacy of information, and probability to use for finding a doctor in the future than the web. All results were statistically significant with a P value <0.01.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 75

Gu, Emily

Determining the Effects of Drinking Saline Versus Water on the Amount of Subfornical Organ Neurons Activated in Hibernating Thirteen-Lined Ground Squirrels

Completed Project, Science, Behavioral

Thirteen-lined ground squirrels hibernate annually for 6 to 8 months, cycling between two phases: torpor, a 2-to-3-week state of low metabolism and body temperature, and interbout arousal (IBA), a 24-hour state of normal activity. Throughout hibernation, squirrels consume almost no water even when offered it in laboratory settings. Based on prior thirst physiology research, water deprivation increases blood osmolality, signaling the neuroendocrine thirst circuit (NETC) to trigger a thirst sensation and encouraging water consumption. It is well-established that the subfornical organ (SFO) acts as the beginning of the neural part of the NETC. Hibernating animals show very prominent thirst suppression, suggesting that the thirst circuit is interrupted during hibernation. Non-hibernating rats and mice, along with active squirrels, exhibit a strong preference for drinking water over 0.5M NaCl (saline). By contrast, IBA squirrels prefer saline while barely consuming water. It is unknown how this preference switch originates in the NETC or how drinking different solutions affect neuronal activity. This project's purpose was to find a physiological explanation for this preference switch, specifically in the SFO. During this project, the mentor conducted a behavioral experiment, provided guidance, and supervised. The student conducted immunohistochemistry procedures, staining tissues with c-Fos and nNOS to identify activated or inhibited SFO neurons, and imaged the slides using a confocal microscope. The data was analyzed using image comparisons and graphs. All mammals share the NETC, so learning more about this aspect of thirst can bring us one step closer to understanding the circuit, especially in humans.

Amity High School

Teacher: Catherine Piscitelli

Project # 76

Hebbar, Shreya

The Effect of Emotional Regulation Methods on Burnout Levels in Adolescents

Completed Project, Science, Behavioral

Recently burnout, a psychological syndrome emerging as a prolonged response to chronic interpersonal stressors, has become more common within students. The three burnout categories include emotional exhaustion, depersonalization, and personal achievement. Emotional regulation is the ability of an individual to modulate an emotion or set of emotions, including problem solving, somatic relaxation, emotional experience, distraction, avoidance, or rumination. The purpose of this experiment was to see how emotional regulation methods can lead to varying burnout levels in adolescents. The hypothesis was if highschool students complete the Maslach Burnout Inventory along with the Cognitive Emotion Regulation Questionnaire, results will show that those taking part in avoidance/escape will have higher burnout levels while those who take part in problem solving and somatic relaxation will have lower levels since those are healthier coping methods. The independent variables were the emotional regulation methods while the dependent variable was the burnout levels measured through a 1-5 scale. After returning consent forms, students completed a questionnaire including the CERQ and MBI. Each participant was sorted into an emotional regulation method and a specific burnout level, corresponding with low, moderate, or high burnout. I then performed a statistical analysis, and data so far has supported the hypothesis. Overall, students with lower burnout levels are more likely to lead healthier lives with reduced mental illness. It is important to understand student coping methods to differentiate them and help enforce healthier alternatives in order to reduce negative outcomes and create a better society and community within schools.

Amity High School

Teacher: Catherine Piscitelli

Project # 77

Kompalli, Nidhi

Determining the Correlation Between Demographics and Children's Emotional Competence

Completed Project, Science, Behavioral

Emotional competence is one's ability to interact with others, and communicate emotions properly. It has been discovered that children who are emotionally competent do better in school. Research has also shown that socialization and interaction between children can be beneficial to children's emotional labeling capabilities. In the past, demographics have affected the way children are taught in school, and how they comprehend certain tasks. The purpose of this project was to determine the correlation between demographics on children's emotional competence/ability to label their emotions. The hypothesis was that there is a correlation between the two factors, because studies have shown that children develop differently in Asian households compared to American households. The independent variables in this study were the demographics of the children. The dependent variable was scores on an emotional competence test. For the methods, the mentor already conducted the data, making this a secondary data analysis (all children are from pre-schools in CT, ages 3-5). The children's scores were assessed individually based on the data collected, and were scored on a 100-point scale. The points were based on how accurately the child labeled and described emotions. All data analysis were done mainly through t-tests, and ANNOVAs when necessary. Results thus far concluded that there is a correlation between emotional competence and demographics in children. Findings from this study will be able to help researchers understand young children's brain development further, ensuring their needs are met.

Amity High School

Teacher: Catherine Piscitelli

Project # 78

Liu, Yuqi

Determining how VR-simulated psychedelic experiences affect phenomenological thought processes

Completed Project, Science, Behavioral

Previous studies have demonstrated that psychedelic imagery shown in VR simulations has promising results in replicating the effects of actual psychedelic experiences, which may include the enhancement of cognitive functions. This study sought to investigate how psychedelic experiences simulated in VR affect phenomenological thought processes in users. The hypothesis was that participants that underwent the simulated psychedelic experience will have greater positive results in each of the measures of phenomenological thought than participants in the realistic simulation group or the control group. The independent variable in this study will be the type of VR simulation the participants undergo (options include a simulation of a realistic environment, a psychedelic simulation, or no simulation at all). The dependent variable will be participants' performance on various measures of phenomenological thought, including a remote associates task, alternative uses test, ego dissolution inventory, freely moving thought questionnaire, and psychological thoughts questionnaire. The control was participants not subject to any type of VR simulation. The type of tests given, the general age range of the participants, the type of tests given, and the time spent in the VR simulation was held constant. Data was previously collected by the mentor; the mentee was responsible for data analysis and using the test results to generate a numeric score for the participants' phenomenological thought. Results thus far support the hypothesis. The implications of this study are adding to our understanding of the effects of psychedelics as used in VR simulations on human behavior.

Amity High School

Teacher: Catherine Piscitelli

Project # 79

Lowder, Bridget

Determining the Effects of Initial Age of Onset for Heroin Usage and Other Demographics on Neurocognitive Capabilities

Completed Project, Science, Behavioral

Very limited recent research has been conducted concerning heroin and the effects of using heroin on a person's neurocognitive functioning in regards to age of first use, gender, and socioeconomic status. The purpose of this experiment was to determine how the initial age of onset for heroin usage, gender, and socioeconomic status affects a person's neurocognitive capabilities in adulthood. It was hypothesized that people who start using heroin at younger ages, and women and those of lower socioeconomic status that use heroin would have more severe effects on their neurocognitive capabilities. The independent variables were the age of initial onset, gender, and socioeconomic status of the heroin user. The dependent variable was the neurocognitive capabilities of participants who are addicted to heroin. The control was participants who have never used heroin. All participants completed the self-reported brief inventory of neurocognitive impairment to assess their neurocognitive capabilities. The results of the control group served as a baseline for all of the other groups. The mentor administered the test and offered guidance throughout the data analysis process. Statistical analysis was used to determine if there were relationships between heroin use at younger ages, gender, and socioeconomic status of the user, and effects on neurocognitive capabilities. The data thus far supports the hypothesis. Findings from this project could lead to a better understanding of the effects of heroin usage over different periods of time, whether males and females are impacted differently by heroin use, and whether the user's socioeconomic status has an impact.

Amity High School

Teacher: Catherine Piscitelli

Project # 80

Napolitano, Andie

Determining the topics surrounding childhood cancer that encourage the most discourse on social media.

Completed Project, Science, Behavioral

In the United States, around 10,500 children are diagnosed with cancer annually. Cancer diagnosis and treatment, especially involving children, impacts the mental health of patients and their loved ones, and many people affected by childhood cancer experience mental health issues. This community uses social media to disseminate information and emotions surrounding childhood cancer. Information about topics surrounding childhood cancer that generate discourse on social media can give public health organizations insight into issues that people affected by childhood cancer experience and are passionate about. This project aims to determine which topics surrounding childhood cancer receive the most engagement on social media. The independent variable of this project is the topics that are present on social media surrounding childhood cancer. The dependent variable is the level of engagement for each of these topics. The data for this project was collected using the Ncapture data capture tool for Twitter, using the phrase childhood cancer to retrieve data from Twitter's public database. After retrieving the dataset, irrelevant and false information was filtered out. The remaining data were analyzed and sorted into categories based on their content. Then, the level of engagement for the data points in each category was averaged, compared, and statistically analyzed. Thus far, the analysis suggests the topics of personal stories relating to childhood cancer and information about childhood cancer research are the most prevalent. Implications of this project include understanding the effectiveness of social media as an outlet for those affected by childhood cancer.

Amity High School

Teacher: Catherine Piscitelli

Project # 81

Novak, Eric

Determining the Most Effective Rewirement Technique to Improve the Overall Happiness and Well-being of High School Students

Completed Project, Science, Behavioral

Teenage depression has been correlated to teenagers unconsciously training their brains to focus more on negatives rather than positives. A rewirement technique is used to help participants think more positively through repetition. The four rewirement techniques that were used in this experiment were finding daily positives, meditation, doing random acts of kindness, and writing things you are grateful for. The purpose of this research was to determine which rewirement technique is most effective for high school students. The independent variable of this study was the type of rewirement technique that was used. The qualitative dependent variable was the preference of each technique to the participants. The quantitative dependent variable is how scores fluctuated in the EPOCH survey. The control group will not use any rewirement technique while the experimental groups will be the four rewirement techniques that will be used in a randomized order. Before performing a rewirement technique, the participants will take a Pre-EPOCH survey to establish a score to compare the end results to and enter them into a Google Form. For one week the participants will try their best to perform the rewirement technique assigned to them. After a week off, this procedure will be repeated with a different rewirement technique in a randomized order for a total of 8 weeks. The results thus far show that finging daily positives is the most effective technique for improving the happiness of teenagers. The implications of this research will allow teenagers to know the most effective rewirement technique.

Amity High School

Teacher: Catherine Piscitelli

Project # 82

Quayle, Emma

Extent of Coverage as a Measure to Validate the Media Contagion Theory as an Explanation of Mass Shootings

Completed Project, Science, Behavioral

In 1999, the Columbine shooting received more attention than the death of Princess Diana and in the month after, 400 related incidents were reported across the country. Previous researchers found that people who commit mass shootings in America tend to share three traits: rampant depression, social isolation, and pathological narcissism. Individuals with these traits may look for methods of gaining bounteous amounts of recognition and, when exposed to coverage of violent events that gain widespread notoriety, they may be inclined to copy those events. This is known as the media contagion effect. With the rise of the 24-hour news cycle in the last decade, media coverage has become more extensive and prolonged, which may drive potential shooters to copy these events to achieve fame or notoriety. This study seeks to analyze the relationship between media coverage and mass shootings through the interaction of media exposure and common personality traits of most shooters as described by the media contagion theory. This study used two databases, The Violence Project and Mother Jones, to identify 59 mass shootings from 2010-2022. Identified events were analyzed for patterns and trends of media coverage, such as variability in coverage between different types of mass shootings using the New York Times archive database and key search words. Data suggests that more coverage of mass shootings facilitates more subsequent events, especially coverage of school shootings. Data indicates that broadcasting of mass shootings, especially school shootings, should be limited to the fewest amount of media coverage possible.

Darien High School

Teacher: Guy Pratt

Project # 83

Sweeney, Edwin

Examining the Association Between Amygdala-Prefrontal Connectivity and Externalizing Behaviors as a Function of Social Impairment and Cognitive Performance

Completed Project, Science, Behavioral

Externalizing behaviors, such as aggression, irritability, and noncompliance, are prevalent worldwide. On a neural level, externalizing behaviors have been associated with disruption in networks involved in emotion regulation, including the amygdala-prefrontal cortex circuitry. Recent work has also suggested a link between level of externalizing behaviors and social impairment. However, it remains unclear if dysfunction in amygdala-prefrontal connectivity is modulated by level of social impairment and cognitive performance in children. The purpose of the study is to examine if the relationship between amygdala-prefrontal cortex functional connectivity and externalizing behaviors is moderated by levels of social impairment and cognitive performance. The Adolescent Brain Cognitive Development (ABCD) study was used as the data source and contains cognitive, social, and imaging data of over 10,000 youths between the ages of 9-10 in the first release. The following continuous measures were used in analyses: the Child Behavior Checklist Externalizing Behavior Problems scale for externalizing behaviors; the Social Responsiveness Scale (SRS) for social impairment; and the National Institute of Health (NIH) Toolbox Cognition Total Composite Score for cognitive performance. Standard preprocessing and analysis of imaging data was conducted using FSL FEAT. Connectivity analysis tested the functional synchrony between the amygdala and all other regions of the brain. Preliminary results suggest that positive connectivity between the motor and medial frontal cortex is largely responsible for expressing externalizing behavior. This work will advance understanding of circuit-level disruptions in emotion regulation and the development of brain-based biomarkers that can inform assessment and treatments for youths with externalizing behaviors.

Amity High School

Teacher: Catherine Piscitelli

Project # 84

White, Anna

The Effect of Placebos and Nocebos on Pain Perception

Completed Project, Science, Behavioral

The placebo effect is a relatively well-known concept, but few people are familiar with the nocebo effect. The placebo effect is a term that describes a supplement or treatment plan that has no effect on a person's body but creates the sense that something is getting better, in this case pain relief, due to the anticipation or expectation associated with taking the supplement. The nocebo effect, on the other hand, is based on a person's negative expectations or prior information about their treatment, causing the treatment to have a worse overall outcome than it would, otherwise. This is related to pain and how people tend to exaggerate the severity of their pain merely due to negative implications/reactions in the moment. This project will consist of figuring out how the placebo and nocebo effects affect the perception of pain through the use of neurological and psychological processes, performing an experiment, and drawing suitable conclusions through the data being analyzed. The experiment being conducted for this project will utilize muscle testing/applied kinesiology. The logistics include holding up a card displaying a positive or negative image or phrase, and we will be testing to see the muscle resistance. What will also be targeted through muscle testing is different organs in order to see which organs showed strength or weakness, and the information will be linked back to the placebo and nocebo effects.

Newtown High School

Teacher: Timothy DeJulio

Project # 85

Xu, Alice

Determining the Association Between Early Autobiographical Memory and Context Binding Skills in Middle Adolescents

Completed Project, Science, Behavioral

Autobiographical memory is one's memory of events from their life. Context binding is the ability to encode relations between co-occurring stimuli, allowing one to remember detailed events. Childhood amnesia is the phenomenon of having little to no memory of events from infancy and early childhood. The purpose of this project was to determine the association between early autobiographical memory and current context binding skills in middle adolescents. The variables were context binding task scores and autobiographical memory task scores. Participants ages 14 to 17-years-old were given consent forms to sign, then were individually given an autobiographical memory task and context binding task. In the autobiographical memory task, participants were recorded recounting memories from before turning 5 for four minutes, then were asked to describe their earliest memory and age of that memory. In the context binding task, participants were shown two presentations each containing 40 events of cartoon characters in locations with objects, and given two self-paced tests with 20 questions each. Autobiographical memory interviews were parsed and put into one of five categories: autonoetic content, second-person references, past tense, present tense, lists. Scores for this task were participants' number of autonoetic and past tense clauses. Scores for context binding tasks were the number of correct answers. The correlation was determined using the Pearson correlation coefficient. Results thus far show an association between greater context binding skills and more extensive autobiographical memory. The findings of this research could provide insight into what factors allow for retaining and recalling early memories.

Amity High School

Teacher: Catherine Piscitelli

Project # 86

Akbar, Faryal

Determining the Efficiency of using a Ceramic Based Membrane on Wastewater Filtration versus using a Polymeric Membrane

Research Proposal, Engineering, Physical Science

Currently, polymeric membranes are in use for water filtration tactics, however, they do not fulfill the conditions of membrane technology, especially operation at high temperature and harsh environment. Whereas ceramics have been used in environmental remediation before and are low-cost, mesoporous, and chemically stable to be developed as catalyst supports. The purpose of this project is to test the efficiency of using a ceramic based membrane versus a polymeric based membrane in water filtration. This will be done by analyzing the quality of the wastewater post treatment. To begin, a ceramic-based membrane will be created by myself as well as the synthetic wastewater. The replicated contaminants will be mineral, sand, and phosphate and different batches of wastewater will be created with different amounts of ingredients per batch. One ceramic based membrane will be used of the same thickness as the polymeric membrane. Each batch of wastewater will then be dispersed on each membrane to ensure similar conditions as real wastewater. A pH sensor will be used to assess the difference in qualities of water. Next, the salinity will be measured as well as using a phosphate tester. Also, the sand will be weighed in the end to assess which membrane filtered out the majority. To analyze the results, t-tests will be performed on the pH levels recorded as well as other statistical analysis. The results of this will help to determine a new method in wastewater treatment that is more durable and efficient than methods that are currently in use.

