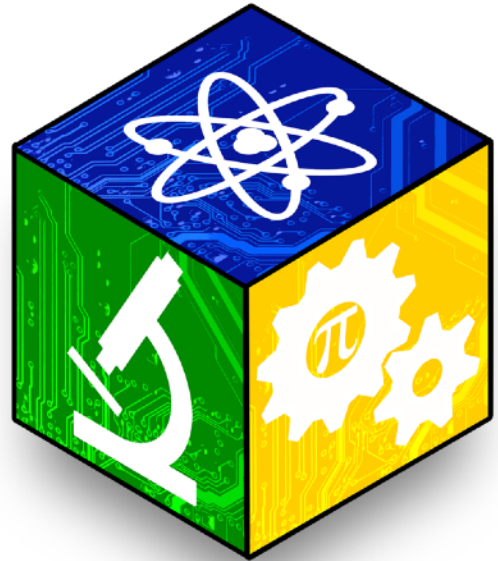


CONNECTICUT  
SCIENCE &  
ENGINEERING  
— FAIR —



**75th Annual Fair**  
**March 6-18, 2023**

**Student Abstracts**

## Fair Categories

	Life Sciences	Physical Sciences
<b>7<sup>th</sup> &amp; 8<sup>th</sup> Grade</b>	<b>LT (1001 – 1999)</b>	<b>PT (4001 – 4999)</b>
<b>7<sup>th</sup> Grade</b>	<b>L7 (2001 – 2499)</b>	<b>P7 (5001 – 5499)</b>
<b>8<sup>th</sup> Grade</b>	<b>L8 (2501 – 2999)</b>	<b>P8 (5501 – 5999)</b>
<b>High School</b>	<b>LS (3001 – 3499)</b>	<b>PS (6001 – 6499)</b>
<b>High School Team</b>	<b>LST (3501 – 3999)</b>	<b>PST (6501 – 6999)</b>

## Technical Disciplines

<b>AT = Applied Technology</b>	<b>EE = Engineering: Electrical &amp; Mechanical</b>
<b>AS = Animal Science</b>	<b>ET = Energy &amp;</b>
<b>BE = Behavioral &amp; Social</b>	<b>EV = Environmental</b>
<b>BI = Biochemistry</b>	<b>EM = Environmental</b>
<b>CB = Cellular &amp; Molecular</b>	<b>MA = Mathematical Sciences</b>
<b>CBIO = Computational Biology &amp; Bioinformatics</b>	<b>ME = Medicine &amp; Health Sciences</b>
<b>CH = Chemistry</b>	<b>MI = Microbiology</b>
<b>CS = Computer Science</b>	<b>PH = Physics &amp; Astronomy</b>
<b>EA = Earth Science</b>	<b>PS = Plant Science</b>
<b>EN = Engineering: Materials &amp; Bioengineering</b>	

## Technical Discipline Composites

<b>Biotechnology</b>	<b>AS, BI, CB, EN, ME, MI, PS</b>
<b>Environmental</b>	<b>EV, EM</b>
<b>Engineering</b>	<b>EN, EE</b>
<b>Sustainability</b>	<b>EA, EN, EE, ET, EV, EM</b>

# CSEF Official Abstract and Certification

Word Count

273

2023

Fair Category

LS

Project  
Number

3002

**Title:** A Robust Active Learning Framework for Identifying Liver Cancer using Giga-pixelated Histological Images

**Student Name(s):** Q. Jiang

## Abstract:

Histopathology remains a state-of-the-art method for cancer detection. The procedure typically involves well-trained pathologists analyzing microscopic, H&E-stained slides of tissues acquired via biopsy and providing a diagnosis. The limitation of experienced physicians, however, renders it inaccessible and costly. With recent advances in deep machine learning, such manual image-classification tasks may be replaced by neural networks given sizable training datasets. Still, the scarcity of fine-grained labels hinders deep learning-powered analysis of giga-pixelated histological whole-slide images. Each whole-slide image can only be treated as one class, label errors may occur during the weakly supervised training due to the mixture of multiple phenotypes on one slide.

This research develops a self-supervised learning system that trains a liver-cancer-classification CNN model with minimal labels involved. To maximize training efficiency given limited samples, we utilize the BatchBALD (Bayesian Active Learning by Difference) acquisition function to extract feature-rich data points and eliminate noises, formulating a label-error-aware model. The model's general effectiveness is validated on a large-scale natural image set (CIFAR-10), reaching a stable 94% accuracy. Its competence with our custom histopathology dataset is manifested by a decent ROC AUC score. The metric is chosen over direct accuracy per the dataset's imbalanced nature.

This work simplifies traditional histopathological liver cancer detection processes. Our pretrained-models accurately process H&E stained biopsy slide samples, eliminating the need for preliminary expert analysis. Future works involve subtype detection and semantic segmentation, provided that a more balanced and diverse dataset is available. Additionally, multi-scale spatial feature aggregation could be implemented for further performance augmentation.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME CS CBIO

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

247

2023

Fair Category

LS

Project Number

3005

**Title:** Association of COVID-19 Vaccine Rates and Mortality During the Omicron Period Among Different Age Groups

**Student Name(s):** J. Li

## Abstract:

**Background:** In the last year, I analyzed the relationship between vaccination and the post-holiday surge in cases, confirming that vaccination was effective in decreasing COVID-19 infection and death. This year, I focused on studying the impact of vaccination on death rates during the emergence of the omicron variant in the different age groups.

**Method:** Data was retrieved from CDC databases and was organized into Excel Pivot Tables to be analyzed using RStudio. Vaccination rate as of 12/1/21 (time of first omicron case in US) and death rates of different age groups in the three-month omicron period (Dec 2021, Jan 2022, Feb 2022) were analyzed using correlation and linear regression.

**Results:** During the surge of omicron, a total of 175,000 Americans died from COVID-19, and 70% were ages 65 and up. As expected, a higher full vaccination rate among adults under 65 was significantly correlated with less deaths ( $r = -0.35$ ,  $p = 0.01$ ). A similar correlation was shown for people 65 years and older ( $r = -0.39$ ,  $p = 0.004$ ). Partial vaccination showed similar protection. The rate of the first booster was not correlated with mortality rate in both groups. Multiple regression analysis found that a higher rate of  $\geq 1$  vaccination in adults under 65 had a stronger effect on reducing death in adults  $\geq 65$  compared to the rate in this age group.

**Conclusion:** Vaccination showed a protection against omicron. Surprisingly, vaccination in the younger age group protected older ages from risk of COVID-19 caused death.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME MA CBIO

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3006

**Title:** Simulating The Effect of Ants vs. Worms on Plants and the Resulting Carbon Emissions Using a C#-Based Game Engine

**Student Name(s):** S. Schneider

## Abstract:

“Ants vs. Worms - Carbon Consumers” is a simulated experiment on how ants, as compared to worms, affect the carbon dioxide output of a corn farm, as well as comparing their contribution to its growth. This idea is based on a study that proved that ants increase carbon absorption into rock up to 335x - and is simulated in comparison to worms, to test the theory that ants, which aerate the soil and provide nutrients similar to worms, may reduce the carbon footprint of farms. Similar to PhET simulations, it is an interactive program created in Unity, so that it may be replicated and observed at all stages by CSSF participants. All data used in this experiment is recorded from online textbook resources, as opposed to an actual experiment, due to complications designing a physical experiment to test this. To determine some of the variables in the simulation, calculations of data were used, as certain variables had no open studies to draw data from. The results of the calculations used in the program showcased that ants are far more carbon efficient; even reducing the amount of carbon dioxide that would have originally been emitted in the farm (whereas worms were carbon-neutral.) However, many ant species increase the presence of aphids on plants, which is not desirable for a sustainable farm. The experiment produced results that are similar to the studies it drew from. Due to time constraints, this program is a prototype and may not accurately represent all possible variables.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CBIO CS EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3007

**Title:** Development of Buoyant, Lignin-Based Fulvic Acid Supply Device (FASD) to Prevent Ocean Desertification

**Student Name(s):** Y. Lee

## Abstract:

Phytoplankton is a crucial component of the oceanic food chain and plays a significant role in absorbing atmospheric carbon dioxide and producing oxygen. The proliferation of phytoplankton is essential for maintaining the ocean's ecosystem, and their growth rate is accelerated by the consumption of iron in the form of fulvic acid. Due to the declining whale population, scientists have attempted to create artificial whale feces to provide sufficient fulvic acid for phytoplankton growth. However, the lack of buoyancy in these artificial whale feces has been a persistent issue. This study aimed to develop a Fulvic Acid Supply Device (FASD) capable of remaining afloat for an extended period and accelerating chlorella proliferation by supplying fulvic acid. I created a model of desertified seawater by adding oyster and abalone shell powders to artificial seawater and gave chlorella to two different samples kept at 15°C and room temperature (26°C). The lower temperature setting showed a more severe desertification effect, suppressing chlorella's growth rate to 71.5% compared to 79.75% at room temperature. The FASD composed of cornstarch, agar, and water hyacinth in powdered form, with added fulvic acid, was found to be the most optimal in buoyancy duration, acceleration of chlorella growth rate, maintenance of water temperature, and prevention of further water contamination. The study concluded that the developed FASD was capable of accelerating chlorella proliferation by providing sufficient fulvic acid while remaining buoyant for an extended period. Further research is required to confirm the FASD's effectiveness in actual desertified ocean environments.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN EM EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project  
Number

3008

**Title:** How the Intensity of an Exercise Affects Cell-Mediated Immunity Through the Release of Anti-Inflammatory Cytokines, Specifically Interleukin-6

**Student Name(s):** G. Sandhu

**Abstract:**

Physical exercise, to a degree, has both harmful and beneficial effects on one's immune system. Inflammation can be increased in specific sections of the body due to numerous proteins, or cytokines produced. However, it has been shown that this is only true for high-intensity. It was hypothesized that medium intensity might have a good effect since the number of cytokines released would rise, resulting in greater health and more effective utilization of the immune system. Understanding the impact of exercise on the immune system can lead to more effective treatment choices for patients as well as improved overall health. Medical engineers are now exploring approaches to enhance cytokine release in persons who suffer from deficits. Different workouts of varying intensities (low, medium, and high) would be investigated to see which cytokine proteins are produced more and what effect they have on the immune system. The goal of this study was to gather information on different intensities of exercises, and their relationship to cell-mediated immunity via the release of anti-inflammatory cytokines, and a comparative-meta analysis was conducted. After the gathering of data had been done through many different studies, all having experiments ran on the IL-6 concentration levels, it was concluded that medium-intensity exercise was most beneficial in releasing IL-6. It was observed that around 50 pg/ml was the average IL-6 concentration for medium intensity, and about 150 pg/ml for high intensity, which would cause inflammation. Low intensity barely affected IL-6 release.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

ME CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

155

2023

Fair Category

LS

Project  
Number

3009

Title: Developing and Testing a Functioning Bone Chip

Student Name(s): J. Wong

## Abstract:

Bone is an active organ that has an innate ability to grow upon itself, a property defined as osteogenic, making it uniquely able to adapt to birth defects, hormonal changes and outside damage to the bone in order to maintain its integrity. Traditional bone tissue models relied on 2D and 3D cell culture, which has significant limitations to mimic an authentic bone tissue due to the lack of a blood circulation component thus causing a limitation of bone chips to successfully replicate the conditions in vivo. Here, we will design a microfluidic device that can integrate a circulation system with a bone tissue culture capacity. In the future, my design of the microfluidic device can be used for bone tissue chips contributing to improved bone models for studying bone diseases and developing therapeutics. In this project, I will design a tissue chip that will propose a microfluidic chip for the further understanding of microchip technologies.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project  
Number

3010

**Title:** Identification of Therapeutics for Neurological Disorders through Development of a Novel Machine Learning System for Predicting Drug-Gene Interactions in the Glymphatic System

**Student Name(s):** A. Malkin

**Abstract:**

Neurological disorders affect millions of people worldwide. The glymphatic system - the brain's waste clearance system - has been recently identified as a likely origin for a wide array of neurological disorders including stroke, Alzheimer's Disease, and epilepsy. Since few drugs are known to treat irregularities in the glymphatic system, drug discovery in this area has the potential to make a meaningful impact on treatment of neurological disorders. In the past decade, machine learning has emerged as a tool to aid chemists and biologists in the field of drug discovery; however, currently, databases of glymphatic-related genes and drugs do not exist. The first stage of this research developed GlymDS, the first database of genes with a related function to the glymphatic system and drugs that interact with their proteins. This was done by compiling information from Gene Ontology, AlphaFold, DGIDB, and DrugBank and includes 400 newly assembled protein and drug structures. The second stage developed GlymRx: a novel machine learning system to predict which drugs would interact with genes regulating the glymphatic system. GlymRx contains three custom machine learning models – a K-nearest-neighbors (KNN) model, an XGBoost model, and a neural network. In stage three, 11,575 FDA-approved drugs were evaluated by all three models to identify drug-gene pairs with significant enough interactions to suggest potential medical use. Of these, 273 drugs were identified by all three models as having strong interactions with glymphatic-related proteins. GlymRx trained on GlymDS would save as much as six years of drug development time.