Amity High School

Teacher: Catherine Piscitelli

Project # 87

Archibald, Lily

Effects of breathing during a swim workout in adolescent athletes on cognitive short term memory

Research Proposal, Science, Behavioral

1. The purpose of this study is to determine the changes in cognitive short term memory that occur preceding different breathing techniques during swimming workouts in adolescent athletes. 2. During a weeklong study, I will test athletes (ages 14-17) before and after their workouts will be tested on their short term, working and long-term memory. They will be tested using the practical psychology website. Their short term memory test will be performed within 5 minutes of their exercise. The athletes will then be tested on their working memory and long-term memory using the same website within 20-30 min after exercise. And then comparing these results to a non-swimming day using the same tests. Additionally, having a test group of non athlete adolescents who perform the same tests before and after breathing exercises.alz 3. n/a 4. Could the act of swimming reduce symptoms of Alzheimer's?

Ridgefield High School

Teacher: Patrick Hughes

Project # 88

Barnard, Kate

Coral Reef Recovery Surrounding Soundscapes

Research Proposal, Science, Environmental

Imagine a beautiful coral reef, filled with fish and other marine animals. It is assumed that in 20 years, all coral reefs will be degraded without a change in their current situation. This is a global crisis that affects millions of people who rely on reefs for food, storm protection and income. However, there is hope. A healthy coral reef creates a healthy soundscape. This means that when a reef is in prime condition, it contains a wide variety of loud sounds that can be recorded. Using recordings taken from healthy reefs, scientists will be able to play these recordings in degraded reefs to revive the biodiversity. This is important because coral needs biodiversity in order to retrieve its necessary nutrients from other animals. Without receiving nutrients, the coral can become bleached and then die. Using recording software, scientists are able to measure the intensity and phonic richness of reef's soundscapes. These recordings are measured to classify the status of the reef; healthy, degraded, or restored. It is expected that using the recordings taken from healthy reefs and playing them in reefs classified as degraded will make the reef acoustically attractive and cause organisms to settle. The data will be analyzed using the recordings taken and measured by the sound intensity and phonic richness. This experiment is important due to the fact that over half a billion people rely on coral reefs and without the efforts to recover reef soundscapes, many animals will lose their habitats due to climate change.

Darien High School

Teacher: Christine Leventhal

Project # 89

Bates, Elizabeth

The Use of Neurointerventional Therapy With tPA to Improve Outcomes of Patients With Embolic Ischemic Stroke

Research Proposal, Science, Health

A stroke occurs when there is a deficiency of oxygen supply to the brain due to a complication of the circulatory system.. Ischemia is the most common form of stroke, often caused by a blood clot in the brain. Current treatment for ischemic stroke is by intravenous application of tissue plasminogen activator, tPA, after a stroke is diagnosed on a computer tomography scanner (CT). tPA works to break up clots and allows blood to circulate through the brain, delivering essential oxygen. Studies have shown tPA to be less effective when blood clots are larger than 8mm and (1.08±0.02)×103 kg/m3 in density. In patients where tPa is ineffective a change in treatment is necessary, prolonging the time the brain is without oxygen. Patient outcomes are reduced due to the increase in the severity of damage from the ischemic stroke. Neurointerventional therapy is a semi-invasive treatment where a catheter is fed into the brain to remove the clot, improving the circulation of oxygen. I propose that the immediate use of neurointerventional therapy alongside tissue plasminogen activator in patients with clots larger than 8mm in size and (1.08±0.02)×103 kg/m3 in density when diagnosed on CT, will lower a patient's score on the Rankin Scale of Neurological Disability for patients suffering an embolic ischemic stroke.

Darien High School

Teacher: Guy Pratt

Project # 90

belluscio, Emma

Efficacy of Hyperbaric Oxygen Therapy in Patients with Cognitive Impairments Related to Long-Term Covid-19 Effects

Research Proposal, Science, Health

In recent years, people with recurring or continuous symptoms of COVID-19 are said to have post-COVID-19 syndrome. One of the most common symptoms of long COVID-19 is cognitive impairment. Therapeutic options as of now are limited, However recent studies have shown hyperbaric oxygen therapy (HBOT) for those recovering from long COVID to be beneficial. HBOT is the therapeutic use of oxygen at absolute pressures greater than the atmosphere's. HBOT is a very successful treatment for several authorized clinical conditions, such as chronic diabetic ulcers. HBOT may help cognitive impairment, as it has been shown to improve neuroplasticity. Neuroplasticity reorganizes synapses in response to oxygen stimuli, optimizing function and cognition. Over two weeks, ten patients will undergo ten sessions of HBOT each at 2-3 atmospheric pressure. Each treatment session will last 105 minutes, 90 of which will consist of 100% oxygen exposure. The remaining time would be dedicated to an air break, in which the oxygen concentration inhaled by the patient will reduce from 100% to 20%. This change lessens the possibility of oxygen poisoning. The Montreal Cognitive Assessment (MoCA) will be performed on days 1 and 14 to validate HBOT efficacy. The objective of this proposal is to assess HBOT's effectiveness on those suffering from cognitive deficits as a result of long-term Covid-19.

Darien High School

Teacher: David Lewis

Project # 91

Boeding, Maxine

The Correlation between the Socioeconomic Standing of a School District and the Success of its PreKindergarten Program

Research Proposal, Science, Behavioral

Research has shown that a successful pre-kindergarten (preK) program is a valuable resource for 4-year-olds in terms of having them achieve their potential throughout their school career. It can also boost social and emotional skills that still have positive effects during middle and high school years later. Although pre-K programs have grown throughout the country, the quality remains inconsistent. Successful pre-K programs have the following characteristics: educated, attentive, and caring teachers; a safe and nurturing environment; age-appropriate planned learning activities that foster development; solid channels of communication between teachers and parents; and encouragement of each child's culture and unique learning needs. This study will analyze preK programs across the nation for these characteristics to determine if the school district's socioeconomic region influences the PreK program's quality. The PreK programs will be analyzed using the Early Childhood Environment Rating Scale (ECERS). It is hypothesized that the districts that are in higher socioeconomic areas will be better funded, and will have higher-quality pre-K programs. This study will provide evidence that more needs to be done to provide quality pre-K programs to all children, regardless of the socioeconomic status of the area in which they live.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 92

Boudreau, Melissa

The Preventative Effects of Allium sativum (garlic) on Escherichia coli (E. Coli)

Research Proposal, Science, Health

Escherichia coli (E. Coli) bacteria is a common bacteria that can be found everywhere in our world, so wouldn't it be great if there was a way to prevent it with a common day item? Garlic has pervious antibacterial traits, so I want to test if garlic will be successful in the prevention of E. Coli growth. The procedure being used in this experiment is called the agar disc diffusion method. I will be having a well plate that contains K-12 E.Coli, I will place circular pieces of garlic soaked filter paper into the plates. Then I will leave the plates for a period of time, and once they have time to sit and grow, I will look at the circumference around the pieces of paper, and see how much of the bacterial growth was prevented by the garlic. The amount of bacterial growth prevented by the garlic will be collected and if bacterial growth has stopped then it will show how effective garlic is at preventing the bacteria. And once again, the data will be obtained using the agar disc diffusion method, which in turn will show how effective garlic is at fighting off E.coli bacteria. I predict that based on garlics preventative effects on other bacterias like Lyme disease and oral bacteria, it will be a successful in preventing the growth in E.coli as well.

Joel Barlow High School

Teacher: Paul Testa

Project # 93

Brissette, Kaylin

The Role of Stellate Cells in Liver Regeneration

Research Proposal, Science, Health

Stellate cells make up a small percent of the liver and are usually quiescent in healthy adult livers but can be activated upon injury to the liver. When not activated they reside in between the hepatic cells and the lining endothelial cells. The inactive stellate cell stores a large amount of vitamin A within the body. Upon activation, the stellate cell will go through a drastic phenotypic change and take on a phenotype akin to a myofibroblast. The activation or transdifferentiation of stellate cells, forces them to forgo the vitamin A storage and occurs following an acute injury. Once activated, stellate cells play an important role in the production and remodeling of extracellular matrices within the liver by synthesizing various proteins and increasing amounts of collagen produced. In order to support this hypothesis, pre- existing cell metabolism and gene expression data sets will be analyzed. The purpose being to assess the possible influence stellate cells have on the rate of cell divsion and proliferation within liver regeneration. Stellate cells' use of fibrosis allows them to create provisional scar tissue at the site of injury, similar to myofibroblasts. The provisional scar tissue prevents the liver from sustaining more damage and decreases the burden of the hepatocytes. As a measure of significance, statistical analysis will include p value t-test and linear regression. All data has been previously published and no work with humans or human tissue or biological materials will be conducted, only data analysis. Stellate cells have been shown to synthesize various scaffolding proteins that are valuable to modeling of the extracellular matrix.

Newtown High School

Teacher: Timothy DeJulio

Project # 94

Brown, Kate

Evaluation of Network Analyses and Diffusion Tensor Imaging in Major Depressive Disorder

Research Proposal, Science, Behavioral

Major Depressive Disorder (MDD) has been conceptualized as a brain network disorder that affects nearly 32 million people. 50% of all completed suicides annually occur within a depressive episode, and patients with MDD are 20x more likely to die by suicide than healthy individuals. In this study, we will use magnetic resonance diffusion tensor imaging (DTI) data from 60 patients with MDD and 60 healthy controls (HCs) and investigate the two MDD subgroups selected based on their disease duration. Complex network analysis will characterize brain networks using indices that are computable based on quantitative data of brain connectivity. These indices will be calculated by connectivity, CC, global efficiency, and modular resilience (Rubinov & Sporns, 2010) that have been used in similar studies on patients with MDD. This study will examine the correlation between network indices and disease duration by observing differences between the MDD subgroups and the HC group. The expected results of this study based on the network resilience analysis predict that MDD subgroups are higher than the HC group, supporting that MDD has relatively more randomized networks in the subject's brain. The purpose of this study is to determine which areas of the brain correlate with disease duration and their impact on networking patterns using correlation analysis. Through this data, we can determine if MDD patients have networking abnormalities compared with HC and the effect of disease duration. This data will be taken into account in the clinical practice for the detection and treatment of patients with MDD.

Darien High School

Teacher: Christine Leventhal

Project # 95

Brown, Lyle

The effects of caloric restriction on erythrocyte lipid composition compared and correlated with skeletal muscle acid profiles after caloric restriction

Research Proposal, Science, Health

The goal of this experiment is to deetermine the effects of caloric restriction (CR) on erythrocyte lipid composition and to compare and correlate these changes with skeletal muscle acid profiles after CR. Erythrocytes were taken from 20 healthy women before and after 4 weeks of 33% CR in post-exercise conditions; muscle biopsies were obtained from the same athletes after 4 weeks of 33% CR in post-exercise conditions. Samples were used for FA determination by gas chromatography. The results would be similar to that when used with men. Which is that CR significantly modified erythrocyte FAs composition. The skeletal muscle FA profile was extremely different from that of the erythrocytes. Conclusions that I expect to be drawn from this experiment are that CR modifies erythrocyte lipid composition, mainly omega-6 FAs. Erythrocyte monounsaturated, polyunsaturated, and omega-6 FAs, were significantly positively correlated with skeletal muscle FAs. There is a lack of consistency between saturated and omega-3 FAs from erythrocytes and muscle, but monounsaturated, polyunsaturated, and omega-6 fatty acids are positively correlated.

Darien High School

Teacher: Guy Pratt

Project # 96

Buchesky, Alexia

Disc degeneration affecting the apoptosis, viability and proliferation of nucleus pulposus cells via the PKM2 gene

Research Proposal, Science, Health

Intervertebral disc degeneration (IVDD) is the leading cause of lower back pain. Scientists observed that there is increased cell apoptosis and decreased cell viability and proliferation in nucleus pulposus cells (NPCs) undergoing degeneration. That being said, the knowledge on the etiology of the disease is still limited and effective non surgical treatments are limited. The current non surgical treatments are for symptomatic relief rather than treating the root cause, therefore it is important to learn more about the etiology in order to find a more efficient and low risk treatment. There has been recent exploration of the composition and physiology of intervertebral discs (IVDs). It has been supported that the ATF4 and PKM2 genes play roles in the apoptosis, viability, and proliferation in IVDs. A new study observed the relationship between the two genes and IVDD. They conducted a knock out study of ATF4 to observe the effects. I propose that they further investigate the relationship between PKM2 and IVDD by conducting a knockout study with PKM2. I predict that the knocked out PKM2 gene will cause a rise in apoptosis and affect the health of the NPCs. I plan to analyze the results of the apoptosis levels, cell viability, and proliferation in the NPCs. I expect to find that the silenced PKM2 will cause a rise in apoptosis and decreased health of the NPCs. This study will provide more information on the role that PKM2 plays in the NPCs and IVDD.

Darien High School

Teacher: Guy Pratt

Project # 97

Buckjune, James

A Combined Modeling Approach to Observe Near Surface Wind Flow in the Wirtz Crater: Feasibility of CFD Modeling

Research Proposal, Science, Physical Science

Mars is a focal point for space research because of its accessibility. Although there is a general understanding of Martian wind processes, more research is needed to be able to accurately map wind and dune processes. The Martian atmosphere is one hundred times thinner than Earth's atmosphere. The thin atmosphere results in a higher transport capacity - higher wind speeds are necessary to initiate sediment transport. These variations make it difficult to model wind, sand transport, and other factors on the Martian surface. One method that has been successful in modeling near-surface wind flow is a combined approach using global climate modeling (GCM), mesoscale modeling (MRAMS), and near-surface wind flow modeling computational fluid dynamic modeling (CFD). This methodology applies data from the macroscale, collected by the Ames GCM to mesoscale (MRAMS) and microscale (CFD) programs to produce a combined model of near-surface wind flow in a specific region. This methodology was successful in modeling near-surface wind flow in multiple regions including the Nili Patera barchan dune field, as well as the Proctor Crater. This study will expand upon previous studies by applying this method to the Wirtz Crater. The Wirtz Crater is located in the southern hemisphere at 48.6° south and 26° west and stretches 75 miles in diameter. It is expected that this study will yield models that match previous studies of near-surface wind. This study will further test the feasibility of CFD modeling as well as reveal the near-surface wind process in the Wirtz Crater.

Darien High School

Teacher: David Lewis

Project # 98

Bulsara, Karishma

Examining the Relationship Between Pain and Weight During the COVID 19 Pandemic

Research Proposal, Science, Behavioral

Throughout the pandemic, many routines and habits were abruptly interrupted. While unemployment rates skyrocketed, so did the birth rates. Raising children with less access to nutrition had a serious impact on their future health. The rates of pediatric obesity have almost doubled since the start of the pandemic. Obesity is defined as having a BMI of greater than 30. Previous research has tried determining the relationships between obesity and chronic pain symptoms. The purpose of this study is to determine the effect of the covid 19 pandemic on the participation of obese individuals based on demographics of the participants. The hypothesis is that if the participant came from a lower socioeconomic background with preexisting medical and psychological conditions, then they would be most impacted by the pandemic because access to nutritious foods become more difficult for this demographic. The independent variable is the background of the participant which includes socioeconomic status and pre existing medical/psychological diagnoses. The dependent variable is the participants participation in the weight management programs which will be measured by a cutoff date in the program indicating how long they were in the program. There is no control since this is a comparison focus group study. The age group of participants, along with a general range of BMI will be kept constant in this study. My mentor will collect all the patients from Connecticut Children's Hospital. They will be split up based on socioeconomic status and pre existing medical/ psychological conditions. Once I receive patient information, with the help of a research assistant, I will conduct interviews with the participants asking a series of questions to assess changes they experienced throughout the pandemic. Question will assess the individual's relationship to eating, activity and mood. Parents will also be separately interviewed to gather more background data. Once the data is collected, I will analyze the data to see if the participants with similar backgrounds also shared similar outcomes in terms of obesity. The specific statistical analysis test that we will use will be determined once data is collected. The results of this study will be most applicable to kids today, as the pandemic is still around. Modes of treatment and resources can be established to help decrease the rates of pediatric obesity for the future.

Amity High School

Teacher: Catherine Piscitelli

Project # 99

Burbank, Aiden

Ping Pong Robot

Research Proposal, Engineering, Physical Science

Can robotics be used as a replacement for human players in Ping Pong? I will find this out through designing and creating a Ping Pong robot that will successfully return a Ping Pong ball hit by a human player. This will be done through having multiple arm-like segments, each controlled by its own motor. The robot will see the ball with a multiple camera system that will track the ball and predict its location in real time. I will first design the Ping Pong robot in Solidworks, then 3d print my design on a smaller scale. With the model, adjustments will be made until the design has minimal flaws. With this more complete design I will go to a metal manufacturer and have a full sized model made out of aluminum. A mix of ROS(robot operating system) and python coding will be used to control the robot. Basic functions like moving will be coded into the robot first, then more complicated things like tracking the Ping Pong ball movement will be completed. After all of the functions are incorporated improvements will be made to increase speed and efficiency for a better outcome. I expect that the robot will be incapable of the goal at first but I will keep making improvements until it does work. When the robot fully works I think that it will be capable of replacing a human player on a low level and will be able to return a ball back across the table.

Newtown High School

Teacher: Timothy DeJulio

Project # 100

Cannon, Emma

Determining the Ability of Polytrichum commune (hair cap moss) and other mosses to Remove Algae-Causing Phosphates and Nitrates From Water

Research Proposal, Science, Environmental

When large amounts of phosphates and nitrates enter a body of water, algae blooms can occur, causing the surface of the water to become covered. This leads to poor water quality since the algae growth blocks sunlight from underwater plants. In addition, when the algae dies, the oxygen in the water is consumed. This lack of oxygen makes it difficult for aquatic life to survive. The purpose of this study is to determine if naturally occurring moss, specifically Polytrichum commune, or common haircap moss, will be successful in removing large quantities of these nutrients due to the distinct ridges running across their leaves. Polytrichum formosum, or black haircap moss and Polytrichum juniperum, juniper haircap moss, will also be tested. First, a fertilizer containing phosphates and nitrates will be added to water, and the initial levels of these nutrients will be recorded. One fourth of the water will be set aside to be used as a control. The 3 mosses will then be each exposed to the polluted water and the water will be tested for phosphates and nitrates over time. It is expected that the Polytrichum commune will remove a significant amount of the phosphates and nitrates from the water. The implications of this experiment are that mosses can be used along the shoreline to remove the algae-causing pollutants before they enter the water. Water will become safer to swim in, and will also be more environmentally stable for the marine life who inhabit it.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 101

Cardamone, Beatrice

Transmissible Spongiform Encephalopathies: A Possible Treatment

Research Proposal, Science, Health

Transmissible Spongiform Encephalopathies (TSE's), or Prion Diseases, are neurodegenerative diseases, about which we know very little. They seem to be associated with a type of protein, called the prion protein (PrP) and its malformation, the scrapie prion protein (PrPsc). These diseases are always fatal, and there are, in essence, no treatments available. Within the last decade, we have, however, made significant strides in understanding their pathology. Based on this, several things have been tested as possible treatments, but none have produced considerable results. These previous ideas have all revolved around what is called the Prion Only Hypothesis, which states that the malformed prion protein is the infectious particle in TSE's, and there is therefore no genetic component. Over the years, there have been mounting studies seeming to contradict this idea. My goal is to, by analyzing available data, propose a new kind of treatment, which may, in the future, help TSE patients live longer.

Newtown High School

Teacher: Timothy DeJulio

Project # 102

Chan, Katherine

Antibacterial Activity of Fucoidans From the Brown Algae Saccharina latissima Against E. coli

Research Proposal, Science, Health

This project will be conducted to explore a possible novel and cost effective way of treating E. coli. Today, E. coli poses a major problem to public health. Annually, E. coli infections lead to approximately 265,000 illnesses and 100 deaths in the U.S. alone. Therefore, an inexpensive and effective treatment is needed to treat E. coli and stop its spread. Sugar kelp is a type of native brown algae that has been used a nutrient rich food source for thousands of years around the world. Brown algae is known to contain fucoidans, sulfated polysaccharides found in the cell wall that demonstrate promising antibacterial properties. This project will test if fucoidans, obtained by extraction from sugar kelp will kill E. coli bacteria. It is hypothesized that if the fucoidans are used to soak disks, placed on a lawn culture of E. coli bacteria, it will result in the death of most of the bacteria as evidenced by a clearance zone around the disk spots of the culture. The fucoidans will be extracted with water and gradient precipitation with different concentrations of ethanol. Hopefully, the disks soaked with fucoidan extract will show significant antibacterial properties against E. coli through a notable clearance zone.

Joel Barlow High School

Teacher: Paul Testa

Project # 103

Chaudhari, Neil

Evaluating Media Bias with Artificial Intelligence

Research Proposal, Science, Behavioral

Media, especially news, is a conduit for information to pass through and has an immense influence on its consumers. Unfortunately, bias is prevalent in almost every news source around the world. Bias leads to untruthful news and influences the way consumers perceive current events. The objective of this project is to create a machine-learning model that detects bias in such articles which can be achieved by collecting data from a wide variety of sources across the internet using web scraping algorithms such as Newspaper3k. Prelabeled data can even be collected from websites such as bitterlemons.org, which labels the way their articles are biased. Prelabled data can be used to train the models, while unlabeled data can be used to test the models. Using prelabeled data, bias can be detected by tokenizing the text and filtering out filler words from keywords. These keywords can then be funneled into an algorithm called word2vec. Word2vec uses neural networks to learn word associations from text and assigns vector values to words based on how they are perceived. The main models that computer scientists use for Natural Language Processing and Sentiment Analysis are Support Vector Models and Recurrent Neural Networks. The machine learning algorithm can teach itself by adjusting its weights and biases. Vector values for words can train these models, and allow the machine to teach itself whether certain keywords are biased towards a predetermined topic. One effect such a project could have on society would be the ability for consumers to make informed decisions, and acknowledge bias in the media around them.

Greens Farm Academy

Teacher: Mathieu Freeman

Project # 104

Conopask, Ella

Teenage Anorexia Identification Using Deep Learning Principles

Research Proposal, Science, Behavioral

Anorexia Nervosa can go undetected in teenagers because family members do not recognize the warning signs such as skipping meals and excessive exercise. A deep learning algorithm could be beneficial in helping family members identify Anorexia risk in teenagers. A multilayer perceptron could identify at-risk teens by assessing the importance of characteristics related to Anorexia development. In order to accomplish this, data will be gathered by simulating a parent's perspective when filling out a form. The data will be split into a training set and a testing set. Data points will be drawn from the forms and scaled to integers that can be input in a self-made algorithm. After preliminary weights and biases are assigned, the algorithm will modify them by using the loss equation which will compare the actual result given by the training dataset to the output of the algorithm. Once completed, the algorithm will take inputs and output a decimal 0-1 based on the level of risk a given teenager has of Anorexia, with anything over .8 being of high concern and .2 being low risk. To assess the accuracy of the algorithm, it will be run with the testing data set and the outputs will be compared to the individual client risks. Teenagers with Anorexia, or at risk of Anorexia are rarely aware they need help. This algorithm could be used by concerned parents questioning whether to seek medical help for their teens.

Greens Farm Academy

Teacher: Mathieu Freeman

Project # 105

Costello, Isobel

The Effect of Temperatures on the Carbon Dioxide Output and Food Consumption Rate of Darkling Beetles; Implications for Migration, Pest Control, and Climate Change Adaptability

Research Proposal, Science, Behavioral

This study will look at food consumption and CO2 output by darkling beetles at elevated temperatures. The increased consumption of crops by the darkling beetles may simulate what occurs during climate change. It is hypothesized that the increased CO2 output and food consumption predicted for the darkling beetles in the container under the heat conditions could impact the environment in negative ways. Twenty four beetles will be separated equally into two containers. Both containers will have wood sticks, apple flesh, and hay pellets and the experimental variable will be in a light box with high temperatures. The control container will be in room temperature conditions. The CO2, humidity, and temperature will be checked every 72 hours. The CO2, humidity, temperature, apple flesh, stick, and pellet masses will be recorded 12 days after the start. A second phase is underway with a higher temperature experimental group. Results thus far indicate that more food consumption occurred and more CO2 was produced in the higher temperature conditions. After 12 days, three beetle larvae under the heated conditions were the only beetles left surviving. This could indicate that darkling beetles thrive in warmer conditions, and implications for climate change would be that more pests could thrive. The increased consumption rate for the darkling beetles under the heat conditions could affect food production and distribution in areas affected by climate change as the beetles, in response to high temperature conditions, may eat an excess amount of farm crops.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 106

Cox, Lydia

Using Sunscreen as a way to distribute Beneficial Microorganisms for Corals (BMCs)

Research Proposal, Science, Environmental

Using Sunscreen as a way to distribute Beneficial Microorganisms for Corals (BMCs). This project is trying to create a BMCs enriched sunscreen that will be used to distribute the BMCs to a natural reef environment. To do this a 2-section sunscreen compartment will be created. In half of the container freeze-dried BMCs will be stored, the other half there will be non-nano zinc oxide (the sunblock). The first question that will be tested is will the BMCs rehydrate in the zinc or in water. To see how effective the BMCs are at mitigating the effects of bleaching a heat stress simulation will be performed. There will be 12 fish tanks used in the whole experiment but only 6 tanks will go through the heat stress simulation. The water temperature in the 6 tanks will start at 26°C and be raised to 30° C over a period of 10 days. Then the water temperature will remain at 30 degrees celsius for 10 days, before being lowered back to 26°C over 10 days. There will then be a 20-day recovery period. To inoculate the coral, mannequin arms will be used, on them will either be the BMCs, zinc-oxide compound or just zinc. Mannequin arms will be used instead of actual people to avoid working with humans, farther down the road the sunscreen will be tested on humans. The other 6 tanks will remain at 26°C as a control. This sunscreen could be a way to distribute BMCs to natural environments.

Newtown High School

Teacher: Timothy DeJulio

Project # 108

Datta, Snahasish

Testing the Effects of I-Raum and Hybrid E Alterations on the Effectiveness of Hohlraums in Inertial Confinement Fusion

Research Proposal, Science, Physical Science

As the world transitions from using fossil fuels for energy production toward renewable energy sources, nuclear fusion has emerged as a possible viable source. Although fusion reactions have been produced by researchers, there has only been one instance of achieving ignition, in which a fusion reaction becomes self-sustaining and produces a greater energy output than the energy required to begin the fusion reaction. Inertial confinement fusion (ICF), in which fusion reactions are initiated by compressing and heating targets containing a fuel mixture of deuterium and tritium using lasers, is a method that has been successful in nuclear fusion research. The target of the lasers, the hohlraum, has been successfully optimized using two methods: I-Raum, which alters the shape of the hohlraum, and Hybrid E (HyE), which alters the amount of energy transferred. In this study, a combination of these methods will be used to assess their effects on fusion performance. This will be tested 4 times: once in which both I-Raum and HyE are used, twice in which I-Raum and HyE are tested individually, and once in which they are not used at all. These tests will be assessed on the total energy yield and ion temperature. The success of these methods could provide a more effective hohlraum which would result in a better fusion reaction.

Darien High School

Teacher: David Lewis

Project # 109

DiDona, Danielle

Better Delivery of Drugs Through the Blood-Brain Barrier

Research Proposal, Science, Health

The problem is that drugs and treatments needed to help cure brain cancer can't get through the blood-brain barrier because it is too constrictive. The approach to solve this is to test the ability of certain drugs and how they get through the BBB. Some methods are to use drugs that are helpful for the curing of brain cancer and see how well they penetrate the barrier.

Ridgefield High School

Teacher: Patrick Hughes

Project # 110

Donovan, Chelsea

Post Traumatic Stress Disorder and Anxiety in Adolescent Emergency Medical Technicians (EMTs)

Research Proposal, Science, Behavioral

Post Traumatic Stress Disorder and Anxiety are common mental health disorders that afflict first responders. This study attempts to determine if there is a significant mental health impact on adolescent EMTs at Darien EMS, Post 53 by examining the difference in the mental health of the adolescent and adult EMTs within the organization. It is expected that adolescent EMTs will endorse higher levels of PTSD and Anxiety on average in comparison to adult EMTs. Due to the intense stressors these EMT high school volunteers face, it's more likely that they will suffer more mental health issues than adult EMTs. Prior to participation in the study, the director of Post 53 will inform the parents of adolescent EMTs about the study and how their child's responses will contribute to the study's data. Additionally, informed consent will be included in the survey for individuals who voluntarily participate. All participants will be asked to fill out the survey online through Survey Monkey, which contains the PC-PTSD trauma screener and the GAD-7 anxiety screener. Through the survey, participants will anonymously self-report their symptoms and provide demographic data (age, gender, sexual-orientation, race, school grade, EMT/non-EMT). Benefits from the study can include early identification, early prevention, and early intervention for students who may be at risk for a mental health crisis. Results of the study also provide Post 53 with valuable information regarding the mental health status of their student volunteers, which would allow them to direct dedicated resources to support this population.

Darien High School

Teacher: David Lewis

Project # 111

du Pont, Sophie

Epidemiological Observations About Comorbid Phenotypes Related to PTSD Development in Offspring

Research Proposal, Science, Behavioral

Animal and human studies have been performed to document developmental (or sensitive) periods that can have an effect on brain function and structure. This can, as a result, affect the behavior and disease of humans and animals, and their offspring. Although epigenetic research on PTSD has supported involvement in differential risk and resilience for PTSD in the aftermath of trauma, less research has been done on the distinct genetic tags that regulate PTSD development and their ability to be inherited. Through performing an analysis of electronic health records for phenome-wide accusation studies, software algorithms can be used to substantiate epidemiological observations about comorbid phenotypes related to PTSD development in offspring. Findings are expected to support that environmental exposure interactions with the genome in the neural system of parents will translate to their offspring's susceptibility to PTSD development upon the inheritance of epigenetic tags. These findings can help to provide a hopeful future for understanding the biology of epigenetic relation to PTSD, which provides promise for future interventional approaches routed in aiding the prevention of the disorder.

Darien High School

Teacher: Guy Pratt

Project # 112

Dudas, Paloma

The Spread of Vaccine Behavior in a Social Network

Research Proposal, Science, Behavioral

Vaccinations can reduce the spread of illness and protect the most vulnerable in a community; however, some people have vaccine concerns that lead them to opt out. It would be interesting to understand vaccine hesitancy and how individuals influence one another in their vaccination behaviors. Social network studies also suggest the possibility that similar benefits in reducing the spread of illness in a community can be obtained by targeting vaccinations to central social nodes in a community. I aim to explore how targeting vaccines to those who occupy central "influencer" positions within a community may increase vaccinations throughout the whole of the social networks and perhaps also efficiently reduce the spread of the virus itself. I propose collecting data to model the social networks in two similar towns. The models will identify the central nodes and concentrated social groups in each town. The information will be used to target vaccinations to the social nodes in one town, while no targeting will be done for the second town. Software tools such as Trellis and Breadboard will be used to evaluate differences in the spread of vaccinations and disease between the two towns. It is expected that the number of vaccine takers will be higher and the spread of disease lower in the town where vaccinations are targeted to centralized nodes. This data can be used to target limited resources to contain illness. The data may also help to limit the fallout from vaccination hesitancy.