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

CBIO ME CS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

204

2023

Fair Category

LS

Project  
Number

3011

Title: The Role of Hepatic Stellate Cells in Liver Regeneration

Student Name(s): K. Brissette

## Abstract:

Stellate cells oftentimes may be overactive and can increase risks of cancers and cause scarring of the liver. Hepatic stellate cells, originally described as Kupffer cells are operative in the modeling of the extracellular matrix and are activated following injury stimuli to the liver. They are exceptionally versatile and have a high proliferation capacity but remain inactive within the healthy adult liver. Once activated, stellate cells transform from fibroblasts into myofibroblasts. Stellate cells' ability to remodel the cellular matrix by synthesizing collagen and lamin allows them to contribute to the maintenance of homeostasis but also makes them a large player in fibrosis. The fibrotic liver is then increasingly carcinogenic and linked to various cancers such as hepatocellular carcinoma. In addition, stellate cells have an ability to stimulate the migration and transformation of other nearby cells through the secretion of chemokines. Various genes may alter the capacity of which a stellate cell may carry out its various functions or the ability to activate or deactivate. Gene expression analysis through linear regression could be used to find patterns in proliferative capabilities. Patterns of proliferative capabilities would prove insightful in the aim of better understanding the delicate nature of a double edged sword such as stellate cells.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

234

2023

Fair Category

LS

Project  
Number

3012

Title: Effects of Electricity on Wisconsin Fast Plants

Student Name(s): B. Akaratovic

## Abstract:

Due to their tremendous growth rate and short life cycle, Wisconsin Fast Plants are often used in Biology courses as an introduction to the development, behavior, and growth of plants. It would be highly beneficial if plants that produce vegetables, fruits, and berries grew as quickly as Wisconsin Fast Plants. This would result in agriculture thriving, having various healthy foods more plentiful, more accessible and less expensive to food markets. Over the centuries, farmers experimented with techniques from a branch of agricultural science known as electroculture, where electrical currents were applied to plants to monitor any positive or negative effects on their growth rate. In this experiment, four groups of Wisconsin Fast Plants, (each containing five self-watering plant pots, having each pot containing five Wisconsin Fast Plant seeds) were used. Four out of the five pots in each group were subjected to electrical currents. but at varying voltages and one group of plants weren't subjected to electricity, for they served as the control of the experiment. In terms of the plants growth rate and height, the overall response of the plants was minimal. However, it was noticed that plants subjected to the highest voltages showed abnormal changes regarding their health. Rapid deterioration in leaves, stem thickness and structure, and overall color appearance were negatively affected. The leading reason for the plant's rapid deterioration was the absence of the complex molecule known as Chlorophyll.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3013

**Title:** Spectrophotometric Determination of the Total Polysaccharide Content of Ganoderma Lucidum Grown Under Different Conditions

**Student Name(s):** S. Squatrito

## Abstract:

For over 200 years mushrooms have been used for medicinal purposes in Asian regions. Though they bring effective results, they still weren't commonly used in western research until recently. Mushrooms have taken a bigger role in medicinal research, being tested against many diseases, including cancer. Specifically, the Ganoderma Lucidum mushroom, which has been shown to be an effective agent against cancers like Inflammatory Breast Cancer. Studies have proven that the anticancer effects of G. Lucidum can be attributed to the partially polysaccharides found within the mushrooms. The polysaccharides induce apoptosis, disrupt cell cycle, and prevent metastasis. In these studies, the growing conditions the G. Lucidum used is unknown. Though polysaccharides of G. Lucidum are vital to research, there have been no studies on how growing conditions affect the total yield of polysaccharides. In this study, two G. Lucidum specimens were grown in different conditions. The mushrooms were then freeze-fractured using liquid nitrogen and extracted in ethanol inside a sonication bath. The extracts were then filtered and the ethanol was evaporated, sulfuric acid and 5% phenol solution was added. Extracts were then analyzed in a spectrophotometer at 490 nm. The original hypothesis theorized that the G. Lucidum grown with higher carbon dioxide and higher moisture content would contain higher amounts of polysaccharides due to the other condition not being able to fully develop. But the opposite was proven, this study showed that G. Lucidum grown with higher amounts of oxygen and lower amounts of humidity yield a higher amount of polysaccharides.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

245

2023

Fair Category

LS

Project Number

3014

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

Student Name(s): K. Podila

## Abstract:

Type 1 Diabetes (T1D) is characterized by autoimmune destruction of pancreatic beta cells. Currently, there is a lack of knowledge on the progression of beta cell destruction in T1D and how this impacts other pancreatic endocrine cells. To address this gap, I assessed the hormonal composition of endocrine cells in pancreata from organ donors in the Network for Pancreatic Organ Donors with Diabetes (nPOD) biorepository. Using digitized immunohistochemistry images, Qupath software was used to manually quantify single endocrine cells positive for insulin, glucagon, somatostatin, or pancreatic-polypeptide, and multicellular islets in nondiabetic control, autoantibody-positive (Aab+), and established T1D donors (n=5 each). Islets were categorized as insulin+/glucagon-, insulin+/glucagon+, or insulin-. Results showed that donors with T1D had a reduced % of islets that were insulin +/glucagon- ( $p < 0.01$ ) and insulin+/glucagon+ ( $p < 0.01$ ), and an increased % of insulin- islets compared to the control ( $p < 0.01$ ). No differences were observed in the densities of single cells positive for insulin, glucagon, or pancreatic polypeptide. Contrarily, donors with T1D exhibited an increased density of single somatostatin+ cells, compared to control and Aab+ ( $p < 0.05$ ) donors. T1D is classically viewed as a disease of beta cells. However, this data suggests there are changes in the distribution of multiple endocrine cell types (beta, alpha, delta) in the pancreas of individuals with T1D. This research provides an avenue for further exploration of how altered islet architecture may impact hormonal secretion and normal paracrine interactions between endocrine cells in T1D.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

239

2023

Fair Category

LS

Project  
Number

3015

**Title:** Understanding Algae Dominance in Benthic Communities of San Salvador, Bahamas  
Using Photo Machine Learning Technology

**Student Name(s):** A. Susco

**Abstract:**

Coral reefs are among the most diverse and economically important ecosystems on the planet. As time goes on, due to human interference, coral reefs in San Salvador, Bahamas have started to shift from coral to algae domination. However, little work has been done to understand what species of algae are present and abundant. To understand what algal communities are developing and how that might differ around the island, I have been studying the shift and what is growing there. First, my professor at Eastern took over 250 photos of 5 sites on different coasts of San Salvador. Then we put all the images into a site called CoralNet. After that the photos were in this database we were able to label the species under 200 random points on each image. Then when all images were annotated the CoralNet was able to estimate the percentages of benthic attributes at the different sites. We then used ANOVA and Bray Curtis to understand if the algal communities around the island differed from each other. ANOVA allowed us to determine whether algal cover differed significantly among sites. Bray Curtis was then used to tell whether the various sites had distinct communities of algal, coral, and invertebrate species. The study allows us to have a more nuanced view of how dominant algal communities might differ due to geographic factors like current, prevailing wave direction, and proximity to human influence (e.g., sewage, fertilizer run-off).

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

238

2023

Fair Category

LS

Project  
Number

3016

**Title:** Investigating the Usage of Treated Nano-Clay Composites for the Efficient Removal of Emerging Contaminants in an Aqueous Solution

**Student Name(s):** S. Mohanraj

## Abstract:

Many water sources contain emerging contaminants that currently lack sufficient regulation but lead to debilitating health and environmental effects, yet little knowledge exists on emerging contaminants and current standard water treatment processes cannot remove most such contaminants from water. This project researches the usage of Fe<sub>3</sub>O<sub>4</sub> nanoparticle doped montmorillonite clay enhanced by hydrochloric acid (HCl) treatment and 150°C thermal treatment for removing specific emerging contaminants, namely pharmaceuticals, pesticides, and microplastics from water. With montmorillonite clay's advantageous adsorption properties further enhanced by the increased surface area available for sequestration of contaminants through the addition of Fe<sub>3</sub>O<sub>4</sub> nanoparticles, it was expected that an efficient contaminant removal method would be devised. Pharmaceutical and pesticide removals were measured using liquid chromatography mass spectrometry (LC-MS), and microplastic removal was measured using digital WiFi light microscopy and light spectrometry using a homemade spectrometer. Fe<sub>3</sub>O<sub>4</sub> nanoparticle doped montmorillonite clay was indeed highly efficient for emerging contaminant removal, as expected. Furthermore, the highest levels of removal were achieved using Fe<sub>3</sub>O<sub>4</sub> nanoparticle doped montmorillonite clay with HCl and thermal treatment; 71% of acetaminophen was removed (pharmaceutical), 62% of DEET was removed (pesticide), 72-78% of PETE microplastics. This demonstrates considerably efficient removal through this inexpensive, environmentally-friendly, easily-implementable, and sustainable method. A prototype of a standard household filter utilizing Fe<sub>3</sub>O<sub>4</sub> nanoparticle doped montmorillonite clay further modified with HCl and thermal treatments will soon be developed using 3D modeling software and refined for real-world implementation.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM EN BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

215

2023

Fair Category

LS

Project  
Number

3018

Title: Mytilus edulis ability to control algae blooms from nitrogen rich fertilizer.

Student Name(s): M. Hatfield

## Abstract:

This experiment evaluated the potential ability *Mytilus edulis* has in controlling algae blooms from nitrogen-rich fertilizer. Algae blooms can be detrimental to an ecosystem and are directly caused by nutrient runoff from fertilizer.

*Mytilus edulis* is a species of mussel that lives near the coast in the North Atlantic. The mussels were observed in four separate tanks. Nitrogen fertilizer was added to the tanks in different concentrations to imitate fertilizer runoff. The tanks were observed for three days and the amount of plankton as well as the amount of ammonium were tested every hour.

It was concluded that *Mytilus edulis* is able to stabilize large fluctuations in the plankton. If there is fertilizer present the mussels are able to initially decrease the amount of plankton when the fertilizer is first introduced and then stabilize the amount of plankton at a lower level for a continuous period of time. The mussels' behavior helps support the idea that they are capable of helping stabilize fluctuations of phytoplankton. They are able to compensate for the increase in plankton by opening their shells wider.