Darien High School

Teacher: David Lewis

Project # 113

Ehrlich, Ella

Studying the Inhibition of Genetic Proteins in C.elegans to Reduce the Occurrence of Obesity

Research Proposal, Science, Health

Obesity has been an important issue studied throughout history, especially in recent years. According to the Centers for Disease Control and Prevention, the rate of obesity in the United States from 2017 to 2020 was 41.9%. This percentage represents a significant increase from the 30.5% reported for the years 1999 to 2000. Related obesity conditions include heart disease, stroke, type 2 diabetes, and cancer. This study will survey the effects of inhibiting genetic protein variants on the fat storage and glucose uptake in C.elegans. The variable group for this study will be the group with the knockout gene GPR75 for obesity. The C.elegans wild type with this gene intact will be used as the control group. Both the wild type control and knockout gene variable C.elegans will be fed a high-glucose diet. At the end of the trial, fat storage and glucose levels will be tested. Specifically, dark field microscopy will be used to study fat storage and a glucose uptake measurement kit will be used to measure glucose uptake levels. The lifespan of each group will also be monitored. The expected results of this study are that the knockout of the GPR75 gene variant will decrease the prevalence of obesity by lowering both fat storage and glucose uptake levels in the C.elegans. It will also result in a longer lifespan. This study will significantly contribute to obesity studies, which can eventually be used to reduce the rate of obesity in the human population.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 114

El-Masry, Claudia

Predicting a Rise in Smoking Due to the Psychological Effects of the Coronavirus Pandemic

Research Proposal, Science, Physical Science

The data collected from the Severe Acute Respiratory Syndrome (SARS) epidemic in China showed an increase in depression rates among the Chinese population during that period of time. The coronavirus pandemic has likely had a similar effect on the American population. Depression and other mental illnesses have been linked to tobacco abuse, especially among youth. I hypothesize that there will be an increase in depression rates among Americans, which will lead to an increase in smoking. I am using data taken by the organization Let's Get Healthy California regarding depression and smoking statistics. I will then use machine learning and deep learning to determine by what percentage depression increases the risk of smoking. I predict that I will see an increase in depression rates similar to what was recorded in China. I predict that due to this increase, I will see a spike in smoking in the United States. Smoking is extremely harmful to a person's health, but even more so to youth. Predicting which areas will be hit the hardest by depression will help organizations that educate against smoking to pinpoint where they should focus their educational and aid efforts.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 115

Finn, Maggie

Comparing the Ability of the Molecule EGCG, found in Green Tea, and the Enzyme Hsp104, found in Yeast, to Break Amyloid Fibrils into Soluble Oligomers as a Treatment for Alzheimer's disease

Research Proposal, Science, Health

Alzheimer's disease (AD) is a neurodegenerative disorder that causes the brain to shrink and brain cells to die. Researchers have centered on the role that two proteins play when studying the cause of AD. These proteins are beta-amyloid fibrils, which lead to amyloid plaques, and tau proteins, which lead to neurofibrillary tangles. This study will compare the ability of Epigallocatechin gallate (EGCG), from green tea, and Hsp104, from yeast protein, to transform the amyloid fibrils into soluble oligomers to treat the disease. A spectrophotometer will be used to first measure the transmittance of light to detect the insoluble amyloid fibrils in the test solutions. It will also test aggregation prevention by the molecules EGCG and Hsp104. The cloudiness of the amyloid fibrils will represent aggregation and this will be measured by lower light transmittance. It is predicted that when the amyloid fibrils are allowed to react with EGCG and Hsp104, a higher transmittance of light will take place and this will show less aggregation. Once the test tubes containing amyloid fibrils and EGCG and the amyloid fibrils with Hsp104 are shaken and placed in the spectrophotometer, they will be examined in five-minute increments over a total 30-minute time intervals. Results will continue to be measured daily for two weeks. The results may show the potential for these molecules to reduce the aggregation of amyloid fibrils. This study will give insight into reducing the symptoms of Alzheimer's disease. and could lead to improvements for other neurodegenerative diseases, such as Parkinson's Disease.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 116

Foley, Annabelle

Analysis of Previous and Current CRISPR Based Treatments for Huntington's Disease with the Goal of Developing a New Treatment

Research Proposal, Science, Health

Currently, Huntington's disease(HD) is incurable, despite the efforts of numerous clinical trials. Huntington's disease is a hereditary neurodegenerative disease. The disease is determined by the huntingtin (HTT) gene. Mutations in the HTT gene cause the onset of Huntington's disease. The large role genetics play in the onset of HD makes Huntington's disease a good candidate for CRISPR based genetic engineering treatments. CRISPR is a relatively new method of gene engineering that allows genes to be found, edited, and/or replaced. CRISPR treatments have the potential to treat HD both after diagnosis and before symptoms begin to show. However, there have been various unsuccessful trials attempting this treatment. This project will attempt to find a detailed, theoretical way to use CRISPR treatments in treating HD by analyzing past and current experiments/ trials in this area of research. This data will be compared and analyzed with the goal of finding the flaws in each trial, combing the information, and developing a plan for how future experiments can succeed in the treatment. This project will look at Huntington's on both a genetic level and a larger scale by analyzing any brain scans and gene sequences included in past experiments. This data will be compiled and any insight will be thoroughly recorded throughout the course of the research process. A conclusion will be be drawn from this data analysis. If the experiment is successful, this conclusion will include a plan for the development of a new CRISPR-based treatment for Huntington's disease.

Newtown High School

Teacher: Timothy DeJulio

Project # 117

Formica, Filippo

The MacroEnvironment

Research Proposal, Science, Environmental

The objective for this project is to build and record data from an enclosed environment simulating the variability of the atmosphere naturally, using temperature differences to recreate the water cycle inside of a fish tank. If this objective is achieved, the process in which we study environmental impacts can be made easier, so instead of simulating the environment, scientists can recreate one inside of an enclosed space, making the process of studying environmental science more natural. Procedure: -Create an enclosure that contains water and soil, to simulate the ocean and a continent -Put a heating source on the button of the enclosure to try and simulate the environment needed for evaporation -Put a cooling source on the top of the enclosure to try and simulate the environment needed for condensation -Put a fan on one side to push all condensation to one side until the droplets are heavy enough to fall to the surface onto the soil -Let the water drain from the surface to the ocean and let the cycle repeat -Once the system is running properly, experiments can be conducted by changing the respective temperatures to reproduce different meteorological activities The goal is to create a working water cycle inside of a fish tank, and to be able to let it run without human influence.

Newtown High School

Teacher: Timothy DeJulio

Project # 118

Gaaserud, Ellie

The Relationship Between Extreme Temperatures and EMS Activations

Research Proposal, Science, Health

In 2021, there were nearly 49 million EMS activations. EMS has been utilized more in recent years than ever before, so identifying and managing the causes of the increase in EMS activations is essential. It is known that weather has a notable impact on health. High temperatures can exacerbate cardiac and respiratory conditions, cause emergencies like heat stroke, and increase the risk of certain accidents such as drowning. Low temperatures can exacerbate respiratory conditions, cause emergencies like hypothermia, and increase the risk of certain accidents, including motor vehicle collisions. This study seeks to identify the correlation between extreme temperatures and EMS activations. First, weather data will be gathered from the National Oceanic and Atmospheric Association (NOAA). The weather data will be connected by zip code to EMS data by the National Emergency Medical Services Information Service (NEMSIS). The data will be analyzed with alphanumerical hashes in place of the zip codes to obey patient confidentiality laws. In order to determine extreme weather events, the study will examine how much daily ambient temperatures deviate from monthly median temperatures. To isolate the effects of extreme warmth and heat, warm-season months (May to September) and cold-season months (January to April and October to December) will be examined separately. The incidence rate ratio and associated confidence intervals for the association between daily temperature and rates of EMS activations will be estimated by logistic regression. Larger deviations from monthly median temperatures are expected to increase the percent change in EMS activations.

Darien High School

Teacher: Guy Pratt

Project # 119

Gil, Brookley

The Effect of Informative Stimulus on Viral Protection and Transmission

Research Proposal, Science, Teams (Research Proposal)

1) After the rise and decline of SARS-CoV-2 there has been a societal disinclination towards preventing the spread of viruses. In schools, masks are not mandated, people are not advocating for hand washing or sanitizer use, and virus season is at a high in these winter months. Our observational analysis would offer a means to measure the effect of educatory stimuli on combating viral infection. 2) We would start by selecting 30 classrooms at Barlow to participate in the experimentation, placing informative posters: depicting the dangers of viruses and how to prevent them, by the hand sanitizers of 15, and not using posters in the other 15. At the end of each week, we would collect data on the amounts of hand sanitizer used by class, and compare the differences of use in classrooms with and without the posters. Then, we would obtain anonymous attendance records by class, to find any relation between absences, posters, and amount of hand sanitizer used by class. No students will be interacted with during this process. 3) We predict that this educatory stimulus; the informative posters, will insentience students to use hand sanitizer more frequently, limiting the spread of bacteria, and maintaining a safer classroom environment, which would yield higher attendance rates.

Joel Barlow High School

Teacher: Paul Testa

Project # 120

Glynn, Liam

Methylphenidate treatment of Parkinson's disease in Drosophila melanogaster

Research Proposal, Science, Health

Parkinson's disease (PD) is the second-most common neurodegenerative disease. PD research and correlating treatments have largely focused on the neurodegeneration of dopaminergic neurons in the substantia nigra, overlooking the locus coeruleus which is the primary site for norepinephrine synthesis in the brain and another site of Parkinson's-related neurodegeneration. Norepinephrine has been demonstrated as a protectant against neurotoxins and its deficiency has been identified as the primary cause of executive function impairment in PD. Methylphenidate is a central nervous system (CNS) stimulant that slows the reuptake of both dopamine and norepinephrine, thereby increasing their intracerebral levels. In this study, methylphenidate will be administered per os in titrated weight-based doses to three experimental groups of Drosophila melanogaster expressing a gene, SNCA, causative of human alpha-synuclein, a protein that is deposited in the affected portions of the brains of PD patients. Two negative control groups will be examined; one will consist of unmedicated flies expressing SNCA, while the other group will consist of unmedicated flies not expressing SNCA. Drosophila from each group will be assessed in the areas of locomotion with a climbing assay and an open-field arena test and executive function with an optomotor maze. It is expected that improved locomotion and executive function would be demonstrated in affected Drosophila treated with methylphenidate over affected but untreated Drosophila. Improved results in the experimental groups will indicate the potential feasibility of methylphenidate as a Parkinson's disease treatment. Future work may investigate the use of stronger but related CNS stimulants such as amphetamines.

Greens Farm Academy

Teacher: Mathieu Freeman

Project # 121

Greco, Bella

The effect of cold therapy on palms in between workout sets on physical performance

Research Proposal, Science, Health

1) Athletic performance while lifting has been known to drop as muscles overheat and tire over time. 2) -(without any cold therapy) have 5 test subjects complete 4 sets of 3 different exersizes until failure on different days and count the reps - (with cold therapy) have 5 test subjects complete 4 sets of the same 3 exersizes until failure on different days and count the reps -put ice packs on palms during 3 minute rest between sets - compare number of reps until failure each set with and without cold therapy 3) - My expected results are a 40-60% increase in muscle stamina and number of reps each set 4) Many lifters and athletes around the world could use my research to improve performance and muscle gain.

Ridgefield High School

Teacher: Ryan Gleason

Project # 122

Gupta, Siddharth

The Use of Ground Granulated Blast Furnace Slag in Concrete for the Purpose of Increasing Unconfined Compressive Strength

Research Proposal, Engineering, Physical Science

N/A

Joel Barlow High School

Teacher: Paul Testa

Project # 123

Hardy, Madeleine

Analyzing the relationship between environmental factors and equine encephalitis

Research Proposal, Science, Environmental

Throughout the past decade, mosquito populations have either doubled or tenfold in size, leaving not only the human population more exposed to virus but the equine population as well. With Florida hosting the highest frequency of horse farms, it can be seen how mosquitos may play a relevant part in Equine disease, with Florida having a large mosquito population plaguing the southern region. One of the most common mosquito-borne infections is called encephalitis, an infection that targets the brain causing it to swell and cause severe damage such as seizures and movement problems. As the population of mosquitoes has grown subsequently the number of equines with encephalitis has grown as well. This study aims to discover which environmental factors affect the number of horses with equine encephalitis in the United States. The location of a ranch is incredibly vital to the health of its horses. This study will look at environmental factors such as distance to cities, mountains, rivers, ponds and lakes in relation to its mosquito population in relation to the equine encephalitis cases. Discovering the environmental factors that aid in encephalitis cases will help ranchers protect their horses from disease and in uncovering more information about encephalitis itself.

Darien High School

Teacher: Christine Leventhal

Project # 124

Hicks, Cate

Caffeinated Energy Drinks Effects on Health and Performance

Research Proposal, Science, Health

1. Problem Statement: Creating awareness and helping to educate the public and athletes of all levels to the possible effects consuming caffeinated energy drinks may have. As well as, increasing our knowledge of how these energy drinks and they herbs they contain may boost athletic performance. 2. Methods, procedures, and approach: My approach to conducting this research will either be to- 1. Distribute a survey to athletes; collecting data on how they feel common caffeinated energy drinks boost their performance during training and competition. 2. Study non vertebrae such as fruit flies, conduct an experiment in which specific herbs found in caffeinated energy drinks such as guarana and ginseng affect certain functions of the organism studied. 3. Findings and results: I expect to find that caffeinated energy drinks do not have significant effects on athletic performance as advertised. However, specific herbs found in these drinks such as guarana and ginseng may have effects such as speeding up metabolism and stamina. 4. Implications: By educating athletes on these drinks and the effects they may have, they will better be able to understand what they are putting into their bodies and wether or not they will enhance athletic ability.

Ridgefield High School

Teacher: Ryan Gleason

Project # 125

Huitron, Martha; Krishnan,Ashwika

Finding Microplastics in Marine Organisms Using Hydrogen Peroxide and Nile Red Dye.

Research Proposal, Science, Teams (Research Proposal)

Finding Microplastics in Marine Organisms Using Hydrogen Peroxide and Nile Red Dye. Microplastics are extremely small pieces of plastic debris left in the environment. They mainly come from polypropylene, a material used for packaging items, but can come in many forms. Microplastics are not visible to the human eye and are present in many objects in our daily lives, such as our clothes and even our food. Several studies regarding microplastics have used a fluorescent dye called Nile Red dye. The dye employs a combination of fluorescence microscopy and image analysis software in a semi-automated process and attaches itself to the plastic particle, making it visible under a fluorescent microscope. Using this dye and hydrogen peroxide, marine organisms such as shrimp, muscles, and oysters that humans typically consume will be tested for microplastic they could have eaten in the ocean before being caught. Microplastics are expected to be found in the various samples of invertebrate marine organisms. If there are statistically significant results, this will bring awareness to the large problem regarding microplastics. It would further the research on the impact of microplastics on marine ecosystems and human consummation of seafood.

Ridgefield High School

Teacher: Ryan Gleason

Project # 126

Jackson, Hope

Environmental Effects on Eel Grass and Scallop's Reproduction

Research Proposal, Science, Environmental

Environmental changes & new predators (green crabs) have depleted eel grass, which is the natural habitat for scallops and the only place they will reproduce.

Darien High School

Teacher: Christine Leventhal

Project # 127

Not Participating

Project # 128

Jones, Alyssa

Regenerative Abilities of Animals and How They Can Transfer to Humans

Research Proposal, Science, Health

Humans do not have the ability to flawlessly heal wounds or regenerate limbs due to the scarring of tissue. The only organ that is able to do this is the liver, utilizing specialized stem cells. However, many different animals have mastered this ability, such as the sea star, flatworm, and jellyfish. These three organisms use similar methods of employing stem cells in order to heal organs, limbs, and wounds. I will be proposing an experiment to discover and compare the different mechanisms that these animals use in regeneration. To do this, these three organisms will be looked at under a microscope while healing different areas of their bodies. There will be a focus on observing and recording how the stem cells work within these organisms. The findings of this experiment will then be compared to the healing of human liver in order to find areas of overlap or insight into how stem cells can be introduced or activated throughout humans' entire bodies. From this experiment, one overlap is expected to surface and a comprehensible plan will be able to be formed to create a way that humans would be able to use a healing mechanism. If successful, this will have a great impact on the ways that humans can heal and will have many benefits in the health industry, with the potential to regrow lost limbs and wounds without scarring.

Newtown High School

Teacher: Timothy DeJulio

Project # 129

Keating, Riley

The use of Relyvrio for Spinal Muscular Atrophy in addition to a Single-Dose Gene-Replacement Therapy

Research Proposal, Science, Health

Spinal muscular atrophy (type one) is a fatal disease in infants caused by the deletion or mutation of the survival motor neuron (SMN1) that leads muscles to atrophy. SMA1 is the most common form of SMA and there are currently only 3 treatments and no definite cures to the disease. In previous studies, gene replacement therapy was used to add a survival motor neuron gene to patients with SMA. Although this gene therapy was supported by motor function increase in most patients, this treatment was not as effective in patients with a later diagnosis of SMA who started the treatment later in their infancy. Relyvrio, an oral drug commonly used to treat ALS, could be used to increase motor function after gene therapy. This treatment is commonly used to prevent motor neuron loss and slow disease progression in patients with ALS. Relyvrio is not known to be effective or safe in infants with SMA1. Through performing an analysis of data about Relyvrio, whether it can be supported to be used for SMA1 can be determined through using software algorithms. Findings are expected to support that Relyvrio will increase motor function and be a safe treatment for SMA in addition to gene therapy. This research is expected to also support an increase in the effectiveness of this gene therapy, especially for patients with a later diagnosis. This research and treatment could lead to a longer life and increased motor function in infants with SMA1.

Darien High School

Teacher: Guy Pratt

Project # 130

Keehlwetter, Lily

The Effect of Ascorbic Acid and Aspartame on Livers in Rats

Research Proposal, Science, Health

Aspartame is an artificial sweetening agent used for its zero-calorie properties. Although approved by the FDA, studies have demonstrated Aspartame's potential carcinogenic properties with long-term use. Ascorbic Acid (AA) is a vitamin aiding the growth and repair of tissues. AA has shown potential success in countering Aspartame's negative effects and preventing organ deterioration. This study will investigate how the liver, an organ that detoxifies blood, is affected when consuming Aspartame and AA. If rats are fed AA, then their livers will be protected from the harmful effects of Aspartame. This proposed experiment will use 30 male Albino Wistar rats, aged 8-12 weeks old. Rats will be divided into 3 groups: 10 controls, 10 fed Aspartame, and 10 fed Aspartame and AA. Drugs will be crushed and combined with pellets for oral consumption. Blood samples will be collected twice: before the consumption of drugs and after. Three blood tests will be performed: blood serum bilirubin, serum albumin, and prothrombin time. After 6 weeks, rats will be sacrificed and their livers will be removed. The Paraffin Embedding Method will help examine liver structure. It is predicted that AA should prevent Aspartame from damaging liver tissue. Evidence is expected to show no change in the control group, negative change in the group fed Aspartame, and minimal/lesser change in the group fed Aspartame and AA. Results from this experiment will provide information regarding the role of Aspartame in an organism and the benefits of AA.

Darien High School

Teacher: David Lewis

Project # 131

Kholmanskikh, Maria

LncRNA DILA1 inhibits Cyclin D1 degradation and contributes to temozolomide resistance in glioblastoma cancer

Research Proposal, Science, Health

LncRNA DILA1 binds to cyclin D1 (CCND1) and protects it from degradation. Here, I propose to investigate if DILA1 plays a pathologic role in a hard to treat cancer – glioblastoma (GBM). The COSMIC database of cancer mutations states that CCND1 is overexpressed in nearly 6% of samples. GBM cells become resistant to the drug of choice temozolomide (TMZ) leading to 100% relapse rate. The level of CCND1 expression in patient-derived treatment naïve GBM cells before and after TMZ treatment will be measured by Western Blot and qPCR, and levels of DILA1 expression could be measured using RT-qPCR. Adding antisense oligonucleotides (ASO) against DILA1 to TMZ resistant cells will be followed by treatment with TMZ and measuring their viability using MTT assay. By adding ASO treated and untreated cells to immune-suppressed mice, I will be able to watch the formation of tumors. By measuring years of survival as a function of various levels of DILA1 expression in patients, mortality rates can be determined. When comparing the parental (naïve GBM cells) to the TMZ resistant cells, I expect to find that the levels of CCND1 and DILA1 are higher in the TMZ resistant cells. DILA1 knockdown will lead to lower cell viability in vitro and minimal tumor growth in vivo when treated with both ASO and TMZ. I expect to see higher mortality rates in people with higher DILA1 expression. This research could lead to using the level of expression of DILA1 to determine prognosis and finding a drug to target DILA1.

Darien High School

Teacher: David Lewis

Project # 132

Kosnik, Greta

Grey and White Matter Differences in Adolescents and Young Adults with Autism Spectrum Disorder and Major Depressive Disorder

Research Proposal, Science, Health

Adults with autism spectrum disorder (ASD), a developmental disability that affects about 2% of children in the United States, are known to have co-occurring psychiatric conditions, with depression as one of the most common co-occurring disorders. It has also been found that depression or major depressive disorder (MDD) is related to brain circuitry abnormalities in suicide attempters, especially in young adulthood when suicide is the leading cause of death. Identification of brain circuitry abnormalities in adolescents/young adults with depression is important for generating widely effective early prevention strategies for suicide. This study will examine brain circuitry in adolescents/young adults with autism and depression, only depression, only autism, and typical development (TD), the control group. Thirty-three young adults with ASD and 28 young adults with TD will undergo structural and diffusion-weighted magnetic resonance scanning. Whole-brain analyses will compare grey matter (GM) volume and white matter (WM) fractional anisotropy (FA) between participants. Participants with ASD and MDD will have the most differences in GM volume and WM FA. Participants with only ASD or only MDD will have some differences in GM volume and WM FA, but fewer differences than participants with both disorders. These findings will suggest that grey and white matter alterations in adolescents/young adults could serve as a form of suicide prevention in those with ASD and co-occurring depression. Future studies may include larger cohorts to obtain a clearer understanding of specific relationships between the disorders and brain matter, and effects in additional sections of the brain.

Darien High School

Teacher: Guy Pratt

Project # 133

Kulkarni, Avani

Creating Accurate Models Of Mass Transferring Eclipsing Binary Star Systems To Predict The Conditions Necessary For Blue Straggler Star Formation & Evolution

Research Proposal, Science, Physical Science

The purpose of this project is to create accurate models of mass-transfering eclipsing binary star systems in order to predict the conditions necessary for blue straggler star formation, as eclipsing binary stars, when combined due to transfer of mass, form blue straggler stars. The project involved creating light curves of three different eclipsing binary star systems, two younger systems and one older system, from the data from the telescopes TESS and ASAS-SN. The eclipses and dips in the light curve were used to determine various physical parameters of the eclipsing binary stars, such as the masses, radii, and temperatures, among others. The light curves were cleared of contamination from other nearby star systems by setting apertures on the telescopes and manual removal of extraneous data. Values of parameters were determined using various equations and principles of eclipsing binaries, applied in the program PHOEBE using Python. A model light curve was created from the parameters and matched to the measured light curve, confirming the accuracy of the parameters. Monte-Carlo simulations are being used to determine confidence intervals of the models/parameters. Successful models have been made of all three star systems, and analysis of results to determine the relationship between individual parameters of eclipsing binary stars and the behavior of the eclipsing binary system and blue straggler stars is ongoing. Implications of this study are that there is an increased understanding of the behavior of eclipsing binary systems and further insight into the root of blue straggler formation.

Amity High School

Teacher: Catherine Piscitelli

Project # 134

Larizza, Chloe

Testing Phosphorus and Nitrogen Levels in Connecticut Waters

Research Proposal, Science, Behavioral

Decent water quality is required for human consumption, recreational activities, and ecological conservation. However, industrialization has led to an increase in agricultural growth and the use of phosphorus and nitrogen containing fertilizers, heavily contributing to water contamination. The phosphorus and nitrogen used in fertilizers eventually gets brought to its surrounding waters through runoff, becoming a dissolved nutrient for organisms in the water, and forming a large abundance of algae. The algae then coats the top layers of many waters, denying organisms of sunlight, and ultimately killing them; this process is called eutrophication. Many New England states have banned the use of phosphorus-containing fertilizers, with the exception of Connecticut, which make many question whether Connecticut's efforts to reduce phosphorus levels, such as the 2012 Public Act of 12-125, are effective enough to prevent eutrophication in Connecticut waters. This experiment will test the levels of dissolved phosphorus and nitrogen in Gorham pond located in Darien, Connecticut which connects to the Goodwives River. The study will first use a LaMotte nitrogen testing kit to determine the levels of nitrogen. This testing kit allows one to compare a sample of regular tested water to a sample of the tested water combined with mixed acid reagent and nitrate reducing reagent, to reveal the levels of nitrogen through colors. The study will secondly use a LaMotte phosphorus testing kit, which tests the levels of phosphorus present in the sample by adding VM phosphate reagent and reducing reagent to the sample revealing a color which corresponds to different levels of phosphorus. The experiment is expected to reveal high levels of nitrogen and phosphorus due to Connecticut's lack of attentiveness to its waters.

Darien High School

Teacher: David Lewis

Project # 135

Lash, Camilla

Efficacy of Melatonin as IL-4 Production Inducer Measured by Monthly ELISA in COPD Modeled Rattus norvegicus Domestica.

Research Proposal, Science, Health

While normally used to regulate sleep cycles, Melatonin, a hormone that can be synthetically made, is also responsible for activating Helper-T Lymphocytes, which increase the production of Interleukin four. Interleukin four is a cytokine that regulates the release of antibodies and controls inflammation within the body. This study will identify whether or not there is a correlation between melatonin dosage and a significant increase in Interleukin four levels in mice modeled with COPD. After four weeks of COPD induction*1, twenty-four Rattus norvegicus Domestica will undergo Sandwich ELISAs*2 by use of 15 µl blood samples and marker Cy-5 Streptavidin. The subject IL-4 levels will be recorded and entered into MyAssay's Software*3. Group one will receive 40mg melatonin, dilute with normal saline 100ml in a 20cc syringe, the second group will receive an 80mg melatonin dosage, and the remaining eight will receive no treatment. The melatonin treatment will be administered twice a week for eight months through a 3mm intra-arterial cannulation tube, with new ELISA results recorded at the end of every month. The activation of Helper-T lymphocytes will also be assessed by the DC maturation and differentiation, and up-regulation of activation markers. It is predicted that groups receiving melatonin treatment will have significantly higher IL-4 count. The results of the study will help further research for the 16.4 Million Americans with COPD and others around the world. The findings will also indicate the efficacy of melatonin as an inflammatory regulator by analyzing the CD4 Helper Lymphocyte levels.

Darien High School

Teacher: Christine Leventhal

Project # 136

Mendes, Jackson

Effects of sulfur dioxide pollution on the shelf life of gelatin pill capsules Research Proposal, Science, Teams (Research Proposal)

Sulfur dioxide pollution is decreasing the shelflife of gelatin pillsSulfuric acids with a molarity ranging from 0.0003162 to 0.00001 will be measured out. Pure Gelatin pill capsules will be bought. A gelatin pill would be washed with ethanol and air dried then placed in a beaker; Five ml of the sulfuric acid solution will be aerosolized using the modified Sinclair and La Mer method and captured in the beaker containing the pill. After a varied amount of time, the acid would be neutralized using ammonia gas. The pill would be removed and washed with ethanol and air dried. The pill would go under electron spectroscopy to look for bi-products of gelatin delegation due to acid hydrolysis

Joel Barlow High School

Teacher: Paul Testa

Project # 137

Lent, Ian

Investigation of Antioxidant Inhibition of Linoleic Acid Oxidation

Research Proposal, Science, Health

Linoleic Acid is an Omega-6 fatty acid in a wide array of food items. Linoleic acid readily oxidizes and oxidizes Linoleic Acid has been linked to a host of health problems including coronary heart disease, Alzheimer's, and diabetes amongst others. The aim of my research is to determine which antioxidant best prevents the oxidation of linoleic acid. Method: The fatty acid was extracted by, 10 mL of the extraction solvent (iso-propanol/hexane, 1:2) was added and the samples were thoroughly mixed and centrifuged for 15 min at 4.5 × 107 g The top layer, containing the fatty acid, was methylated and analyzed for conjugated dienes. This top layer was diluted with hexane to a concentration of 0.015 mg/mL. Approximately 3 mL of the sample was analyzed for UV absorbance at 235 nm by a Vernier UV-Vis spectrometer against a blank of hexane. A calibration curve was obtained by measuring the absorbance (y) of a series of solutions containing 0–0.03 mg conjugated LA/mL hexane (x) resulting in the linear regression equation x = y/74.306 (R2 = 0.989) [3] The results were expressed as mg conjugated LA/mg initial. The implications of this research are a specific antioxidant can be determined to be most effective in helping prevent the health effects associated with oxidized linoleic acid. This antioxidant can be tested in human trials to ensure it has a similar function in conditions within the body.

Joel Barlow High School

Teacher: Paul Testa

Project # 138

Lewis, Skylar

Combating misinformation and bias through a web browser extension

Research Proposal, Science, Behavioral

I will help combat misinformation and bias in the news through creating a web browser extension. The web browser extension will highlight biased language and hopefully give a score as to the average percentage of biased language per 100 words. I also want to create a pop up that prompts people to think about what they read for a moment. I will research how to code and then how to specifically code a web browser extension. I will also look through various news outlets and collect a list of biased words to make sure that the web browser extension is coded to highlight them. I hope that through using the final product of this project people will be more aware of what they read in the news and recognize that our brains are easily persuaded. If people are aware of what they are reading and actively thinking about it I hope that they will not be as easily misinformed.

Newtown High School

Teacher: Timothy DeJulio

Project # 139

Lonergan, Isabella

Plantar plating is a better surgical method than modified tension band wiring for fifth metatarsal stress fractures

Research Proposal, Science, Health

Stress fractures are a common injury that affects many athletes. Fifth metatarsal stress fractures occur in the bone of the foot that connects the pinky toe to the ankle, and can have trouble healing due to poor blood supply to the area. The stress fracture will then need surgery for it to heal. Although there are different surgical methods that can be used to heal this injury, there are possible complications, including refractures and nonunions. Despite plantar plating being a relatively new surgical method, the small number of case studies conducted has yielded positive results. Modified tension band wiring is another surgical method for this injury and is commonly used, well-known, and has more data. Scientists are still searching for which surgical method has the least complications and allows athletes to return to sports as soon as possible. Would modified tension band wiring or plantar plating be a better surgical method for fifth metatarsal stress fractures? I propose that plantar plating is a better surgical technique than modified tension band wiring for fifth metatarsal stress fractures. I will analyze data from articles on plantar plating and modified tension band wiring for fifth metatarsal stress fractures. I will look at radiographic and clinical results in studies to determine which surgical technique is better. I expect to find that plantar plating is a better surgical technique with less complications and faster return to play for athletes. This research could lead to people with fifth metatarsal stress fractures healing faster with minimal complications.

Darien High School

Teacher: Christine Leventhal

Project # 140

Matyszkowicz, Adrian

The effect of specific treatments on subtypes of obsessive compulsive disorder determined by multimodal neuroimaging compared to treatments that are more general

Research Proposal, Science, Health

Obsessive compulsive disorder (OCD) is a mental illness that affects millions of people. It is characterized by obsessive and unwanted thoughts that result in compulsive actions. In recent studies with mental illnesses, it has become clear that determining subtypes of illnesses can help target specific treatments and help increase the standard of living of those affected. In a recent study, a multimodal neuroimaging method of measuring the Amplitude of Low-Frequency Fluctuation (ALFF) and Gray Matter Volumes (GMVs) using MRI scans was able to determine two subtypes of OCD (OCD 1 and OCD 2). This was focused on the structure and function of the brains of those with OCD compared to those unaffected. In this experiment, those results will be used to analyze specific treatments for each subtype. 100 people with OCD will be split into four groups; two groups for each subtype. One group in each subtype will obtain a specific treatment targeted for their subtype, and the other group in each subtype will receive a baseline treatment generally prescribed to those with OCD. For OCD 1, treatments will be focused on sensory processing and attention. For OCD 2, treatments will be focused on attention control and sense processing. General treatments will focus on the compulsions themselves. Patients' progress in treatments will be recorded, ultimately determining the impact of specific treatments compared to more general treatments. This will help specify treatments and the complexity of mental illnesses will be better understood, focusing on improving the lives of those affected.