Although *Mytilus edulis* has this ability, its overall population has decreased. This is due to overfishing, ocean acidification, as well as other factors. Many species offer unknown capabilities that still need to be discovered.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

AS EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

245

2023

Fair Category

LS

Project Number

3019

Title: The Isolation And Identification Of Polystyrene Degrading Bacteria From Zophobas Morio

Student Name(s): P. Bazemore

## Abstract:

Microplastics are plastic particles with a diameter of less than 5 mm. Microplastics can be ingested by animals such as birds, shrimp, and fish which can kill them. Consequently, it is crucial that methods for degrading microplastics are discovered before the impacts of microplastics on the natural environment worsen. Additionally, *Z. morio* a species of darkling beetle can survive using plastic as the sole source of carbon in its diet. The bacteria within the gut of *Z. morio* are responsible for its ability to degrade plastic. However, the bacteria responsible for *Z. morio*'s ability to degrade plastic is unknown. Moreover, prior research reported that the bacteria *Ideonella sakaiensis* uses a polyethylene terephthalate (PET) hydrolase to degrade PET into bis-(hydroxyethyl) terephthalate (BHET). It is not known whether other bacteria strains can degrade PET or BHET. Therefore, the objective of this study was to isolate and identify additional strains of bacteria capable of degrading PET or BHET. Bacteria were isolated from water samples and the intestinal tract of *Z. morio* and streaked onto plates containing BHET or PET as the sole carbon source. Our research identified bacteria that degrade BHET and PET, one of the most promising performers were designated "#3 PB6", a strain that can use BHET or PET as a carbon source. The bacteria isolated were not known previously to degrade BHET or PET. Going forward it is crucial that methods for degrading plastic are developed to prevent it from accumulating in the environment.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI EV EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

267

2023

Fair Category

LS

Project  
Number

3020

**Title:** A Zero-Waste Product; Pyrolytic Conversion of Walnut Shell Waste to Light-Hydrocarbon Fuels, a Bioherbicide, and a Valuable Soil Additive

**Student Name(s):** K. Young

## Abstract:

Walnuts are widely consumed globally, however ~60% of their mass lies within their inedible shell/husk, which is typically discarded into landfills. In recent work by Chen, the physico-chemical properties and antioxidant activities of wood vinegar and tar fractions of hazelnut shell– chosen for its high lignin content– pyrolysis were examined. Walnut shells (WS) are likewise rich in lignin, but are far greater in popularity and their waste-to-edible mass ratio. This research proposes to recover and evaluate the many valuable resources of WS, via their pyrolysis, including light hydrocarbon (C1-C4) gaseous fuels (that are immediately useful), biochar (a nutrient-rich soil additive), and liquid pyroligneous acid– wood vinegar (that possesses antifungal properties for crop growth). WS were pyrolyzed at 400oC, and the gaseous products, 46.5ml of methane, 3.1ml of propane, and 6.2ml of butane per gram of WS-pyrolyzed (WS-P), were identified via GC-FID and FTIR. Similarly, 0.2645 grams of biochar were produced per gram of WS-P. Lastly, 170µl of wood vinegar was produced per gram of WS-P and was found to include furfural, cresols, and cis-1,2-cyclohexanediol, all of which promote plant growth via their inhibition of plant pathogens. Evaluation of WS-P biochar soil-additive, using a soybean model, highlighted an 18% increase for healthy/normal crop growth, while wilting effects of the *F. verticillium* model fungus were remedied in 12 days. Likewise, the WS-P wood vinegar (0.3% in soil) was found to fully eliminate the wilting effects of *F.v.* in 12 days, and is useful as an antifungal treatment once fungal-wilting is observed.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN EM AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

262

2023

Fair Category

LS

Project Number

3021

**Title:** Analyzing the impact of Covid-19 on the amount of happiness found in nature as shown on social media

**Student Name(s):** M. Crist

## Abstract:

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. It was found 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, even though overall Twitter sentiment went down 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 and their happiness and this research furthers our understanding of the impacts of the Covid-19 pandemic on happiness and provides examples of how to increase happiness during times such as the Covid-19 pandemic.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project  
Number

3022

Title: The Effect of Different Concentrations of Caffeine on Acidophilic and Alkaliphilic Plants

Student Name(s): S. Subramanian

## Abstract:

Caffeine is a natural stimulant. It stimulates the central nervous system in humans, and for plants, when applied to the soil, increases the acidity of the soil. Putting used coffee grounds in soil has become a relatively common practice among farmers, and there has been evidence that coffee grounds encourage the growth of microorganisms in the soil. However, these coffee grounds have caffeine, which has been shown to have mixed effects on plant growth. Caffeine reduces the pH level of the soil, so it can be extremely harmful to plants that grow best in alkaline soils, and even some plants that grow best in acidic soils. Because of this, it would be useful to experiment with differing concentrations of caffeine on acid-loving and acid-hating plants.

In my experiment, I set up four pots with alkaliphilic pea plants, and four pots with acidophilic bean plants next to a window inside. For the first two weeks of the experiment, I used tap water for all the plants, with no concentration of caffeine. After this two-week period, I created solutions of 0%, 0.1%, 1%, and 2% caffeine by dissolving caffeine capsules in water. On a weekly basis, I recorded the heights of the plants.

At the end of this project, the caffeine proved to have no effect on plant growth. There were no significant differences between the plant heights, and regarding appearance, they were very similar as well. My conclusion is that caffeine does not have a significant effect on plant growth.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS EA EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

266

2023

Fair Category

LS

Project  
Number

3024

**Title:** Non-Invasive Pre-screening Approach for Early Detection of The Human Papillomavirus (HPV) to Aid in Cervical Cancer Prevention in Underrepresented Demographics

**Student Name(s):** A. Davis

## Abstract:

This study addresses the concern that cervical cancer is the 4th leading cause of death for women in the U.S. Due to COVID-19, the pap-smear screening rates to detect the Human-papillomavirus (HPV) decreased by 80% according to the CDC. The number of minority women not having access to HPV screenings is a burgeoning crisis. This study found alternative, non-invasive and easily accessible pre-screening methods for HPV detection to decrease the growing mortality rate of women developing cervical cancer. It was hypothesized that if the swabbing of a menstrual pad containing a human blood sample can be examined for irregular cells, then HPV can be detected through a woman's menstrual cycle by the means of a non-invasive pre-screening test.

To confirm validity of the approach, interviews were held with a licensed Pathologist and a presentation was then given by the student-researcher promoting cervical cancer awareness. Two public questionnaires showed 66.7% of women responded they don't schedule annual pap-smear examinations. A simulated-experiment was conducted using vinegar infused pads to detect HPV+cells in menstrual cycle simulated-blood using 3D-printed cervixes.

An extension to further test this study is to use human menstrual blood samples. A prototype HPV pre-screening menstrual cotton pad that is capable of being affordable for all women to have access too for earlier detection of HPV strains and preventing cervical cancer from manifesting using vinegar-pad test strips will be constructed. More research investigating HPV-detection technologies for women in foreign countries will also be collected where healthcare access for women is limited.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN CBIO EE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

238

2023

Fair Category

LS

Project  
Number

3025

**Title:** Assessing the Accuracy of Pelage Characteristics as Species Identifiers of New England Cottontail Rabbits

**Student Name(s):** A. Szydlo

**Abstract:**

The New England cottontail (*Sylvilagus transitionalis*) has suffered a significant population decline since the early 20th century. This is due to many factors, such as landscape fragmentation and competition from the eastern cottontail (*Sylvilagus floridanus*). Consequences of New England cottontail extinction include reduced seed dispersal in the New England landscape, dwindling prey supply for species such as foxes, and the loss of regional history and culture. New England cottontails are usually identified genetically, however this process is tedious and not all samples may yield quality DNA. It is difficult to differentiate the New England cottontail from the eastern cottontail based on appearance alone, but both species have subtle coat markings that differentiate them. Since the decline of New England cottontails is an urgent crisis, experts are looking for more immediate ways to identify the species. The purpose of this research is to assess the accuracy of pelage characteristics as species identifiers of New England cottontails. I analyzed over 2,000 sets of data from a CT DEEP database, selecting 628 usable datasets. I ran a chi-square goodness of fit test to analyze the accuracy of expected cottontail species identification collected by field researchers compared to observed cottontail species identification based on pelage characteristics. The results demonstrated that there was no statistically significant difference between the expected and the actual species identifications. These findings are important to conservation efforts, namely developing reliable field identification methods of the New England cottontail.

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

EM EV AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

204

2023

Fair Category

LS

Project  
Number

3026

Title: eGFPuv-based Biosensors for Detecting CRISPR-mediated Genome Engineering

Student Name(s): D. Schwartz

## Abstract:

Currently, the application of GFP-based biosensors for detecting CRISPR-mediated genome engineering tools requires expensive equipment and tedious sample collection and preparation. It is necessary to build biosensors with an easy readout for monitoring the genome engineering invasion in real-time. eGFP uv has been optimized for maximal fluorescence to be observed by naked eyes under UV lights without a fluorescence microscope, which makes it a suitable reporter for building biosensors monitoring the CRISPR-mediated genome engineering tools in real-time (Yuan et al. 2021b). However, until now, there is no report on applying GFPuv for monitoring CRISPR-based genome engineering tools in plants. Our lab has successfully built the GFP-based biosensors for monitoring CRISPR/Cas9-based genome engineering tools including CRISPR/Cas9, CRISPR/Cas9-based base editor, CRISPR/dCas9-based activator, and the prime editor (Yuan et al. 2021a). Here, a similar strategy is to develop the eGFP uv-based biosensors for monitoring the CRISPR-mediated genome engineering tools. I will be planting genetically modified seeds that have been sent by Oak ridge national laboratory. The basis of my project has been stated above however the form my project will take will be purely that of growing plants and making observations.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project Number

3027

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

**Student Name(s):** M. Bernal

**Abstract:**

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. It was hypothesized that bilinguals would outperform monolinguals but take more time doing so. 45 participants were recruited through convenience sampling. 28 were monolingual and 17 were bilingual. The participants' grades ranged from 9-12th. The 9-10th grade were sent a separate copy of the same form sent to 11-12th grades for comparison of results by age. 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 self-recorded the time they took taking the survey. Ultimately, 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 (9th and 10th) did not exhibit the same trend. My study fills the gap relating to research on the cognitive parser correlated with bilingualism in adolescents, a group that is often overlooked in linguistic studies. It provides additional findings on the brain's ability to suppress interferences when completing tasks in general, which is a recurring topic in cognitive research.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

225

2023

Fair Category

LS

Project Number

3028

**Title:** Analysis of Contributing Factors to Overdose Death Variabilities within U.S. States from 2015 to 2022 and Cost-Benefit Calculation of Drug Overdose Prevention Programs

**Student Name(s):** H. Yu

## Abstract:

**Objective:** The overall trend of drug overdose (DO) deaths in the US showed a steady increase from 2015 to 2018, stabilization between 2018 and early 2020, and a sharp increase during the pandemic (beginning in March 2020). However, four states – South Dakota, New Hampshire, New Jersey, and Massachusetts – either had a decrease or a significantly lower increase in DO deaths in the first year of the pandemic. The objective of this research is to analyze factors contributing to DO death variabilities, correlate spending on DO prevention and treatment and DO death rates and calculate the cost-benefit of DO prevention programs.

**Methods:** Microsoft Excel was used to calculate DO death rates, prevention and treatment spending, and economic loss for four states, MA, IL, GA, and WV, which represented a low, medium-low, medium-high, and high (WV) increase of OD deaths.

**Results:** Mean yearly increase of DO death rates (50 states plus DC and NYC) between 2015 and 2022 were 10.0%, 21.1%, 4.5%, -2.3%, 9.0%, 29.8%, and 17.6%, respectively. The highest increase was in 2020-2021. Higher spending on DO prevention and treatment correlated with lower DO deaths.