Darien High School

Teacher: David Lewis

Project # 141

May, Katie; Nemec, Kate

Determining Skin Cancer Prevention Behavior, Perceptions, and Knowledge Among High School Students Across the United States: A National Cross-Sectional Survey

Research Proposal, Science, Teams (Research Proposal)

Skin cancer is the most common cancer in the United States with melanoma, the most serious type of skin cancer, exhibiting more than 200,000 cases each year. It is the deadliest progressive skin cancer that may require invasive treatment and result in negative long term effects. This study will survey high school students by gender and region across the country to determine sun and skin care knowledge, trends, and practices. States surveyed will include CT, CA, NY, MI, LA, MO, FL, MD, PA, TX, MA, NJ, IL, NE, and WA. Previous studies show that the Northwest Central region practices the most sun safety, including wearing hats, sunscreen, and long-sleeved shirts. It is therefore hypothesized that the students in NE and MO will have the most knowledge of sun protection and the students in LA, FL, and TX will have the least. It is predicted that teenage males will have less knowledge of sun protection as previous research indicates that sunburn prevalence is higher among males. A cross-sectional survey on sun protection knowledge and behavior will be sent out using a network of schools. It is expected that females and students in the Northwest Central region of the U.S. will have the most knowledge about sun protection, while males and southern students will have the least. This will be the first comprehensive survey of high school students as it relates to skin cancer prevention. It will provide information highlighting the regions and gender that need education on sun protection.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 142

Medeiros, Malin

Allergic complications following the BNT Pfizer and Moderna SARS-CoV-2 vaccination: correlation with immunosenescence?

Research Proposal, Science, Health

The mRNA-based SARS-CoV-2 vaccine is a nanoparticle-encapsulated lipid, nucleoside-modified messenger RNA that encodes for the SARS-CoV-2 spike glycoprotein. This includes excipients such as polyethylene glycol (PEG), known to cause hypersensitivity reactions. It was identified that anaphylaxis, a severe type of allergic reaction, occurs in only .000005% of vaccine doses administered. If patients receive either the BNT Pfizer or Moderna SARS-CoV-2 vaccine, will anaphylaxis be correlated with the immunosenescence of allergy sensitivity to PEG? The prevalence of anaphylaxis due to the SARS-CoV-2 booster vaccine will be recorded in samples of 300 vaccine recipients within the United States who have previously reacted to the initial vaccine. Patients will be split up into 2 groups of 150 recipients: one group under the age of 40 and the other older than 40 years of age. The severity of the reaction will be gathered and correlated with the age group for further analysis. This comparison will determine whether immunosenescence affects the overall prevalence of an allergy to PEG. It is expected that the older group (>40 years) will have a greater prevalence of anaphylaxis due to the SARS-CoV-2 vaccine. This is because of a development in sensitivity to PEG over time, including the weakening of the immune system. The results may be used for further reference for patients receiving the vaccine, allowing physicians to discourage older patients with an allergy to PEG from receiving the vaccination. This study will prevent a deadly allergic reaction to the SARS-CoV-2 vaccine from affecting recipients because immunization of the general population, including those with a history of anaphylaxis, is an important goal for the prevention of SARS-CoV-2.

Darien High School

Teacher: David Lewis

Project # 143

Meier, Lucas

Design and Testing of a Termite-Inspired Building Model for Optimized Ventilation and Thermoregulation

Research Proposal, Science, Environmental

The complex nest architecture of the fungi-cultivating Macrotermes termite species has been widely studied for its impressive demonstrations of ventilation and thermoregulation. Analyzation of the mechanics of Macrotermes nests can give insight into more effective ventilation and thermoregulatory properties for human architecture with the purpose of limiting the use of air conditioning, and its subsequent fossil fuel release, in buildings. Modern research on the nests of a wide array of species has made the implementation of termite properties into human buildings possible. The objective of this proposal would be to design and test a miniature termite-inspired building model under environmental conditions for its circulation and thermoregulatory properties. Predicted results would most likely demonstrate this model's effective thermoregulation and ventilation capability with minimal use of air conditioning or electricity powered mechanics. The results would additionally aid in further methods of modification for this model and other model constructions to improve the systemic air circulation and temperature maintenance. If the results emerge as predicted, this study will have developed and presented a successful building model for possible human-sized construction and use. The findings of this study would help demonstrate the possibility and potential of termite-inspired human buildings, and hopefully inspire future studies on this topic.

Darien High School

Teacher: Guy Pratt

Project # 144

Messina, Sophia

Identifying Novel Classes of Gliomas Based on Radiomic Imaging Features

Research Proposal, Science, Health

Gliomas are types of tumors that occur in the brain or spinal cord. Astrocytomas and glioblastomas are types of gliomas. Gliomas are given a grade, demonstrating their severity on a scale of 1-4, with one being the least aggressive, and four being the most aggressive. In 2000, the World Health Organization devised a classification system to categorize central nervous system tumors. Many tumors do not fit well into these categories and glioma classes are currently based exclusively on pathology. This creates issues because radiologists encounter tumors from the same pathological classification that look different on imaging. Radiomic features are quantitative features in medical images. Clustering algorithms cluster data points based on their shared characteristics/similarity. The purpose of this research is to identify novel subtypes of gliomas based on radiomic imaging features. It is hypothesized that distinct, novel subtypes of gliomas can be identified using imaging features of gliomas The independent variable is the imaging features the glioma has, and the dependent variable is the class of the glioma. The student will cluster a portion of the gliomas from the Yale database of 2000 patients using 4 different clustering algorithms, compare how similar the gliomas are within each cluster, and compare their differences based on the distance between the clusters. Statistical analysis will be performed. Seeing if the features of these tumors are significantly different from their pathological neighbors will help determine whether the gliomas need to be divided into subtypes within the overarching umbrella of the original classification.

Amity High School

Teacher: Catherine Piscitelli

Project # 145

Meyers, Emma

Impact of Methylene Blue on Coral Health in a Mixed Species Controlled Environment

Research Proposal, Science, Environmental

Oxybenzone has damaging effects on coral health and is an active ingredient in most sunscreens. Methylene Blue, MB, a chemical used for the prevention of cellular damage and as an antioxidant, has the potential to replace Oxybenzone as the active ingredient in sunscreen. To compare MB and Oxybenzone, three conducted tests looked for coral reef mortality, ability to protect against UV rays, and DNA double-strand breaks. Detrimental effects of coral were tested by using one species of coral, Xenia Umbellata, in a controlled environment. For MB to be an effective alternative to Oxybenzone, it must be shown to not have detrimental impacts on multiple coral species in a mixed environment similar to that found in naturally occurring coral reefs. The purpose of this study is to determine if environmental exposure to MB by multiple coral species in a controlled environment will result in detrimental impacts on coral health. It is predicted that results for coral mortality will show improvement compared to those of Oxybenzone. If MB does not cause detrimental effects on multiple coral species, further testing and advancement in this study are suggested, such as assessing coral in a replica ocean environment while testing the overall ecology of reefs. With this, there is more reason to believe that MB would be successful in a real-life ocean environment. With that being said, further testing and research must be conducted to determine this possibility, and if a MB-based sunscreen would be successful

Darien High School

Teacher: Guy Pratt

Project # 146

Mills, Lloyd

Effects of Question Style and Supporting Images on Accuracy of Survey Responses.

Research Proposal, Science, Behavioral

1. The way survey questions are made changes the reliability of the results. 2. Two online surveys will be conducted. They will each be asking personal opinion questions (e.g. What is your favorite dessert? What time do you think adults should go to sleep?). The first survey will be a control group, simply asking these questions with a free response box to answer. The second survey will take each of the questions and add some way to influence the respondents answers. Some of these ways include adding images above the question, like a cookie if the question asks about dessert. Another way is including information, like the average time an adult gets to sleep for a question about when people should get to sleep. 3. These surveys will probably find more people choosing answers that coincide with the particular answer suggested with the bias (e.g. more people saying cookies when there is a cookie image). People will also most likely avoid answers that seem to be warned against (e.g. less people will say they like Apple phones the best if there is a photo of broken Apple devices). 4. Some implications this research could have is that it will shed light on how to better conduct surveys to prevent accidental bias and influence on the respondents. This could also increase our knowledge of social influence and to what degree people are influenced by what they see and read. This research could also influence the creation of online tests and quizzes in school to optimize how well it represents the students true ability.

Ridgefield High School

Teacher: Patrick Hughes

Project # 147

Miranda, Bernardo

Conformation-specific Tau Antibody Alz50 Binds to Tau Expressed by Discharged Aggregates from Liquid-Liquid Phase Separation

Research Proposal, Science, Health

Microtubule-Associated Protein Tau (MAPT) is an intrinsically disordered, highly soluble protein found primarily in neurons. Under normal conditions, tau regulates the stability of axonal microtubules and intracellular vesicle transport. However, in patients of neurodegeneration such as Alzheimer's Disease (AD), tau forms neurofibrillary deposits, which correlates with the disease progression. Past research has shown that tau undergoes liquid-liquid phase separation (LLPS) to transition from its soluble intrinsically disordered state to its aggregated, droplet-like state. Along with that, using paired-helical filament (PHF) tau conformation-specific antibodies to detect PHF-tau expressed by neurons has been shown to be a successful way to pinpoint concentrations of tau protein. Using radioimmunoassay to measure the affinity of antibody binding, this study will test if there is a connection between the formation of tau aggregates through LLPS inside of a neuron to tau expression that conformation-specific antibodies–specifically Alz50, T22, Tau-2, and TOMA-1– can bind to. It is expected that the formation of extremely dense tau droplets inside of the cell will cause smaller aggregates (fibrils) to be discharged from the droplet, and those aggregates will be expressed on the neuron. It is hypothesized that Alz50, as a tau aggregate conformation-specific antibody, will bind the most to the neurons expressing aggregates discharged from tau droplets. If supported, this hypothesis will result in easier and more efficient ways to allocate AD, as well as give more information on how the disease works.

Darien High School

Teacher: Guy Pratt

Project # 148

Moore, Bridget

Relationship of the Psychological ACL-RSI Score and Return to Sport After Anterior Cruciate Ligament Reconstruction between Males and Females

Research Proposal, Science, Physical Science

After anterior cruciate ligament (ACL) reconstruction, a successful return to sport demands optimum physical and psychological recovery. The Anterior Cruciate Ligament-Return to Sport after Injury (ACL-RSI) scale is an instrument used to measure a patient's psychological preparedness to return to sport following this surgery. The primary aim is to analyze the progression of females versus males ACL-RSI scores from preoperative to the 2-year follow-up. This prospective study includes athletes older than 16 years in all sports and levels of play who had ACL reconstruction throughout a certain time period. Afterward, they will respond to all study questionnaires throughout their follow-up. The outcome of the study is predicted to have a difference between females' and males' ACL-RSI scores obtained preoperatively at 4-month, 6-month, 1-year, and 2-year follow-ups. The secondary outcomes will likely compare females' and males' return to sport (running and the same preinjury sport) rate. The predicted results will show that the ACL-RSI score will improve in both females and males. Additionally, males are predicted to return to sport earlier than females.

Darien High School

Teacher: Guy Pratt

Project # 149

Navin, Samantha

Testing the Antibacterial Properties of Pumpkins

Research Proposal, Science, Environmental

Testing the Antibacterial Properties of Pumpkins Bacteria damages the immune system and causes illnesses. In order to stay healthy, we have to avoid getting infected with too much bacteria, so there needs to be solutions that can combat the spread of bacteria. Many vegetables have shown they have antibacterial properties, so I am testing pumpkins to see how their saponins can combat the bacteria. I will extract the saponins from Connecticut field pumpkins (Cucurbita Pepo) by mixing them with various solutions and using an orbital shaker. Then, I will mix the extracted saponins with E. coli to test how they affect the spread of the E. coli bacteria. The result of my experiment will reveal how effective pumpkins are at fighting bacteria, to be able to know how pumpkins compare to other vegetables, and whether they can be used as a natural way to fight sicknesses.

Joel Barlow High School

Teacher: Paul Testa

Project # 150

Olvany, Steven

Evaluation and Comparison of the Percent Lipid Yield of Different Algae Types

Research Proposal, Science, Environmental

Producing fuel products renewably could provide a solution to the draining of fossil fuel reserves. Additionally, producing fuel in a more sustainable way helps to reduce the detrimental effects that fossil fuel extraction has done on the environment. The extraction of lipids from algae is capable of being an efficient, renewable, and much more environmentally friendly method of producing fuel products. This study will serve to determine what strain of algae will produce the highest percent lipid yield. It is expected that Bottryococcus braunii will produce the highest percent lipid yield, as previous studies have provided it to contain a high lipid content (Taylor L. Weiss). The experiment will compare the percent lipid yields of 4 different types of algae: Bottryococcus braunii, Chlorella vulgaris, Haematococcus pluvialis, and Nannochloropsis oculata. For all algae types, a modified Bligh and Dyer method will be performed to extract the lipids (B. Ramola). The sample will then be refined through an evaporation process such that the end product has a relatively high lipid purity. After extracting and refining the lipids from the algae sample, an analysis will be performed to determine the percent lipid yield of each algae sample. Through this data, it will be determined which algae type allows for the highest percent lipid yield, thus indicating which algae type allows for the most efficient fuel production.

Darien High School

Teacher: David Lewis

Project # 151

Patricio, Ana

The Role of the Prefrontal Cortex in Confidence: Can One's Sartorial Choices Boost Confidence?

Research Proposal, Science, Behavioral

An individual's sartorial choices might not only influence how others perceive them and how one perceives themselves, but can also influence decision-making in significant ways through their influence on processing style. Studies suggest that the nature of an everyday experience—wearing clothing—affects cognition broadly, impacting the processing style that changes how objects, people, and events are construed. Enclothed cognition depends on both the symbolic meaning and the physical experience of wearing clothing, describing the systematic influence of clothes on the wearer's psychological activity. Similar to physical experiences, the experience of wearing clothes triggers associated symbolic meanings. Consequently, when a piece of clothing is worn, a psychological influence is exerted on the wearer's psychological processes by activating associated abstract concepts through their symbolic meaning. The backyard brain's spiker box will be used to detect signals and brain waves in the frontal cortex during the participant's use of different clothing options. Additionally, a confidence or self-esteem survey will also be used to detect and recognize patterns in confidence when wearing different clothing. The findings and results of this experiment are expected to suggest the ways in which an individual's sartorial choices benefit their performance and boost their confidence levels. It is expected that the signals presented by the participants' brain waves and survey results will designate the influence clothing has on the wearer's psychological processes and behavioral tendencies. Thus, this study will suggest how enclothed cognition influences brain function in the frontal cortex as well as one's self-confidence.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 152

Petrizzo, Allison

Detecting Per-and Polyfluoroalkyl substances (PFAS) in Medical, School, and Delivery Uniforms

Research Proposal, Science, Environmental

Per-and Polyfluoroalkyl substances, or PFAS, are a class of chemicals known as forever chemicals because their bonds are extremely strong. These chemicals are usually found in soil and water and derive from non-stick and stain-repellent products and firefighter foam. PFAS has been shown to cause immune defects and interfere with the body's natural hormones. This study aims to determine how prevalent PFAS chemicals are in common uniforms, such as nursing and pharmaceutical scrubs, and delivery and school uniforms. Textiles will be cut into 2x2 mm pieces, then weighted into 15 mL polypropylene tubes and extracted twice with 3 mL of 4:1 hexane/ isopropyl alcohol, followed by 3 mL of 1:1 methanol/acetonitrile. For each extraction step, the sample will be shaken for 30 min and then centrifuged at 3000 g for 5 mins. The supernatants will be combined, reduced in volume to 5mL, cleaned with activated carbon by vortexing for 1 min, concentrated to 500 uL under nitrogen, then filtered using a centrifugal filter, and transferred into a 1 mL polypropylene vial for a final sample volume of 1mL. The samples will then be run through an LC-MS/ MS and GC-MS Analysis. It is expected that all textiles labeled stain resistant or waterproof will have PFAS present. This study will help people be more aware of the prevalence of PFAS in stain-resistant or waterproof clothing, specifically uniforms, and will hopefully lead to more environmentally-friendly options to make clothing with these desired characteristics.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 153

Philip, Lara

Observatory technology in the study of dark matter

Research Proposal, Science, Physical Science

The study of dark matter becomes increasingly relevant as the need to find future colonies in space arises during climate change and natural destruction: although dark matter has been theorized to affect aspects of the universe such as expansion rate, scientists know little about the substance. Therefore, little about space exploration can be understood without taking into account the effects dark matter has on the universe. However, when looking at observatory technology such as satellites and improving on their abilities, the search for dark matter becomes much more likely. First, properties of dark matter must be completely understood and taken into account in order to infer which pieces of technology would be most useful in the race to find dark matter. Then, using studied information from existing technology and theory of possible future technology, theoretical data can be calculated and analyzed to find the probabilities of using certain machines to contain and study dark matter. This could be done using computer programs that can calculate probability when inputs of different variables such as speed, size, and resilience are used. It is expected that little modern technology could be used to study dark matter, but that theoretical alterations and improvements could be defined for future studies.

Darien High School

Teacher: Christine Leventhal

Project # 154

Prince, Lucas

Predicting the Trajectories of the Portuguese Man-of-War to Protect Public Beaches

Research Proposal, Science, Behavioral

The Portuguese man-of-war is infamous for washing up on beaches, in numbers from one to thousands, like the Basque Coast incident (on the northeast coast of Spain) in 2010, where roughly 3500 Portuguese man-of-war washed up and closed beaches in the area for days. Portuguese man-of-war commonly wash up on beaches worldwide in tropical and subtropical waters. Propelled by wind and water currents, the Portuguese man-of-war has a sail on the top of its gas chamber, which it uses to catch the ocean breezes and float across the ocean's surface. In 2020, Ferrer and Hernandez studied the region of origin of the Portuguese man-of-war involved in the 2010 Basque Coast incident. They used a wind drift equation for the organism in a particle tracking model and found it was most likely to originate in the North Atlantic Ocean. This proposal uses the same model and equation as Ferrer and Hernandez to predict the trajectories of future Portuguese man-of-war landings that might occur on the East coast of Florida, as seen during the fall to spring months. It is hypothesized that many of the model's predicted landfalls of the Portuguese man-of-war will be reflected in a real-life incident. For future work, if the hypothesis is supported, it would be suggested that this same experiment be carried out in more locations than just the coast of Florida, potentially around the world.

Darien High School

Teacher: Christine Leventhal

Project # 155

Qin, Bo-Jun

Long-term Orbital Stability of Planets in Single-star Systems vs. in Binary Star Systems

Research Proposal, Science, Physical Science

As astronomers continue their search for habitable exoplanets, a study of a planet's orbit about its host star system becomes important, especially as its star system likely differs from the solar system. Stars in the universe often form in pairs where two stars orbit each other about a common center of mass. A planet in a binary system either orbits one of the stars (circumstellar) or both stars (circumbinary). This study will compare the stability of a planet in a single star system to that of a circumstellar planet in a binary star system. N-body simulations will be used to mimic the evolution of single and binary star systems while hosting a planet. Stars and their systems will be randomly assigned properties of stellar and planetary mass, semimajor axis, binary mass ratio, eccentricity, and semimajor axis ratio, each from their respective distributions. The effects of these properties on how long a planet survives will be examined between single-star systems and binary systems to determine their orbital stabilities. It is expected that a single-star system will be the most stable in hosting a planet because of the strict parameters necessary for a circumstellar planet to orbit a binary system. In the future, this study could be applied to assessing the habitability of an exoplanet in terms of its orbital stability and ultimately lead to a better understanding of the solar system's stability in regards to other systems in the universe.

Darien High School

Teacher: Christine Leventhal

Project # 156

Rathjens, Anton

Utilizing simulation to determine the most energy-efficient structure and phase of doped 2DT-form TiO2 for splitting Hydrogen Peroxide into Hydroxide

Research Proposal, Science, Physical Science

Photocatalysis - catalysis utilizing light - is a worldwide point of interest. TiO2 is a photocatalyst used to clean fluids and synthesize hydrocarbons. TiO2 has two phases (anatase and rutile) that have separate uses. TiO2 has flaws: the microscopic sheets that it forms into (2DT) have difficulty adsorbing non-UV wavelengths, and TiO2's valence bands can deactivate during photocatalysis. Doping 2DT can alleviate these issues. A procedure was constructed using TiO2 to synthesize formaldehyde from methane. For this procedure, a subreaction must be completed: H2O2→2HO. This project's objective is developing a TiO2 structure for catalyzing the H2O2→2HO conversion with the least energy (ΔE), determining the most efficient phase and dopant. It is predicted that anatase will be most efficient, due to success in prior studies. Experimentation involves altering the dopant and phase of doped TiO2 and determining the energy requirement after a H2O2→2HO reaction. The format of 2DT will remain unaltered, as well as the H2O2. Testing of structures will be digitally simulated. The mentor will provide software techniques and help alleviate errors. The student's role will be building structures and running simulations. The plan is to dope anatase 2DT virtually, and compute the ΔE. Once the least ΔE with a doped structure is extrapolated, rutile will be tested. The phase of the most efficient structure is most useful. If the results of this project are significant, it will help optimize the formula for the CH4→CH2O reaction. This will help to provide insight for converting pollutants into valuable materials with TiO2.

Amity High School

Teacher: Catherine Piscitelli

Project # 157

Ritossa, Olivia

Using Graphene to Create a 3D Printed Starch-Based Bioplastic that is Thermally and Electrically Conductive

Research Proposal, Science, Environmental

Nearly 400 million tons of plastic waste are produced every year globally, and the United States is responsible for 40 million tons. Plastic waste is growing at an annual rate of 9%, however, the recycling rate is declining. Bioplastics that are also compostable can create a desirable circular waste system. It is hypothesized that the bioplastic produced in this study will be biodegradable, compostable, and be able to be 3D printed. In addition, the added graphene will make the bioplastic conduct heat and electricity. Psyllium husk will increase the bioplastic's strength. Two protocols will be tested. The first will include banana peels, sodium metabisulfite solution, hydrochloric acid, glycerin, and sodium hydroxide. The second will have banana peels, honey, thyme, and cinnamon. The overall methods will be the same for each protocol. Each protocol will include samples with and without graphene and psyllium husk. The samples without graphene and psyllium husk will represent the control group for the experiment. The first experimental group will contain graphene and the second will contain psyllium husk. The third experimental group will contain both graphene and psyllium husk together. Conductivity, strength, biodegradability, and 3D printing capability will be tested for each group, as well as for traditional plastic for comparison purposes. It is expected that the bioplastic with graphene and psyllium husk will be the most useful bioplastic due to its conductivity and strength. The optimum bioplastic produced can be used in the development of batteries, diodes, electrochemical capacitors, sensors, electrochromic devices, and fuel cells.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 158

Roche, Natalie

Toxoplasma Gondii and its Potential Causative Relationship with Alcohol Addiction in Mice

Research Proposal, Science, Health

Toxoplasma gondii, a protozoan parasite, is the causative agent for toxoplasmosis, an illness that infects the brain, causing behavioral and physical changes. It is an extremely prevalent disease, affecting 11% of the United States population, up to 60% of the world population, and up to 92% in Brazil. Because of its high exposure in countries like Brazil, it has possibly been tied to addiction of alcohol in humans, because of Brazil's similarly high levels of addiction. It is important for scientists to understand the relevance of Toxoplasma gondii in addiction in order to prevent the growing statistics of drug use and its effects. This study will use 80 three to four week old female mice to assess whether Toxoplasma gondii increases the addiction to alcohol. The 40 experimental mice will contract five cysts of the cystogenic ME-49 T. gondii strain through a gavage. They will be kept in two cages (experimental and control) with a consistent temperature of around 22 degrees Celsius. The 80 mice (experimental and control) will be given free access to alcohol, with their intake measured over six months. The 40 control mice will not contract Toxoplasma gondii, but will have the same access to the alcohol. From there, the aberrant behavioral and physical traits of the mice will be recorded, and the addiction-indicating behavior will be taken into account. This may include aggression, abnormal activity levels, and abnormal appetite. Total alcohol consumption by group will also be recorded.

Darien High School

Teacher: Christine Leventhal

Project # 159

Rutkowski, Sophie

Repellent Properties of Eastern White Pine Needles on Simulium Vittatum (Adult Blackflies), Relating to the Northern Goshawk Population in Connecticut.

Research Proposal, Science, Environmental

There has been recent scientific literature reporting the increased prevalence of avian blood parasites (Leucocytozoon toddi) in the Northern Goshawk (Accipiter gentilis) population in Europe and North America. Many accipitrides have been observed to place fresh leaves on the outside of their nests. The scientific literature studying the effectiveness of natural repellents uses oil extracts rather than pine needles in their natural state. There is currently no literature on the repellent properties of Eastern White Pine needles on blackflies, a potential carrier of blood parasites in Northern Goshawks. The purpose of this experiment is to determine the repellent properties of Eastern White Pine Needles (Pinus strobus) as it relates to adult blackflies (Simulium Vittatum). This experiment can be carried out using two Procedures, with Procedure 1 measuring the number of flies per given container, where one container has a pine sample (crushed, extract, or natural state) and Procedure 2 dealing with the number of flies per petri dish, where one food dish has a pine sample and the other does not. Results: the container with the least flies would be the most effective in repelling. The knowledge gained from this research would address the effectiveness of White Pine Needles in repelling blackflies, providing a basis for how pine needles themselves are a factor in decreasing nestling losses, as it relates to blackflies and the potential blood parasites they carry. Post-habitat loss, the needles' tetrides (scented chemicals emitted which have given properties) could be incorporated into nesting boxes to aid conservation.

Weston High School

Teacher: Christopher Gamble

Project # 160

Shah, Layla

Determining the Pigmentation of Overexpressed BAP1 on 92.1 GFP Cell Lines to Predict Prognosis for Uveal Melanoma

Research Proposal, Science, Health

Uveal melanoma, a rare cancer that occurs in about 5.1 per million cases per year in the U.S., originates from cells that produce melanin. A promising prognosis marker for uveal melanoma is the morphology: Gene Expression Profile (GEP1) cells have an epithelioid shape, while GEP2 cells have a spindle shape. Moreover, the loss of the BAP1 (BRCA1 Associated Protein1) gene in GEP1 cells is known to lead to the more aggressive GEP2 cell type. GEP1 cells have properly functioning BAP1, which protects against metastasis, driving the aim to assess the effects of overexpression or knockdown of BAP1 and other genes on the pigmentation of the cell. Via RNA-sequencing, we confirmed that BAP1 was overexpressed in different cell lines while simultaneously targeting different genes in the melanogenesis pathway that play a role in melanin production. Furthermore, protein isolation and identification via Western Blot analysis will reveal that the BAP1 proteins are present in these cell types. Finally, colorimetric assays will determine the phenotypic readout of pigmentation in the different cell lines in a 96-well plate assessed over a month. Collectively, these data will demonstrate that the BAP1 gene relates to the production of melanin and likely influence the evolution of GEP1 cells into the more aggressive GEP2 cells. Knowing this, we can now develop novel therapeutics to either upregulate or downregulate various genes to control the type of cell that forms to mitigate the harmful effects of uveal melanoma.

King School

Teacher: Victoria Schulman

Project # 161

Weiss, Alexander

Nano-Plastic Filtering utilizing 3D printed Polyethylene Terephthalate Glycol Filters with a maximum surface area design.

Research Proposal, Engineering, Physical Science

1. Can PETG filament be used to create a nano-plastic filter that can selectively filter polycarbonate nanoplastics from tap water. Procedure: 1. 3D model a filter shape using dynamic simulation software 2. Export filter shape for 3d printing, 3d print with PETG under necessary settings 3. Preform water absorption tests on the 3D printed filters, 24 and 48, including active flowing water tests 4. PER EXP- Grind a 1cm by 1cm by 3 mm piece of polycarbonate to nano-plastic size 5. Test filter design via submersion in water with polycarbonate nano-plastics mixed in, 24hrs, and 48hrs 5. Test filter design via submersion in moving matter with polycarbonate nano-plastics mixed in, 24hrs, and 48hrs 6. Take masses of each filter and send samples to Sacred Heart for SEM processing. 7. Determine amount of plastics left in the water sample via Sacred Heart SEM test 3. Findings will be calculated based on mass difference as well as the amount of particles visible under microscope screening. 4. As this is a 3D printed filter, this theoretically could be mass produced, allowing for the lowering of tap water nanoplastics throughout the world via the use of a similar filter.

Joel Barlow High School

Teacher: Paul Testa

Project # 162

Shen, Sophie

Efficacy of Plant Extracts as Potential Therapeutic Agents in Tauopathies Using Drosophila Melanogaster

Research Proposal, Science, Health

Tauopathies are a class of neurodegenerative disorders characterized by the aggregation of abnormal tau protein in the human brain. Several common tauopathies include but are not limited to Alzheimer's disease, progressive supranuclear palsy, and corticobasal degeneration. While there are currently no effective disease modifying therapies for tauopathies, several studies have found various plant extracts - including grape seed polyphenolic extract (GSPE), curcumin, and ashwagandha - to have possible therapeutic effects. In the model organism Drosophila melanogaster (a species of fly), tau expression results in locomotive defects. Thus, the effectiveness of these plant extracts in treating tauopathies will be measured through a Rapid Iterative Negative Geotaxis (RING) assay, a type of adult fly climbing assay, by comparing the mean climbing height achieved between wild type flies, tau expressing flies, and flies treated with dilutions of GSPE, curcumin, and ashwagandha respectively. It is expected that the wild type flies perform the best in this assay, but that the tau expressing flies treated with plant extracts will perform better than the untreated tau expressing flies because the plant extracts are expected to reduce the locomotive defects resulting from tau expression. If there are statistically significant results, this would merit further consideration of plant extracts as therapeutic agents using vertebrate organisms in order to pursue the development of viable tauopathy treatments.

Ridgefield High School

Teacher: Ryan Gleason

Project # 163

Smith, Dakota

The Effects of Vermicomposting on Textile Types

Research Proposal, Science, Environmental

Problem Statement: Which textiles are most biodegradable in a composting environment? Methods, procedures, and approach 1. Have three different containers that can become vermicomposting environments. 2. These three containers will represent the three different textiles that I will be testing: wool, cotton and nylon. 3. These three containers will be filled with earthworms (lumbricus terrestris) as well as a bedding made up of dirt, a mix of brown and greens, and unbleached paper (cardboard). 4. Over time, I will see how the worms react and what textiles decompose the fastest. Findings and results I think cotton will decompose the fastest because it is the least thick material. Then wool, and finally nylon, which may or may not decompose because it is a synthetic material. Implications My research is important because it will help people make more conscious choices about what clothing they buy and how their choices affect the environment.

Ridgefield High School

Teacher: Ryan Gleason

Project # 164

Smith, James

The Longterm effects of CD19 Targeted CAR-T Therapy on Systemic Lupus Erythematosus Mice

Research Proposal, Science, Health

The proposed study is based on the autoimmune disease Lupus which affects 1.5 million Americans. This will specifically explore treatments concerning B cell depletion through CAR T-cell therapy. Is there a way to work on disease treatment using treatments that have been successful for diseases that mimic Lupus? In a recent study, the CD19b cell was targeted and depleted using CAR-T therapy in Mice. The study was successful in showing sustainable b cell depletion but had drawbacks with the lifespan of the mice. This meant the study failed to show the long term effects of the treatment and its effectiveness after the five month period of testing. This poses the question, will the effects of the study, B cell levels, continue to stay manageable after the testing stops? From this question I came up with the experiment concerning the possibility of B cell levels rising again after the treatment process is over. This study will follow a similar setup as the experiment previously conducted but stopping after the treatment is complete and leaving the mice to live as opposed to sacrificing them. From here the mice will live the rest of their lives, and their B cell levels will be tested regularly to determine if the effects of the treatment are sustained after the treatment stops. It is hypothesized that the B cell levels will rise again meaning a change in treatment is necessary. This will provide information necessary to map out an effective treatment process to Lupus disease.

Darien High School

Teacher: David Lewis

Project # 165

Stewart, Skylar

Emotion and Its Impact on Perception: The Parallel of the Brain and External Reactions

Research Proposal, Science, Behavioral

In this study, it will be determined how a group of participants' perceptions of images are altered according to their current mood and level of emotion. It is important to keep in mind that emotion is a natural instinctive state of mind deriving from one's circumstances, mood, or relationships with others, and perception is the ability to have an awareness through physical senses, especially sight. First, IRB approval will be obtained. I then plan to test my hypothesis on a group of adolescents, using a survey to test their mood. The survey, adapted from the Mood and Feelings Questionnaire by Duke University, will include questions regarding the type of mood they are in. After completing the survey, the participants will then receive images, such as a hill, and be asked questions about the image. It is anticipated that the participants' answers will reflect the hypothesis: if prior emotion is more negative, then participants will have a more negative perception, such as labeling it as a steep hill. When participants are exposed to a higher level of 'happy emotion', they are more likely to have a positive view. In general, the reaction to a given image or scenario will be different if participants have just experienced a negative event or mood, as they will be more likely to view that same image scenario as negative. This study will demonstrate the importance of emotions within one's daily life, and the significant impact on how one encounters, views, and interacts with their surroundings.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 166

Stiker, Julia

Creating and testing an app to help reduce nightmares in at-risk individuals with depression.