**Conclusions:** Pandemic-related factors such as social isolation and reduced access to healthcare contributed to the increase in DO deaths. Higher spending on DO prevention and treatment correlated with a lower increase in DO deaths during the pandemic.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project  
Number

3029

Title: Absorption of Oil & Oil-based Contaminants in Water using Exfoliated Graphite

Student Name(s): R. Karunaratne

## Abstract:

Oil spills can happen in many ways, severely contaminating sensitive environments like beaches, mangroves, and wetlands. Oceanic oil spills generate immediate and long-term impacts on the surrounding ecosystem, especially marine life. Thousands of oil spills occur annually in U.S. waters, and nearly 5 million tons of oil are released, contaminating 14 billion gallons of water. Some oil spills are more significant than others, and after a large oil spill, the consequences to the surrounding ecosystem can be felt for a long time. Cleaning oil spills is very complicated, and more efficient techniques are needed. We explored a new approach to retrieving oil from water by testing the oil-absorbing efficacy of Exfoliated Graphite (EG). Graphite is a naturally occurring form of carbon. When its layers are mechanically or chemically separated, it becomes exfoliated and forms a large surface area. EG is hydrophobic and thus does not absorb water, which creates a favorable environment for absorbing oil and separating it from water. In our research, along with freshwater and seawater, we used six different oil types. Each time, by mixing a small volume of oil with water and adding EG to absorb it, we discovered that, on average, between 67% - 98% of different types of oil were absorbed by EG. We used nylon meshes to retrieve the oil-absorbed EG from water, and the absorbed oil volumes were calculated using the density formula. We also successfully checked the possibility of using magnets to retrieve the oil-absorbed EG by mixing iron filings.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CH AT PH

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

245

2023

Fair Category

LS

Project  
Number

3030

**Title:** The Effects of Caffeine on Adolescents' Academic Concentration, Anxiety, and Performance

**Student Name(s):** A. Wang

## Abstract:

Caffeine usage has spiked in 21st-century adolescents. Caffeine, a methylxanthine stimulant, can utilize catecholamines to put the brain into a hyperaware state, where various stimulant effects start to display. However, the effects of caffeine on adolescents compared to the adult population have been mostly overlooked. We examined how caffeine affects adolescent cognitive abilities using self-reported data from high school students in Connecticut and California. Participants were asked to respond to surveys inquiring about their alertness, performance, and mood after finishing the beverage. Data were collected at different times to assess how and when caffeine levels varied in the participant's system. Initially, Non-Caf and Caf participants held a 6.82 and 7.14 average alertness (10-point) which later revealed a negative correlation between time-since-consumption and alertness at -0.255 and -0.908 for the two groups respectively. Caffeine consumption demonstrated little correlation with the increase in concentration, anxiety, and performance simultaneously, with Caf participants averagely reporting 30% increase in all three variables while Non-Caf reported an average of 18% better anxiety and performance and 0% change in concentration; When examining each variable individually, there is a significant improvement in the participants' concentration / focus after they consumed caffeinated drinks whereas caffeine interfered with how participants perceived their alertness, likely due to increased concentration in cyclic adenosine monophosphate (cAMP) and global brain lactate. Based on these findings, we provide suggestions on how and when it might be safe to use this substance for intended purposes.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3031

Title: Disruption of Quorum Sensing systems in Escherichia coli

Student Name(s): J. Murray

## Abstract:

The purpose of this project is to determine the efficacy of utilizing quorum sensing disruptors as a method of limiting the rates of population growth in bacteria. The need for alternative treatment has risen due to increasing prevalence of bacterial infections with resistance to existing antibiotic profiles, such as MRSA. The quorum sensing system is bacterial cell-to-cell communication by use of signaling molecules which regulate cell functions. These signaling molecules, known as autoinducers, are passively produced by bacteria under specific conditions and build up in surrounding media. Once a threshold of autoinducers in the medium is reached, autoinducers bind to associated receptors, causing gene expression. This research specifically focuses on the disruption of the AI-2 population growth quorum sensing pathway in Escherichia coli. The disruptors selected for this experimental design are cinnamaldehyde, thiazolidinedione, 4-methoxycarbonylphenylboronic acid, and salicylic acid. These substances were dissolved at ratios of 60 ppm and 30 ppm into distilled water. The solutions were mixed with nutrient broth and E.coli was incubated (38°C/24hr). Population growth was monitored through spectroscopy (600nm). Results of these tests demonstrated that at 30 ppm, when compared to the control, population density increased by 6%, 15%, and 32% respectively. Salicylic acid showed a 27% decrease. With 60 ppm solutions, cinnamaldehyde, salicylic acid and thiazolidinedione showed a 26%, 41% and 5% decrease in density respectively, while 4-methoxycarbonylphenylboronic acid showed a 16% increase. My hypothesis was 100% realized with cinnamaldehyde and salicylic acid, and to a lesser extent with thiazolidinedione.

Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)

MI BI PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

246

2023

Fair Category

LS

Project  
Number

3032

**Title:** Using Bioinformatic Analyses to Identify Key Differences Between the Gene Expression of Normal Cells and Rheumatoid Arthritis Cells

**Student Name(s):** D. Liu

## Abstract:

Rheumatoid arthritis (RA) is a debilitating autoimmune disease that mainly affects the joints and synovium, with studies placing its prevalence between 0.5% and 1% in Western countries. Despite advances in arthritis research and technology, the cause of RA remains unclear. The purpose of this project was to use bioinformatic analyses to identify critical differences in the gene expression of normal cells and rheumatoid arthritis cells. As gene activity tends to vary in the inflammatory and immune pathways with the onset of RA, it was hypothesized that the RA cells would experience the most remarkable differences in gene expression within these specific pathways. Collagen-induced RNA rat data provided by the mentor was normalized in R statistical analysis software, allowing for comparison. Using the “DESeq2” package from Bioconductor, an open-source software, the normalized data were used to identify significant differentially expressed genes (DEGs) and ranked in terms of significance. The DEGs were then plotted on a volcano plot against the rest of the data, before being analyzed using gene ontology (GO) analysis to determine the cellular pathways with the greatest gene expression changes. The most significant genes were Mmp3, Hspb6, Lbp, Tppp3, and Postn. Contrary to the hypothesis, the most significant changes in gene expression for downregulated genes were for muscle system processes while upregulated genes experienced a substantial change in innate immune response. In the future, this study’s identification of key genes in RA pathogenesis can help support the treatment and prevention of the condition.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CBIO ME BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LS

Project  
Number

3034

Title: The Efficacy Of Yoga In Reducing Stress On Special Need Adults

Student Name(s): L. Manuel

## Abstract:

Daily yoga or even the regular practice of it can improve one's flexibility, heart health, endurance, strength, self-control, reduce stress, and instill a sense of calmness. It can also lead to positive changes in self-awareness, changes in your perspective in life, improved energy levels, and overall happiness. With the explosion of yoga's popularity in the western world in the past quarter century, many studies have investigated the link between yoga and stress. Research has clearly shown that the regular practice of therapeutic yoga enhances physical flexibility and muscular strength, promotes healthy respiratory and cardiac function, aids in the treatment of substance use disorders, reduces generalized anxiety, stress, and depressive disorders, promotes healthy sleep patterns, and raises the overall quality of life. However, there has been relatively little research on the benefits of yoga for those with special needs, including people with Down syndrome or Autism. This lack of study is unfortunate as it has shown that stress management does play a crucial role in the successful treatment and management of down-syndrome. My study aims to address the question of whether the regular practice of yoga can aid in stress management for patients with down syndrome and autism. I plan to measure stress reduction through two primary methods: reviewing changes between a pre- and post-treatment survey, a t-survey, and monitoring heart rate. The potential for yoga to aid in stress management for this population of people is an important disparity that should be addressed.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3035

Title: Quest for Creating Sustainable and Safe Nail Extensions: The Amberization of Tree Resin

Student Name(s): S. Soni

## Abstract:

The widely used acrylic nails, made from hydrophobic acrylic monomers, often contain Ethyl methacrylate (EMA) and/or Methyl methacrylate (MMA), linked to a variety of health concerns like cancer and infections. The purpose of this project is to explore if artificial nails made from tree resin can serve as sufficient substitutes for acrylic nail extensions and how it affects its durability and degradation. Using biomimicry concepts, extensions were created through pine tree resin. The curing process of the nail mimics amberization at an accelerated rate. To keep resin malleable with a moderately high viscosity, a small amount of isopropyl alcohol was used as an inhibitor to temporarily halt the polymerization reaction, so the nail can be shaped prior. Three tests were utilized to compare the control (acrylic) to the resin alternative. Hardness was tested through the Mohs Hardness Scale. Both nail types have the same level of hardness, between 3 and 4 Mohs. Durability was tested through a drop test. Although the resin nails were not as durable as the acrylics, a t-Test from VassarStats found that there was no statistically significant difference between the durability of both nail types ( $p$  value  $> .05$ ). The extensions were tested for removability and found, through a t-Test, a statistically significant difference ( $p$  value  $= .01$ ). This proves that resin nails are safer than acrylics, as they require less time in the harsh acetone. Given the data, resin nail extensions serve as a plausible alternative as they hold up to a battery of tests.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME BI PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

243

2023

Fair Category

LS

Project  
Number

3036

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

**Student Name(s):** A. Gupta

## Abstract:

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 in the same manner as natural sugars. The consumption of artificial sweeteners could cause an increase in consumption in an attempt to fully activate the reward pathway. Previous research has demonstrated the multitudes of harmful impacts of artificial sweetener consumption. This research seeks to determine whether consuming three different synthetic sweeteners leads to an increase in consumption when compared to sucrose, a natural sweetener. Four groups of eight wild-type Oregon R strain *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. Food consumption was measured using the Capillary Feeder Assay. Liquid food media was presented to *Drosophila* in glass capillaries placed in a vial. As liquid food is consumed or evaporated, the capillary meniscus declines. Based on the data analysis, consumes up to twice as much of the synthetic sweeteners as it does the pure sucrose solution ( $\approx 68.09\%$  increase in acesulfame-potassium,  $\approx 93.75\%$  increase in aspartame,  $\approx 61.84\%$  increase in sucralose). This research aims to shed more light on the harmful impacts of artificial sweeteners on the brain and body.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3038

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

**Student Name(s):** A. Horn

## Abstract:

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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB ME EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3039

Title: Identification of Synergistic Mutations Responsible for Tumorigenesis

Student Name(s): D. Zhang

## Abstract:

Genetic factors are a fundamental cause of tumorigenesis, often involving oncogene activation and tumor suppressor inactivation. Oncogenesis is a complex, multi-step process, and most cancers are not likely to be the result of a single gene mutation; a mutation in one proto-oncogene would not cause cancer, as would not a single mutation in a tumor suppressor gene. Multiple genes are mutated and inactivated through different pathways over time to amalgamate into over-proliferation and malignancy. The synergistic effects generated by the accumulation of multiple loss-of-function mutations in complex cellular signaling pathways play a key role in tumorigenesis. Synergy occurs when the contribution of two anti-tumor gene mutations to the phenotype of a double mutant exceeds the expectations from the additive effects of the individual gene mutations. Although Lung Adenocarcinoma remains one of the deadliest cancers in the world, most previous studies have focused on single genes. This presents a problem: often, studying single genes do not accurately reveal their role in cancer cellular pathways because of this interaction between genes. Thus, in this study, we utilized cancer genomics databases to screen potential combinations of genes pairs based on their high frequency of being under-expressed together and their correlation with low patient survival rates, and combined with CRISPR-Cas gene knockout technology, we found several synergistic pairs of tumor suppressor genes. This study may provide some valuable information for identifying novel combinatorial drug targets in non-small cell lung cancer through eliciting anti-tumor gene cooperations.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

259

2023

Fair Category

LS

Project  
Number

3040

**Title:** TopoCan: A Novel Histopathological System for Clinical Prediction with Topology- and Spatial Genome-Informed Deep Learning

**Student Name(s):** I. Wu

## Abstract:

Breast cancer is the most prevalent cancer worldwide. Without a systematic method to quantitatively extract interpretable image features, current diagnosis and treatment techniques cannot account for cancer heterogeneity, resulting in inaccurate, non-specific diagnoses and prognoses. This study presents TopoCan: a novel computational pathology system leveraging spatial gene profiling and topology techniques for accurate and low-cost clinical predictions from histopathology samples. In the first stage, emerging spatial transcriptomics techniques are exploited to obtain localized gene expressions and capture spatial context, interactions, and organization. Furthermore, persistent homology is novelly applied to extract image topological features (denoted as ITFs) to quantitatively represent cell structure and spatial arrangements. Finally, directly linking localized gene expression with ITFs through a Topo-Genome Dictionary, the system correlates topology with oncogenic genes to identify novel diagnostic and prognostic ITF biomarkers and potential therapeutic targets. In the second stage, spatial gene expression is accurately predicted from patient images by enriching image features with topology through a multi-input topology deep Convolutional Neural Network (MIT-DCNN), significantly outperforming conventional methods that rely solely on image-based predictions. In the third stage, MIT-DCNN is employed to extract genome- and topology-informed features from patient images, which are inputted into a Multiple Instance Learning (MIL) pipeline to more accurately predict clinical outcomes, such as diagnosis, subtyping, and survival through the combined power of topology and transcriptomics. TopoCan has been developed into a robust, user-friendly diagnostic tool for pathologists and clinical use. TopoCan is applicable to any cancer type and clinical prediction, and can potentially revolutionize personalized healthcare.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CBIO CS ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