Research Proposal, Science, Behavioral

Depression was first diagnosed in the 19th century and is the leading cause of disability worldwide. It is also the second most common cause of death among those aged 15-24. Research has shown that depression is exacerbated by nightmares, and there is no cure. However, there are multiple treatments that have been shown to help reduce their frequency and impact on the individual experiencing them. It is hypothesized that an app can be developed to reduce nightmares. To test human subjects, I will use the Beck Depression Inventory, the Spielberger State and Trait Anxiety Inventory, and the Sleep Disorders Questionnaire. The frequency of participants' nightmares would be evaluated with questions such as, How often have you experienced nightmares in the past week/month?" and "How long have you been experiencing nightmares?" After taking the survey, subjects would use the app. The app would use Imagery Rehearsal Therapy (IRT) and lucid dreaming techniques. The subjects' progress would be tracked weekly. At the end of each week, the subjects would answer a questionnaire detailing the frequency and severity of their nightmares that week. I expect that developing an app to help reduce nightmares will have positive effects on those who use it and will not have any negative effects. The purpose of this study and app is to reduce depression in at-risk individuals. Since approximately 800,000 people each year take their own lives, and up to 60% of those deaths are by people with depression, this study can have significant implications.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 167

Trudel, Evelyn

The Human Impact on the Credibility of Research Complete at Great Houses surrounding the Chaco Culture National Historical Site

Research Proposal, Science, Behavioral

Chaco Canyon is located in mostly the northwestern corner of New Mexico and was a thriving political power from 850-1200 AD. It is a national historical site as well as a UNESCO World Heritage site. During the early 1200s, Chaco Canyon was abandoned for an unknown reason and has lain empty ever since. Chaco Canyon is composed of over 150 Great Houses, which were large Pueblan homes believed to house Chacan royalty. They are used to study the behavior of the Chacan people. Many of these Great Houses are located outside of the historical site and are subjected to misuse by the general public. The objective will be to determine the credibility of research done at these sites outside the Chaco Culture National Historical Site containing Great House structures. The study will look at a minimum of five Great Houses with at least three separate articles containing data surrounding the date of the house as well as the artifact composition. Then, this information will be plotted on a graph and inconsistencies will be discovered. If the difference between the smallest and largest number is over 150%, then that great house will be determined as uncitable in future work. It is predicted that at least one great house will be ruled as unusable in future studies. As society progresses and the environment becomes more and more deteriorated, archaeologists will need to have the most accurate data to prevent another mass abandonment.

Darien High School

Teacher: Guy Pratt

Project # 168

Valji, Allison

Accuracy of Transit Observations of the Exoplanet WASP-1b using the MicroObservatory

Research Proposal, Science, Physical Science

Scientists look at exoplanets – or planets orbiting stars outside the solar system – using large telescopes, such as the recent James Webb Space Telescope, in search of life on other planets. However, in order to use these telescopes to study exoplanets, it is important that scientists have the most up-to-date information about the planet, especially information about its transits, because scientists need to know where a planet is in order to study it with a large telescope. Transits happen when an exoplanet passes between its star and the observer. Updating information about an exoplanet, and its transit, can be done using small telescopes, such as the telescope network MicroObservatory. This study will observe the exoplanet WASP-1b using MicroObservatory. From these observations, graphs showing brightness of the star over time, called light curves, will be presented along with estimations of key parameters, or characteristics, of WASP-1b and its transits. Also, an updated equation for time of transit at a given orbit since the planet was discovered will be presented. The data from the graphs, parameter estimations, and updated equation will be compared to the most recent data found in NASA's exoplanet archive for the accuracy of using a small telescope to observe and update information about WASP-1b. It is predicted that the results will be similar to NASA's exoplanet archive because small telescopes have been proven to be relatively accurate in the past. Therefore, MicroObservatory could be used to update data about WASP-1b in the future for large telescope missions.

Darien High School

Teacher: Christine Leventhal

Project # 169

Veeder, Samantha

Increased risk of developing IMHA due to the bacteria found in unprocessed foods

Research Proposal, Science, Health

Immune-Mediated Hemolytic Anemia, IMHA, is a fatal type of anemia found in Canines. IMHA is an autoimmune disease in dogs in which the body attacks its own red blood cells. This leads to anemia where there are significantly low red blood cell counts, which requires multiple blood transfusions. Treatment for IMHA in canines is aimed at prolonging life rather than curing the disease. Most canines die within the first few weeks of diagnosis. Previous research has identified that IMHA can be caused by disease, adverse drug reactions, leukemoid reactions and infections from Leptospirosis. The purpose of this study is to determine if a diet high in unprocessed foods, such as uncooked meat, leads to an increased risk of developing IMHA due to the bacteria found in unprocessed foods. Upon diagnosis of IMHA, a survey will be given to pet owners to determine what percent composition of uncooked ingredients is found in the canine's diet in search of a common trend in their diet. It is predicted that diets comprised of higher portions of unprocessed food will be found in canines diagnosed with IMHA. High correlations between unprocessed food and IMHA indicate more study is necessary to determine causal link.

Darien High School

Teacher: Guy Pratt

Project # 170

Walsh, Gianna

The Effects of Long-Term Immersion in Character on Sense of Self in Experienced Versus Novice Teen Actors.

Research Proposal, Science, Behavioral

The purpose of this study is to discover the impact of fully immersing oneself into character, and to determine the effects it has on sense of self for novice versus experienced teen actors. This will be tested through in-person and online surveys that will first be approved by the IRB. Data will be collected on how actors view themselves before, during, and after performing. There will be two groups, one of trained actors and one of novice actors, of varying ages in their teens. The Embodied Sense of Self Scale (ESSS) will be used to rate sense of self. It is expected that the novice actors will lose their sense of self based on the hypothesis that trained actors will know how to separate themselves from character. However, it is also expected that trained actors will develop a deep connection to and understanding of their character. The effects of long-term immersion in character have yet to be fully explored and properly addressed on adult actors let alone on teen actors. Children and teens, during their developmental years, are more susceptible to critical feedback than adults and can develop a skewed view of themselves from the pressures and roles that are highly character-immersed and structured. These effects could possibly lead to loss of identity or lack of sense of self in teen actors. This study is significant because it lays a foundation for future research. Although there have been similar studies, a significant body of research has yet to be discovered.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 171

Westbrook, Paige

Multiple subglacial water affected by climate conditions of Mars revealed by MARSIS Data

Research Proposal, Science, Environmental

The detection of liquid water by the Mars Advanced Radar for Subsurface and Ionosphere sounding (MARSIS) could indicate how the different climate conditions on Mars affect the state of matter of water on Mars. Mars's climate is commonly known to fluctuate due to orbital shifts and Mars's seasons; these changes have major impacts on subglacial water. Here, I propose a hypothesis that the warmer climates on Mars lead to the formation of subglacial water on Mars. My predicted results will strengthen the claim that there is liquid water on Mars that formed due to the change in climate contributing to an increase in temperatures. These results would help indicate the place and time on Mars to best find Liquid water for the use or detection of microbial life.

Darien High School

Teacher: Guy Pratt

Project # 172

Wijesekera, Soumya

Determining Differences in Characteristics Between Plasmacytoma Lesions and Other Lytic Lesions in the Sphenoid Wing

Research Proposal, Science, Health

The purpose of this project is to determine if there are different characteristics between atypical plasmacytoma lesions and typical myeloma lesions in the sphenoid wing. A review of the anatomy of the skull will be studied, as well as reading with background information on lesions that can arise in the sphenoid bone. Based on the reading, a list of keywords will be constructed for a PubMed literature search. A summary will be made of the common clinical, diagnostic, imaging, and clinical outcome features of these lesions based on the published cases identified from the literature search. The mentor will provide relevant imaging, biopsies, pathology images, and patient chart notes from the atypical lesion case. Findings will be reviewed and differences in characteristics between atypical and typical sphenoid wing lesions will be determined. Data will be analyzed by examining the differences in characteristics between atypical and typical lytic lesions that can appear in the sphenoid wing. Increasing knowledge of specific atypical characteristics of lytic lesions in the sphenoid wing could help recognize this atypical presentation earlier, and have the patient undergo chemotherapy as treatment instead of invasive surgery.

Amity High School

Teacher: Catherine Piscitelli

Project # 173

Williams, Cate

The Effects of Dispatcher-assisted Cardiopulmonary Resuscitation Survival In Out of Hospital Cardiac Arrest in The United States.

Research Proposal, Science, Health

Cardiac arrest is one of the leading causes of death nationally and is deemed a current public health crisis. Despite countless initiatives in the medical field, the survival rate in the United States remains below 12%. Each minute cardiopulmonary resuscitation (CPR) and intervention is not provided, the probability of survival is reduced by 7–10%. If immediate CPR is provided until defibrillation or EMS intervention, the probability of survival only declines by 3–4% per minute. The effect of bystander and Dispatcher Assisted (DA) CPR can potentially double the survival rates for witnessed out of hospital cardiac arrests, and more importantly, double the rate of neurologically intact survival. By recording the survival rates of OHCAs reported by hospitals nationally and comparing it to the number of which were given DA CPR, a conclusion can be drawn to configure the effect DA CPR has on survival.

Darien High School

Teacher: Christine Leventhal

Project # 174

Willis, Sam

A Gut Microbial Peptide Bacteroides fragilis and Molecular Mimicry in the Pathogenesis of Systemic Lupus Erythematosus

Research Proposal, Science, Health

Darien High School

Teacher: David Lewis

Project # 175

Yee, Emily

A Study in Plant vs. Animal Protein: Soy Protein vs. Beef Protein on Amount of Sleep

Research Proposal, Science, Health

This research will determine if and how plant based (protein) and animal (beef) protein affect sleep quantity. Drosophila is an effective model organism for measuring sleep and is generalizable to humans. Soy protein isolate and beef bouillon powder will be included in the Drosophila diet. Three groups of drosophila will be created. The control group with a basic yeast diet. The second with soy protein isolate included in diet. The third with beef bouilluon powder included. Sleep will be measured using the DAM (Drosophila Activity Monitor) over a period of two weeks. Three trials would be conducted. The data will then be compared for any significant differences and results. It is expected that consumption of plant based protein in drosophila will result in higher sleep time compared to meat protein. More and more people are adopting plant based diets in the world. With this, the debate of the efficacy and health benefits, or lack of, between meat protein and plant based protein is increasing. More research is needed as plant based diets are gaining more popularity.

Ridgefield High School

Teacher: Patrick Hughes

Project # 176

Zaccario, Giorgia

A Comparison of Adolescence versus Adults in the Preferential Incorporation of Emotional Waking Life Experiences Into Dreams and the Impact of Meditation

Research Proposal, Science, Behavioral

Dreams have been studied for many years, with research finding that dreams can correlate to your emotions and daily events. Predictably, people with stressors in life tend to have negative dreams, and positive events can result in uplifting dreams. I will begin this study by obtaining IRB approval. I will then have 20 adolescents and 20 adults write their dreams in a daily journal each morning for two weeks, and state if they had any emotional or stressful events or significant experiences each day. Participants will note major daily activities, personally significant experiences, major concerns, and novel experiences. I will have participants state on a scale of one to ten how emotionally intense each dream is. I expect to find that dreams will contain more emotional life events, especially for the adolescents in the study. This is because teens typically have more intense emotions. In the next phase of experimentation, I will have participants meditate for 15 minutes each night and have them complete the same journal to see if meditation influences dreaming. It is anticipated that dreams will be based on emotional events and will be less emotionally intense with meditation. I will be using the Calm app as a form of meditation. This study will enable greater understanding of the human brain and that which goes into formulating a dream, such as emotions and daily stressors. It will demonstrate the connection between emotional events and dreaming, and demonstrate the possible benefits of meditation to alleviate emotionally intense dreaming.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 177

Zapanta, Jakob

Effects of Tidal Choking from Culverts on Tidal Marsh Soil Nutrients and Soil Respiration

Research Proposal, Science, Environmental

Salt marshes are very important ecosystems for sequestering carbon and reducing storm surge damage. Unfortunately, human influence by means of bridge culverts and mosquito trenches have damaged many salt marshes across North America. This study will observe multiple sections of a tidal marsh by comparing sections with varying degrees of tidal choking due to culverts. Soil cores will be taken from designated points in the marsh, and their carbon emissions will be measured using a carbon probe and soil carbon will be measured using titration. Soil pH and soil nitrogen content will also be measured to provide a better understanding of the ecosystem's health. Research predicts that areas more restricted by culverts (ie. areas further upstream from the ocean) will have significantly higher levels of soil respiration, as well as significantly lower levels of soil total nitrogen and soil total carbon. However, soil respiration levels may begin to decrease if degradation is severe. If soil respiration remains consistent across sample locations, that would imply that the human impact in this marsh is less damaging than predicted. This principle is true regarding soil total nitrogen and soil total carbon as well. If it is found that the marsh has been damaged by human influence (nitrogen levels around 1.99/kg m-3, carbon levels around 31.86 kg m-3) the best course of action concerning the health of the marsh is to widen the culverts, allowing for a better flow of water and preventing further ecosystem imbalances.

Greens Farm Academy

Teacher: Mathieu Freeman

Project # 178

Zecca, Phoebe

Determining Which Rare Earth Metal or Alloy Produces the Largest Electromagnetic Field in Sea Water in Order to Deter Shark Attacks

Research Proposal, Science, Environmental

The number of interactions between sharks and humans began increasing in the 1980s. For example, in Australia the number of bites per year doubled from 2000 to 2015 compared to 1990 to 2000. Electromagnetic shark repellents use magnets to overwhelm the sensitivity of the Ampullae of Lorenzini in sharks. The purpose of this study is to determine which rare earth metal or alloy of metals produces the largest electromagnetic field in sea water in order to deter shark attacks. In order to discover which specific rare earth metals cause the largest electromagnetic field, I will test several key metals and alloys separately and record each metal's field in sea water. I expect to find a specific rare earth metal that produces a large electromagnetic field compared to others, and has the ability to place stress on a shark's Ampullae of Lorenzini. This will cause the shark to deter away from the targeted bait, and prevent any further interactions between the person wearing the metal and the predator. Future work will include testing the most successful metals at a Shark Lab, such as the one in Bimini in the Bahamas. A personal deterrent will be made incorporating the successful metal, and will also be designed to go inside a surfboard. This discovery could present a new tool to prevent shark attacks in the future. Finding a rare earth metal with the ability to attack the shark's sensory system will help deter these predators and prevent future attacks.

Convent of the Sacred Heart-Greenwich

Teacher: Mary Musolino

Project # 179

Zimmerman, Dante

Sustainable Aviation Fuel-Volatile Fatty Acid Blend Soot Composition and Contrail Ice Emission

Research Proposal, Engineering, Physical Science

The aviation industry's reliance on specific energy, and the energy density of its fuels, has kept it a major contributor to greenhouse gas (GHG) emissions. In turn, the International Civil Aviation Organization (ICAO) has created the CORSIA, a plan which quickly requires the reduction of CO2 from aviation businesses. Sustainable air fuels (SAFs) are recognized as the only medium for immediate CO2 reduction, causing SAF blends to be rigorously tested for optimization. Volatile fatty acids (VFAs) can be derived from wet waste through fermentation, and then turned into hydrocarbons suitable for jet fuel in a few more metabolic steps. VFA derived paraffins make for effective jet fuel when blended with a SAF, the blend has the potential to yield up to a 165% reduction in GHG emissions (when compared to fossil jet fuel). While CO2 emissions are analyzed and regulated strictly, the contrails which are almost bound to form from an aircraft's plume are not nearly as studied; even though contrail clouds contribute more to the climate's warming than the total volume of CO2 released from aircrafts' flight. It has only been recorded that soot, the precursor to a contrail, emitted by SAF-VFA combustion is a 34% reduction to Fossil jet fuel, so the objective of this study is to determine the composition of the soot emissions, and then record the formation of ice crystals in the plume of an aircraft running off of SAF-VFA fuel.

Darien High School

Teacher: Christine Leventhal