226

2023

Fair Category

LS

Project Number

3041

**Title:** Analysis of previous and current CRISPR-based treatments for Huntington's disease with the goal of developing a new treatment

**Student Name(s):** A. Foley

**Abstract:**

Currently, Huntington's disease (HD) is incurable, despite the efforts of numerous clinical trials. Huntington's disease is hereditary neurodegenerative disease that is determined by the huntingtin (HTT) gene. Mutations in the HTT gene causes the onset of Huntington's disease. The large role genetics play in the onset of HD made 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. There are various preclinical trials attempting this treatment, with promising results. This project attempted 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 has been and will be compared and analyzed with the goal of finding the flaws in each trial, combining the information, and developing a plan for how future experiments could succeed in the treatment. This data was compiled and any insight was thoroughly recorded throughout the course of the research process. A conclusion will be drawn from this data analysis once further analysis is completed. If the experiment is successful, the end result will include a plan for the development of a new CRISPR-based treatment for Huntington's disease.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

195

2023

Fair Category

LS

Project  
Number

3042

Title: Differences in cognitive ability in high school basketball and football players

Student Name(s): S. Matz

## Abstract:

The purpose of this project is to be able to see patterns among the cognitive abilities of high school student-athletes. I am comparing basketball and football at GCDS specifically. I am using a mash-up of different cognitive tests from different sources and some of my own to test memory, reaction time, and decision-making. These tests will be non-physical, and there will be no risk included. The average time a participant will spend on this is roughly ten minutes. Everyone is taking this completely anonymously using a number system. I will administer every test myself. I expect to see a higher level of cognitive ability amongst basketball players, but I expect very high overall performance from both sports teams. My sample size is about 15 per team. The significance of my research is to show how different sports shape your brain throughout the development stages and to back data from sports psychologists on how a brain is able to shape itself around what you do during adolescence. This is also to see the pros and cons of each sport or the benefits of being a high school student-athlete in any circumstance.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

152

2023

Fair Category

LS

Project Number

3043

Title: Secondary Traumatic Stress in Psychiatric Nurses: A Secondary Data Analysis

Student Name(s): R. Harrison

## Abstract:

Secondary Traumatic Stress is symptomatically identical to Post Traumatic Stress Disorder and only differs in that Secondary Traumatic Stress is a result of exposure to other people's trauma. This project was a secondary data analysis. The purpose of this project was to examine the differences between predictors of each subscale. STS subscales are Intrusion, Avoidance, and Arousal. The analysis for this project was performed using a multivariate model in which the predictors for STS were the independent variables and each subscale was a dependent variable. The model found the significance and other characteristics of each predictor. Correlations were also calculated. Mild heteroskedasticity was found using model diagnostics and corrected. Outliers were also identified and removed from the data set. This project found many statistically significant differences in predictors for each subscale. In the future, these findings may be helpful in developing techniques to target and mitigate symptoms specific to each STS subscale.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

190

2023

Fair Category

LS

Project  
Number

3044

Title: Therapeutic Techniques and their Effectiveness on Intrusive Memories

Student Name(s): A. Puthiyavettle

## Abstract:

Post-traumatic stress disorder (PTSD) is a psychological disorder that can develop after exposure to a traumatic, stressful, or disturbing event. Despite ongoing research efforts, scientists have yet to discover a definitive method for eliminating the distressing memories associated with PTSD. While some invasive treatments, such as electroconvulsive therapy, have been tested, non-invasive techniques such as image rescripting and eye movement desensitization and reprocessing (EMDR) and video games are also commonly utilized. However, a comparative study examining the efficacy of these various techniques in terms of reducing intrusive memories has not yet been conducted. To address this gap, I conducted a simulated experiment to compare the effectiveness of EMDR, image rescripting, and Tetris in reducing intrusive memories. The results indicated that the Tetris group demonstrated the greatest reduction in intrusive memories, followed by the image rescripting group, and then the EMDR group. Additionally, the control group and the Tetris group demonstrated more consistent memory scores, while EMDR and image rescripting groups were more variable. In the future, I hope to ethically evaluate more invasive methods, such as ECT, and ensure that all therapeutic interventions are administered by trained professionals.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

245

2023

Fair Category

LS

Project  
Number

3045

**Title:** Cell type-specific expression of the molecular players in mouse prefrontal cortex during cocaine addiction

**Student Name(s):** E. Teng

## Abstract:

Cocaine addiction is an issue that affects more than 5 million people in America per year. Although there has been much research into the genes and chemicals responsible for cocaine addiction, there are many specific questions left unanswered. Our experiment attempts to further previous research into certain molecular players. We follow up with their use of single-cell RNA sequencing on the prefrontal cortex cells of mice undergoing cocaine intravenous self-administration. Data from 12 samples from both saline and cocaine treated mice which are found on the Gene Expression Omnibus public database were retrieved. Using the Seurat function of RStudio, the data was merged into objects, normalized, clustered, and labeled into one of eight cell types. What resulted was a detailed UMAP plot displaying the clusters, their gene expression level, expression frequency, and their cell type. With this plot, we were able to determine the specific cell types that express the genes encoding the pre-established molecular players ( $\Delta$ FosB, MeCP2, and BDNF). When the analysis was expanded to a cell-type specific level, it was discovered some of these genes were selectively expressed in excitatory neurons and non-neuronal cells. Going further into the analysis, we determined the 6 genes with the most varied gene expression over the 3 stages of cocaine addiction for each of the 8 cell types. Overall, our computational analysis of publicly available transcriptome datasets from the mouse addiction model provides new insights into the molecular basis of cocaine addiction.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

215

2023

Fair Category

LS

Project  
Number

3046

**Title:** Effect of microbiota inoculants on novel bioplastic degradation: a comparative study on backyard and commercially compostable bioplastics

**Student Name(s):** R. Denhart

## Abstract:

The use of petrochemical plastics for packaging materials has become a significant pollution hazard that could be countered in the future through the widespread use of biodegradable bioplastics and home-composting methods. The objective of this study was to determine the effectiveness of microbial inoculants, oyster mushrooms (*Pleurotus ostreatus*) and lactic acid bacteria (*Lactocaseibacillus casei*), on the degradation of various novel bioplastic types in small-scale home compost systems. The experiment was conducted using soil burial tests in a simulated home compost matrix with local indigenous microbiota and three inoculant treatments—fungal, bacterial, and combination. Abiotic factors were also monitored for potential correlations. The fungal and combination inoculants significantly improved the degradation of cellulose-based bioplastics compared to those without any inoculants. This improvement also correlated with the maintenance of a higher internal soil temperature. The treatment had little impact on the resin-based bioplastic. The positive control material exhibited high levels of decomposition in all bins which validated the compost system's function. The results show that the biodegradation of bioplastics depends on both the composition of the material and various environmental conditions, particularly the presence of active microbiota communities. Further extensions of this research should investigate how to optimize the use of inoculation methods for home composting to ensure the complete degradation of bioplastics.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI BI EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3047

Title: The Effect of Metal Salts and Chelation on the Catalase Activity in Alzheimer's Disease

Student Name(s): S. Khan

## Abstract:

I tested to see the effect that metal salts and chelation have on the catalase activity in Alzheimer's Disease. Metal salts have shown to improve brain health and Chelation therapy is currently the most used treatment for patients. Zinc can reduce the effect of the Alzheimer's beta amyloid plaques. I tested to see if metal salts and a chelator, EDTA combined will have a faster and more reactive effect on the catalase activity compared to metal salts and chelation on its own. I used metal salts, catalase, 3% hydrogen peroxide, and EDTA. I tested 5 metal salts and EDTA on their own, and the combination of each metal salt with the EDTA. I used the paper filter method by measuring the time it took for a filter paper covered in catalase to reach the top of a measuring cup containing a metal salt and/or EDTA solution with hydrogen peroxide. When the metal salts alone were tested, Potassium was the most effective and Zinc was the second least effective. When the metal salts were combined with EDTA, Potassium was still the most effective and Zinc was not as effective. All of the metal salts tested were reduced in time when combined with EDTA which proved my hypothesis correct; metal salts and chelation combined increased the catalase activity. However, Zinc was not the most effective metal salt, Potassium proved to be the most effective both alone and with EDTA which means when combined with EDTA chelation therapy, Potassium can help treat Alzheimer's.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3048

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

**Student Name(s):** Y. Sandmeier

## Abstract:

According to CDC, in 2018, roughly 1.7 billion people were infected with Mycobacterium tuberculosis (Mtb). The long treatment times of Mtb infections (6-12 months) hampers the recovery of patients and makes treatment unsustainable. To treat tuberculosis (TB) infections, there has been 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. Thus, we aimed to determine whether there were additional factors responsible for this phenotype. A CRISPR interference (CRISPRi) screen performed in our lab identified rv3579c, a predicted 23S rRNA methyltransferase, to be a novel macrolide-resistance factor in Mtb. 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. 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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

200

2023

Fair Category

LS

Project Number

3049

**Title:** Detection and Remediation of War Polluted Soil Using Deep Learning Robot and Soil Remediating Bioplastic (Biocore)

**Student Name(s):** Y. Oh

## Abstract:

Detection and remediation methods in war polluted soil are very limited due to explosives and unknown chemicals in the soil. This research was conducted to develop a system of detection, remediation, and transport with minimal human intervention by using a mobile robot (MR) that transports SRB-BC to locations that the detecting deep learning (DL) model has detected. The Artificial War Polluted Soil (AWPS) model was made with Iron, Copper, and Diesel, commonly found in battlefields. AWPS showed decreased water holding capacity, higher nitrate, nitrite, hardness, heavy metal levels, less plant germination, and growth. 3 potential SRB species were selected based on plant growth and soil quality test from 11 species. They were coated on BC and placed on AWPS to observe remediation for final selection. The final SRB is one of the Bacillus sp., identified through DNA analysis and an LSTM prediction DL model evaluated its effectiveness. A MR sends image sequences taken to a YOLOv3 based detection model. Using the detection model's results, the MR moved to detected soil contamination and dropped SRB-BC. The system developed in this research was very effective in detecting and remediating war polluted soil. In future research, a field test is needed.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM CS AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3052

**Title:** How Does the Duration of Contact Lens Use Affect the Amount of Lysosome Protein Build-up on its Surface

**Student Name(s):** Z. Demo

## Abstract:

Contact lenses are foreign objects entered into the eyes introducing a variety of factors that can be damaging to eye health. Literature suggests that lysosomal proteins in tears fight bacteria in the eye however, can build up on contact lens surface potentially causing damage to eye health. The purpose of this project is to examine if there is a relationship between duration of contact lens wear and the presence of both lysosomal proteins and amino acids involved in the synthesis of lysosome proteins on contact lens surface. To test this, contact lenses were collected from participants who also provided the duration they wore the lenses. The lenses were placed into sterile vials containing distilled water to dissolve proteins off the lens surface. Each sample was run through a UV-Vis Spectrophotometer and absorbance was recorded at 280 nm to test for the presence of possible synthesis of lysosome and 292 nm to test the presence of lysosome. VassarStats was used to analyze the data to determine if a correlation exists between the variables collected. a p-value of 0.16 and 0.49 showed the data was not statistically significant. It can therefore be concluded that there is no significant relationship between the duration of contact lens wear and the presence of lysosome proteins and synthesis of lysosome proteins on contact lens surface. Meaning the duration contacts are worn for does not directly affect the amount of lysosome protein deposits on contact lens that could possibly lead to threatened eye health.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BI ME EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

256

2023

Fair Category

LS

Project  
Number

3053

**Title:** The Efficacy of Varying Sound Frequencies on Accelerating Colony Formation and Zymolytic Properties of *Saccharomyces cerevisiae*

**Student Name(s):** S. Verdejo

## Abstract:

Yeast are single-celled microorganisms and are at the forefront of multiple scientific studies. Their unique interrelation with sound has researchers utilizing music to accelerate the growth rate of *Saccharomyces cerevisiae* (baker's yeast) because yeast often takes multiple hours to complete fermentation, which is inefficient for the bakery industry and research that requires an abundance of yeast. The experiment tests the effect of low-frequency sounds (50 Hz), high-frequency sounds (15 kHz), Indian classical music (300 Hz-6 kHz), and jazz (300 Hz-2.2 kHz) on yeast growth over 15 minutes. The effect of music on the yeast growth was measured by the height of a foam layer which represents carbon dioxide (CO<sub>2</sub>) production, a product of fermentation. The yeast was exposed to sound intensities ranging from 90-110 decibels (dB). Across all trials, the growth rate of the yeast increased by 49.8% with the high-frequency sound. The Indian classical music also showed an increase in growth. Conversely, the growth rate decreased by 16.7% for the low-frequency sound, and the jazz music slowed yeast growth in comparison to silence. Therefore, the high-frequency sound and Indian classical music effectively accelerated yeast's growth rate. Increasing the productivity of yeast growth can quicken fermentation-specific processes in industries and scientific studies. Yeast also contributes to humans' physical health because of biological components in *Saccharomyces cerevisiae*, like beta glucans which strengthen the immune system. Discovering the ideal frequency could accelerate fermentation processes and provide an efficient method to grow yeast for health benefits and fermentation-dependent companies.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project Number

3054

Title: Key Family Environmental Factors and Their Effects on Mental Health Among Youths

Student Name(s): D. Lu

## Abstract:

There has been a dramatic rise of anxiety and depression within adolescents. Every year as much as 8% of teens experience anxiety and depression, which significantly affects their daily life and academic achievement. There are many factors behind the development of these mental disorders; however, family conditions might be one of the most significant. I hypothesize that youths raised in impoverished and unstable families are more vulnerable to stress and anxiety. This research project will investigate the family environment surrounding one's life, and how it factors into mental health. I used data drawn from the CDC's Interactive Summary Health Statistics for Children–2019-2021. I selected and analyzed the topic: Percentage of daily feelings of anxiety for children aged 5-17 years, which consisted of 4 catalogs: Family structure, Parental employment, Parental Education, and Family income. I found that youths with single parents or foster families show higher anxiety rates than ones with married parents, and those with no working parents have much higher anxiety rates than ones with working parents. In contrast, family income had a slight effect on anxiety rates, but parental education had none. Interestingly, the COVID-19 pandemic increased anxiety in those living in good family environments, but did not affect those living in poor conditions like in the examples above. In conclusion, consistent with the hypothesis, stable family structures and employed parents reduce percentages of anxiety in youths. This research shows that family conditions with working, married parents are essential in maintaining healthy minds within youths.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LS

Project Number

3055

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

**Student Name(s):** A. Narang

**Abstract:**

Wetlands are vital ecosystems to the environment because they act as carbon sinks, filter water, control erosion, and are centers of biodiversity. Impacts from human activities such as rising sea levels and pollution 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 Long Short Term Memory machine learning models (LSTMs) with supplemental temperature 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. NDVI and temperature were collected on a monthly basis at 10 locations in Louisiana's Plaquemines Parish for 21 years through Google Earth Engine's publicly available datasets. Three types of machine learning models were built from this data: a baseline Seasonal Autoregressive Integrated Moving Average model (SARIMA), an NDVI data only LSTM model, and a multivariate LSTM model. Results were analyzed with root mean square error (RMSE). Lower RMSE values correspond to a more accurate model. The results show that, contrary to expectations, the multivariate LSTM model performed the worst, with an average RMSE of 0.248. The SARIMA and NDVI-only LSTM models had similar accuracies, with RMSE values of 0.129 and 0.134, respectively. Therefore, the SARIMA model is recommended as the most consistently accurate alternative when data is limited.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

EV CS EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

268

2023

Fair Category

LS

Project  
Number

3056

**Title:** In-situ Biodegradation of Landfill Styrofoam Waste by Zophobas Morio via an Innovative, Compounded Diet

**Student Name(s):** C. Reynolds

**Abstract:**

1,400-tons of polystyrene are produced daily, where most will be disposed of in landfills, and remain for prolonged periods, accounting for 30% of the landfill's capacity. In recent years, research has emerged highlighting the tendencies of superworms (*Zophobas morio* pupae), to eat and naturally decompose Styrofoam. Unfortunately, the rate at which superworms ingest Styrofoam currently limits its usefulness as a new biodegradation process. Finding a method to accelerate superworm Styrofoam consumption is therefore highly desirable. To that end, superworms were separately raised on traditional wheat-bran, Styrofoam, a 1:1 mixture (v:v), and starvation diets, to determine whether mixing of Styrofoam with other food-stock would enhance the worm's desire for the persistent polymer. For 1-month, at regular intervals, the mass of each superworm and corresponding feed were measured, to track food consumption and worm mass. While superworms placed in separate wheat-bran and Styrofoam feeds ate ~100mg of the respective food in 25-days, and gained from 50-70mg of mass, those housed in mixed-feed ate 8.3% more food (122mg) and gained ~54% more mass (104.2mg), suggested that the mixture was more attractive/palatable. Worm mass increase/mass of food eaten was 0.61 and 0.45 for wheat-bran and Styrofoam, respectively, with a 39% increase (0.85) for mixed feed. Finally, superworms in wheat-bran or Styrofoam began eating aggressively after 15-days of placement, while for those in 1:1 mix ate aggressively in 9-days post-placement, again suggesting enhanced enjoyment of feed. FTIR-spectroscopy of starvation and mixed-diet superworm frass highlights successful oxidation and degradation of the Styrofoam polymer to degradable/useable biofertilizer.

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

235

2023

Fair Category

LS

Project  
Number

3057

Title: Effect of Calcium Nitrate on Green Beans in Deep Water Culture Hydroponics

Student Name(s): K. Allen

## Abstract:

This study focuses on the effect of calcium nitrate added to the water of annihilator green beans (*Phaseolus vulgaris*) grown in a hydroponic deep water culture system on the growth rate of the green beans. This information could be used to produce an ideal nutrient solution for green beans growing in a hydroponic system by adjusting the calcium concentration in the nutrient solution to meet the needs of the plant. Calcium is an essential part of the protein synthesis process in plants, therefore it was hypothesized that a higher amount of calcium nitrate would lead to a higher growth rate. In order to collect data, 8 deep water culture totes were filled with water, nutrient solution, and various amounts of calcium nitrate. Tote 1 was the control with 0 teaspoons of calcium nitrate. Each tote increased by 1 teaspoon of calcium nitrate. Each tote contained four green bean plants. The seeds were germinated outside of the hydroponic system and then transferred to the net pots as seedlings. The height of the plants were measured weekly. This data was used to find the average growth rates of each tote in centimeters per week, which was compared to the amount of calcium nitrate in the water of the plants. The results show that the amount of calcium nitrate does not have an impact on the growth rate of green beans in a hydroponic deep water culture system.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LS

Project  
Number

3058

**Title:** The Effect of Chitosan Polysaccharide C56 H103N9O39  
on the Growth of Human Gut Bacteria

**Student Name(s):** S. Vash

## Abstract:

Nutritional supplements are marketed to consumers seeking to maximize their health. Chitosan is a biopolymer polysaccharide supplement taken to enhance weight loss and satiety. Additionally, chitosan has biomedical applications as an antimicrobial agent. Given the importance of maintaining a healthy, diverse gut microbiome, it is concerning that chitosan is ingested regularly as a weight reduction aid. The composition of bacteria in the human intestine is crucial to many functions. This experiment aimed to test the effect of chitosan on human gut bacteria. This experiment was conducted using chitosan, nutrient broth, and four bacteria, *Serratia liquefaciens*, *Serratia marcescens*, *Enterobacter aerogenes*, and *Escherichia coli*. They were individually resuspended in nutrient broth, and 1 mL of the suspension was added to 10 mL of nutrient broth containing 1000 mg of chitosan. Controls included nutrient broth alone and nutrient broth with 1000 mg of chitosan. Cell densities were measured at 24-hour intervals by spectrophotometry. The hypothesis was: If chitosan has a negative effect on the growth of gut bacteria, then the chosen bacteria in the presence of 1000 mg of chitosan would display reduced growth. The results of this experiment did not support the hypothesis because all four bacteria demonstrated a positive percent change in absorbance (ranging from 16% to 250%) attributable to an increase in cell number. Future experiments will use the stronger chitosan derivative (Chitosan Trimethyl - TMC) with plated agar as a medium. TMC would be expected to have a stronger antimicrobial effect due to its enhanced aqueous solubility.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

238

2023

Fair Category

LS

Project  
Number

3060

Title: The Effects of Family Dynamics on an Individual's Suicide Risk Behaviors

Student Name(s): H. Portman

## Abstract:

Suicide is the fourth leading cause of death among people aged 15-19 years old globally, and is a leading cause of death in the United States. One who engages in suicide behaviors tends to have a higher suicide risk profile, characterized by the interactions between an individual's stressors and their innate vulnerability. Such stressors include individual risk factors (history of mental illness, serious illnesses, addiction, etc.), relationship risk factors (bullying, social isolation, family dynamics, harmful relationships, etc.), community risk factors (lack of access to healthcare, community trauma, discrimination, etc.), and societal risk factors (social stigmas, access to harmful substances/tools, social media, etc.). The purpose of this study is to analyze the effects of family dynamics on an individual's suicide risk behavior in young adults ages 13-18 through survey data. The survey, which included various Likert survey and multiple response questions surrounding the client's suicide risk behaviors and family dynamics as determined by therapists who responded on behalf of their patients aged 13-18. Survey data was collected in Google Sheets and organized per therapist client. Bar graphs were generated to show correlations with suicidal behaviors family dynamics, such as single-parent households, presence of siblings, and feeling of connection to family. 55% of clients demonstrated suicide risk behaviors of some capacity. Of those 55%, 56% reside in a single-parent household. The experiment will educate and bring awareness to a potential solution that could involve all family members.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

237

2023

Fair Category

LS

Project  
Number

3061

Title: The Effectiveness of Ultraviolet Light Sterilization on Disinfecting Aquaponic Systems.

Student Name(s): O. Velasco

## Abstract:

The purpose of this study was to evaluate the effectiveness of wavelengths produced by UV light in eliminating bacteria and microorganisms within aquaponic systems, to possibly develop a faster, more efficient, and alternative way of sterilizing the systems without the use of harmful chemicals or more complicated hybrid-biological systems. It was hypothesized that wavelengths produced within the germicidal range (200nm-300nm) would both disinfect and improve clarity as measured by turbidity. Three hydroponic systems were used. The control group consisted of a system with only plants in a traditional water/fertilizer scenario. A second system was a hybrid,-biological system which contained goldfish and plants to help with nutrient sharing and decomposition. The experimental group consisted of a submersible Ultraviolet Light emitting light rays at 254nm. Alfalfa and Sweet Basil were chosen due to their quick growing capabilities. For 10 days, the systems were closely monitored and turbidity levels tested. As compared to the control and the hybrid-biological systems, ultraviolet light had a powerful effect in decreasing turbidity, efficiently eliminating particles/organisms that might necessitate the need for chemical sterilization of the water or the need to maintain a colony of biological balancers (the fish). Additionally, plants grown within the Ultraviolet system experienced quality growth. It was concluded that UV sanitation of hydroponic chambers is a viable solution to chemical and biological sanitation as it is simple, cost effective, and does not impact plant growth.

Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)

PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

183

2023

Fair Category

LS

Project  
Number

3063

Title: Which Method of Sharing Information is Most Effective?

Student Name(s): R. Stewart

## Abstract:

The purpose of this experiment was to see which method of sharing information is the most effective. I wanted to do this to try and find a way to make learning for people more fun, despite the topic. The methods I chose were just talking with a white board/lecture, an article, a PowerPoint presentation, and a video presentation. After I chose the methods and topic for my experiment, I made the materials needed for each one. After that I created a pre-test and post-test for the people who were going to be learning from my materials. Then I separated my class into 4 random groups. For each group, I had them take the pre-test first, then learn from the assigned method I gave them, and then take the post-test. After everyone had taken the test, I assessed and compared the results of all the groups to see which method did the best. I thought the method that would have the best results would be the video. It turned out that the PowerPoint presentation performed the best, score-wise.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

164

2023

Fair Category

LS

Project  
Number

3064

Title: Tactile Stimulation and Individual Satisfaction

Student Name(s): Q. Zhou

## Abstract:

A sensory receptor is activated by a touch stimulus, which is referred to as tactile stimulation. Generally characterized as tactual stimulation. Receiving the senses signals produced by touch receptors in your skin serves as the basis for sensations. They move along sensory nerves, which are made up of bundled fibers connected to spinal cord neurons. The thalamus receives messages after that and transmits them to the remainder of the brain. The somatosensory cortex is the next stop, where signals are converted into a touch perception. Previous studies have examined the connection between touch and emotions, trying to ascertain whether touch may influence how pleasant something feels. (

Colin Silverthorne, Cynthia Noreen, Tani Hunt & Leslie Rota (1972) The Effects of Tactile Stimulation on Visual Experience, The Journal of Social Psychology, 88:1, 153-154, DOI:10.1080/00224545.1972.9922557)

This research will investigate that does thermal stimulation affect students' participation and engagement during class. The outcome indicates the increment of thermal stimulation within the optimal range positively correlated to class engagement.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3065

**Title:** Measuring Leaf Reaction Times of *Dionaea Muscipula* Based on Differing Concentrations of Calcium Ions present Calcium Nitrate Solutions

**Student Name(s):** F. Maignan

## Abstract:

Carnivorous plants seem to be an idea from a scientific fiction movie, yet several species of them live on this planet. With each of them possessing different trapping mechanisms, they are able to successfully survive in nutrient deprived environments. Specifically within *dionaea muscipula*, or venus flytraps, it is believed that they function on an “internal clock” based on calcium ion concentrations when their trap is triggered. Therefore, I was able to hypothesize that if I gave those plants a source of free calcium, it would change the speed at which they trap their prey. Once I acquired my materials, I placed their pots in containers of ½ inch of water to simulate their natural environment. With hours of sunlight and constant moisture, the carnivorous leaves were finally at a size where I was able to trigger their closure effectively. Leaving one of my plants as a control, I designated three other plants to receive different concentrations of calcium nitrate: 5 ml, 15 ml, 30 ml. With those amounts, I mixed them each into separate containers with two cups of water. I then took those solutions and applied them to their corresponding plant, adding two tablespoons twice a day. The experiment quickly came to an end when the experimental plants died overnight for some unknown reason. The possibilities that led to this outcome could have been too high of a calcium dosage, the presence of the calcium nitrate, lack of sunlight when receiving the solution, or the age of the plant.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LS

Project  
Number

3066

Title: Sounds of Change: Music Therapy's Effect on Apathy in Parkinson's Disease Patients

Student Name(s): Z. Neiss

## Abstract:

Parkinson's disease (PD) is a progressive neurodegenerative disease that degrades patients' quality of life. Initially, motor symptoms were the focus of treatment, but increasingly non-motor symptoms including multiple psychiatric abnormalities have gained recognition as requiring equal attention. After being separated from depression, apathy is an under-recognized and difficult-to-treat symptom of Parkinson's that negatively impacts quality of life. Music therapy has been shown to be efficacious for apathy in studies of other neurodegenerative diseases. This study aims to test music therapy's effect on apathy in PD patients, hypothesizing that music therapy will reduce apathetic feelings.

Fourteen participants were recruited through local Parkinson's organizations; inclusion criteria were a diagnosis of PD and internet access. Participants were asked to listen to music for 30 or 45 minutes each day for four weeks. Each week, participants completed an apathy survey that rendered an overall apathy score and scores in the following categories: cognitive, behavioral, emotional, and other.

Results were found to be statistically significant using ANOVA ( $F = 20.2707$ ,  $n = 14$ );  $p < 0.0002$ . The average net change for the control, 30 minutes of music therapy per day, and 45 minutes of music therapy per day groups were -4.8, 5.8, and 10.5, respectively. These results support the hypothesis that music therapy positively affects apathy levels, causing an overall decrease in apathy prevalence in both treatment groups. Further studies are needed to determine the true extent of this effect and how best to incorporate music therapy to treat Parkinson's disease apathy.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

236

2023

Fair Category

LS

Project Number

3067

**Title:** The Effect of Temperature on the CO<sub>2</sub> Output and Food Consumption Rate of Darkling Beetles; Implications for Migration, Pest Control, and Climate Change Adaptability

**Student Name(s):** I. Costello

**Abstract:**

This research study examined food consumption and CO<sub>2</sub> 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 CO<sub>2</sub> 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 were separated equally into two containers. Both containers had 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 CO<sub>2</sub>, humidity, and temperature were checked every 72 hours. Final CO<sub>2</sub>, humidity, temperature, and apple flesh masses were recorded 12 days after the start. Results thus far indicate that more food consumption occurred and more CO<sub>2</sub> 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. A second phase is underway with a higher temperature experimental group. 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.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

AS EA PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

240

2023

Fair Category

LS

Project Number

3068

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

**Student Name(s):** L. Shah

**Abstract:**

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.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3069

**Title:** Determining the Impact of the Loss of Certain DNA Repair Functions on the Antibiotic Resistance and Persistence Development of Escherichia coli Following Treatment With DNA Topoisomerase Inhibitors

**Student Name(s):** A. Zhan

## Abstract:

Antibiotic resistance is an increasing concern surrounding infectious disease treatment. Escherichia coli is an example of a disease-causing bacteria that has built resistance over time, causing antibiotics to become less effective. It contains numerous genes which encode proteins to repair DNA damage. The purpose of this project was to determine the impact on the resistance and persistence development of E. coli against Levofloxacin and Delafloxacin, two DNA topoisomerase inhibitors that act as antiseptics, when certain DNA repair function genes were removed. Out of the genes umuDC, recA, and ruvA, it was hypothesized that recA was the most vital repair gene and its loss would impact the resistance and survival of the E. coli the most. The independent variable was the E. coli mutant with the specific deleted gene and the dependent variable was the persistence and resistance development of the E. coli strains. A total of three experiments were conducted, including epsilometer tests to determine the minimum inhibitory concentrations of Levofloxacin and Delafloxacin, bacterial killing assays to determine survival fractions, and RIF resistance assays to determine resistance development. Data supported the hypothesis in which the recA mutant exhibited the lowest survival fraction and resistance development overall. Overall, knowing which E. coli repair genes are most vital for its survival can be important to find treatment options other than antibiotics to prevent bacterial resistance. This will open up a new path to treat infectious diseases, providing a possible solution to the increasing concern over antibiotic ineffectiveness against resistant bacteria.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB MI BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3071

**Title:** The Safety and Efficacy of Apple Cider Vinegar as a Topical Antibiotic: Its Antibacterial Effect on Pathogenic and Commensal Staphylococcus Bacteria and Effects on the Human Epidermal Microbiome

**Student Name(s):** A. Moss

## Abstract:

Natural alternatives to conventional medicines are gaining popularity, especially through trends on social media, one being apple cider vinegar (ACV), often used as a topical remedy for many skin ailments. Additionally, antibiotic resistance to common antibiotics is a deadly issue that naturally sourced antibiotic replacements could solve. This experiment aims to conclude whether the trending use of ACV has merit and functions as a safe and effective antibiotic. First, the ACV was tested in vitro on both pathogenic bacteria (*Staphylococcus aureus*) and commensal bacteria (*Staphylococcus epidermidis*), to see if ACV only kills harmful bacteria, or if it could potentially disrupt a component of the skin microbiome. When plates of both strains of staph were punched with a dilution series of ACV it caused a zone of inhibition at all dilutions above 25%, proving it to be an effective antibiotic. Since it killed both pathogenic and commensal bacteria, it could potentially harm the microbiome. The subsequent experiment's methodology was created to test if it does. Using a commercial microbiome testing kit, the test subject's right and left arm were tested at baseline, after a five-minute ACV (right) or tap water (left) soak, and after a week of five-minute ACV or tap water soaks. These results demonstrated that ACV does not harm the epidermal microbiome, but effectively kills specific bacterial species. Thus, the widespread use of topical ACV does have merit, and ACV could be an alternate antibiotic for the specific bacteria species it effectively killed, to fight antibiotic resistance.

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

MI ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project Number

3072

**Title:** Using Machine Learning to Forecast Progression from Cognitive Normal to Alzheimer's Disease

**Student Name(s):** A. Song

**Abstract:**

Alzheimer's Disease (AD) affects approximately 50 million individuals worldwide and is estimated to rise to 152 million by 2050. There is currently no treatment for AD that halts the progression from cognitively normal (CN) and/or mild cognitive impairment (MCI) to AD. The ability to predict disease progression will allow for early treatment. While Machine Learning (ML) has been successful in diagnosing the cognitive state, further improvement is necessary for predicting progression. In this study, Random Forest and Bagging Decision Tree Recursive Feature Elimination (RFE) was utilized to ascertain the cognitive state and forecast progression. Clinical diagnoses, demographics, and post-processed PET and MRI scans used in this study were obtained from the Open Access Series of Imaging Studies (OASIS). The findings suggest that aging and lower levels of education are associated with higher risk. The study found that ML using post-processed MRI and PET scans, particularly RFE ML, is effective in diagnosing cognitive states with 90% accuracy. It can predict progression from CN to MCI or AD with 85% accuracy, which is significantly higher than the average reported in literature. Patients with progression from CN to AD were distinguished by elevated amyloid deposition, hippocampus and amygdala atrophy, left accumbens atrophy, thinning of the left hemisphere temporal, and enlarged inferior lateral ventricles. The study demonstrated that RFE ML is effective in diagnosing and predicting the progression of AD. Future studies will concentrate on identifying the specific regions of amyloid plaque that have the most significant impact on cognitive state and progression.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

CBIO ME AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3073

**Title:** Assessing the Effectiveness of Different Flocculants on Algal and Agricultural Contamination in an Acidifying Ocean

**Student Name(s):** S. Aliminate, N. N/A, N. N/A

## Abstract:

Algae and agricultural waste are sources of ocean contamination that can cause major problems, such as contaminating groundwater and killing animal species. Humans are also affected, as algae can release harmful toxins. This is a continuation of my project last year, which helped me understand that flocculants help aggregate algae for removal from water. I introduced PH, photospectrometry, different flocculants, and a new contaminant for this experiment. I hypothesize that aluminum chloride will be the most effective flocculant and that if the pH of the contaminated solution changes and becomes more acidic, then flocculant application will be less effective in aggregating the contaminant. For the experiment, I grew 4 liters of Nannochloropsis algae solution for 50 days in stable conditions to model the algae in real-life applications. Nannochloropsis is a saltwater species that grows in the ocean, making it a viable model. Agricultural contamination was modeled through soil and fertilizer. Different flocculants, including iron chloride, aluminum chloride, and chitosan, an organic polymer, were used at 0.1 molar to mitigate these contaminants. A flocculant causes the contaminants to clump together and become denser, sinking to the bottom of the water. After this, I analyzed turbidity, PH, and amount of light transmittance to determine the chemical's efficiency. Although all three chemicals independently caused the contaminants to aggregate, iron chloride and chitosan were the most effective and promising for industrial usage, although aluminum chloride is more popular. In conclusion, flocculants can efficiently remove contaminants from water, but efficiency can fluctuate depending on conditions.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV EM EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3074

Title: In Vivo Imaging of Structural Connectivity and Synaptic Density in Alzheimer's Disease

Student Name(s): M. Lu

## Abstract:

Alzheimer's disease (AD) has been considered a gray matter (GM) disease. However, recent studies indicate that white matter (WM) damage may contribute to disease progression. WM tracts connecting AD affected GM regions, including the cingulum parahippocampal tract, exhibit increased damage in AD patients. This study aimed to bridge the gap between WM tract damage and corresponding synaptic damage in GM regions in AD. It was hypothesized that damage in the cingulum parahippocampal WM tract would be associated with synaptic loss in GM regions at the starting and ending points of the tract. Tractography and region-based approaches were used to test this hypothesis. Independent variables included WM tract or WM region integrity, measured using diffusion tensor imaging (DTI). The dependent variable was synaptic density, measured using positron emission tomography (PET) in the entorhinal cortex and precuneus. Analysis was performed on a cognitively normal (CN) control group and an experimental AD group. Mentor provided DTI and PET data from Yale's Alzheimer's Disease Research Unit and provided guidance on data analysis. Differences in WM DTI and synaptic density were determined for AD and CN groups using unpaired t-tests. Using tract and region-based methods, WM integrity was significantly lower in AD compared to CN. The strongest relationship between WM integrity and synaptic density was found through a region-based approach. Synaptic density in the entorhinal cortex and precuneus were strongly correlated with Axial, Mean, and Radial Diffusivity in adjacent WM. These findings provide insights on how WM integrity is involved in AD.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME CBIO CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

254

2023

Fair Category

LS

Project  
Number

3075

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

**Student Name(s):** B. Persily

**Abstract:**

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.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

169

2023

Fair Category

LS

Project Number

3076

Title: Assessing Neighborhood Layout for the Prevention of Wildfire Damage

Student Name(s): I. Kemp

## Abstract:

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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3077

**Title:** Short Term Guided Mindfulness Meditation Compared with a Placebo Stress Supplement in Acute Stress Reduction

**Student Name(s):** N. Christopher

## Abstract:

The placebo effect is an effect from a drug or treatment that is not attributed to the properties of the treatment itself, and is therefore due to the patient's belief in that treatment. This is used to express similar responses from patients as they would have had from a real drug. Psychological stress can be reduced in many ways, from anti-anxiety drugs to meditation, although, how do these methods compare, and what about a placebo anxiety supplement? In this experiment, the efficacy of a mindfulness meditation session was compared with a blinded placebo herbal stress relief pill (bought from Amazon, brand Zeebo). After receiving either a placebo or a guided meditation session (Youtube video), participants were exposed to a stressful situation in which they performed a five-minute speech, and completed an unexpected math problem. Measurements of heart rate and emotional states were taken throughout, using questionnaires. Final results were compared to explore the exploratory phenomena of how expectations and outside stress level affected their performances, as well as to explore if the placebo supplement or meditation were more effective in stress reduction. Conclusions show that meditation was more effective in stress reduction in the expectations and reflection aspects of the questionnaires, as well as that participants thought the placebo supplement had a bigger effect than they felt it did. Physiological measurements of heart rate do not definitively show meditation as more effective in stress reduction, indicating that meditation may be psychologically more effective in stress reduction, but not physically.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

253

2023

Fair Category

LS

Project  
Number

3079

**Title:** Footprint Reduction of PET Fiber Waste in Refuse-Environments via Non-Toxic Ideonella Sakaiensis Degradation

**Student Name(s):** L. Li

## Abstract:

The accumulation of synthetic fibers like PET is a growing problem, as these materials are resilient to degradation processes. When discarded into landfills, synthetic fibers take hundreds of years to decompose, and spread toxic compounds that harm plant and animal life. Previous research found the bacteria Ideonella Sakaiensis (ISAK) evolved to utilize polyethylene terephthalate (PET) as its sole carbon source. It employs a two-enzyme system of PET hydrolase (PETase) and mono(2-hydroxyethyl) terephthalic acid hydrolase (MHETase) to depolymerize PET. This research aims to provide evidence for ISAK degradation's capacity with PET fiber in conditions similar to waste-refuse environments with soil. Plate configurations were made with varied concentrations of an R2A nutrient agar medium, soil, and 100% PET string, and were investigated for three weeks post-inoculation of ISAK. Appearance of fibers and visual evidence of ISAK growth were determined through light microscopy and scanning electron microscopy (SEM). To measure PET loss from cultivation with ISAK, the initial and final mass of tested string samples were determined. Samples exhibited 8.9-15.2% PET mass lost after three weeks of cultivation. For soil configurations, plates with 50% concentration of soil yielded the highest amount of PET mass lost. Additionally, string samples post-experimentation yielded 8-23% loss in linear string density compared to untreated PET string. Visual and quantitative results from this research demonstrate the degradation of PET string using ISAK under soil conditions, thus underlining potential of this method to be applied in future studies involving fibers in waste refuse environments with Ideonella Sakaiensis.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN EM AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

247

2023

Fair Category

LS

Project  
Number

3080

Title: MiMe: Mindly Meditation

Student Name(s): N. Makin

## Abstract:

Due to the pandemic and other global issues, mental health awareness has grown tremendously over the past few years. MiMe: Mindly Meditation is an app that uses simple wavelengths of light and specific sounds to alter your emotions to your choice. To determine what wavelengths of light are most effective in certain situations, a person will be asked a few questions about their mood. Then, they will be placed in a silent, dark room with the app playing a specific sound and showing a particular wavelength of light through the screen. After the session is completed, the person will be questioned once again. This test can also be done without the light and only the sound to prove this application's versatility. These tests concluded with the wavelengths from 750nm-565nm (warm colors) being more calming versus those from 565nm-380nm (cool colors), causing the person to be more alert. With this data, the Mindly Meditation app creates sessions based on what type of mood you want to feel. When you launch the app for the first time, you are greeted with an onboarding screen describing the standard features of the app. Inside the app, you can decide how long you want your sessions and more customizable features. When you open the app, typically, it will ask you what emotion you are feeling at that moment, and the feature to use an AI algorithm to suggest what session to partake in will be implemented in the later releases.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME CS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project  
Number

3081

Title: Is There a Correlation Between Covid-19 and Scented Candle Reviews?

Student Name(s): J. DeFrances

## Abstract:

Correlating COVID-19 and scented candle reviews was an experiment that was inspired by Beauchamp's experiment, however was uniquely run with a separate analysis to determine if conclusions matched. The experiment begins with a full data analysis of 3,552 Yankee Candle Store reviews on Amazon that range from January 2020 to November 2022. For each week between these dates, a total count of reviews along with a count of reviews regarding lack of scent were tracked on an Excel sheet. Comparing these reviews along with weekly COVID cases in the United States, gave a first impression of a surprising truth. It initially appeared that the graphs created from the sets of data had enough information to easily draw the conclusion that these negative reviews really could predict Coronavirus outbreaks in the United States. They even had a moderate to strong positive correlation. Upon more in-depth review, however, dividing the weekly number of negative reviews over the weekly number of total reviews, new weekly numbers showed that when compared against the weekly COVID cases, there was zero correlation. This discovery led to the conclusion that without multiple views of the data, false conclusions can be made. To support that this data could be manipulated so easily, monthly moon temperatures were compared against these new weekly numbers, which had a strong negative correlation. It was concluded that statisticians and audience members must look at statistics with caution, because although none of the information found in this experiment was wrong, it was originally misunderstood.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

212

2023

Fair Category

LS

Project Number

3082

**Title:** A Comparative Analysis: The Efficacy of Carbon Sequestration in Saccharina, Agarum, and Laminaria Kelp Species Versus Andropogon, Schizachyrium, Panicum, and Sorghastrum Prairie Grasses

**Student Name(s):** C. Cline

## Abstract:

The purpose of this experiment was twofold: firstly, it aimed to determine and compare the ability of both prairie grass and seaweed to sequester atmospheric carbon dioxide. Secondly, using this collected data, inform what methods of carbon capture should be prioritized in the near future. Carbon dioxide is one of the leading contributors to global warming, perhaps the most pressing issue in today's world. Prairie Grass and Kelp can both be used to naturally sequester carbon dioxide from the atmosphere. In order to determine the ability of each plant to sequester carbon, a variety of different species of each plant were selected. Over the course of nine weeks, four different types of prairie grass were grown. In addition, three different types of kelp were grown in an 80 gallon tank at optimal temperatures and pH to mimic the ocean environment. After completing the trials, an accepted value for percentage of carbon in kelp was used to determine the amount of carbon dioxide sequestered over the course of the trial. For the prairie grass, the amount of carbon sequestered was calculated by subtracting the ash weight (burned) from the dry weight (original). It was concluded that prairie grass is significantly easier to cultivate, however, is unable to sequester carbon as effectively as kelp.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV PS EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

259

2023

Fair Category

LS

Project Number

3083

Title: Investigating Stress Response Genes in *C. elegans* to Prevent Huntington's Disease

Student Name(s): C. Liu

## Abstract:

Huntington's disease, a neurodegenerative disorder caused by an accumulation of mutant Huntingtin (HTT) protein aggregates, is known to affect cognitive abilities, motor control, and memory in humans, with no cure as of now. To study the molecular mechanisms involved in HTT protein aggregation, we use the model organism, *Caenorhabditis elegans*. Studies have shown that the promotion of longevity in *C. elegans* prevents the formation of HTT protein aggregates, though the specific processes involved are largely speculative. Furthermore, certain genes that positively regulate longevity are often activated during stress responses. To research the connection between these genes and Huntington's disease, we use RNA interference (RNAi) to inhibit their expression in EAK103 *C. elegans*, a strain engineered to contain YFP-tagged mutant human HTT protein.

In our work, we investigate two genes chosen from an initial targeted RNAi screen, *pha-4* and *daf-16*, to study their roles in decreasing protein aggregation in worms undergoing induced stress. Here, we present evidence that *pha-4* is required to reduce protein aggregates under oxidative stress and both *pha-4* and *daf-16* play a crucial role in preventing the onset of Huntington's disease through dietary restriction (DR). In addition, we map out a possible signaling pathway between *pha-4*, *daf-16*, and three additional downstream genes (*lag-2*, *sod-2*, and *rsk-1*) based on an RT-qPCR analysis.

By exploring the relationships between genes involved in regulating longevity to delay neurodegeneration under stress conditions, our work will lead to further understanding of Huntington's disease and the neuropathological mechanisms involved in the disorder.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

217

2023

Fair Category

LS

Project  
Number

3084

**Title:** The Effects of Vitamin D, Ozone, Nitric Oxide and Pesticides on Alzheimer's Disease Induced Drosophila melanogaster

**Student Name(s):** L. Raveis

**Abstract:**

Alzheimer's disease (AD) has recently been declared as the sixth leading cause of death in the US, and third in those 65 and older. AD is commonly known as an incurable irreversible disease that eventually leads to death. This experiment seeks to identify specific environmental factors that may affect the development of AD. Research studies suggest that Vitamin D, Nitric Oxide, Ozone, and Pesticides advances the development of AD, therefore it is probable that the results of this experiment will yield similarly. These environmental factors will be tested on Drosophila with a disruption in the APP protein and in those with regular gene frequencies. Pesticides will be tested through a contact test, Nitric oxide through a chemical reaction of copper and nitric acid that will be infused into the Drosophila chamber, and ozone through an ozone generator. Vitamin D drops were placed in the food of the Drosophila who have a disruption in their AD gene (APP protein), and there is evidence leading that they have negative effects on AD. The progression of AD has been tested through a Drosophila climbing assay as well as the rate of survival per each testing group. Research studies suggest that Vitamin D advances the development of AD, therefore it is probable that the results of this experiment will yield similarly.

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

ME BE EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

162

2023

Fair Category

LS

Project  
Number

3085

Title: The affect of storm drains on water quality

Student Name(s): K. Fiore, J. Huy

## Abstract:

The purpose of this experiment was to see how storm drains affect water quality in certain areas around New Haven. Storm drains can be a meaningful source of contaminants in urban waterways and are known to negatively affect water quality by introducing contaminants found on roads, such as salt or copper from automobile brakes. In this experiment we measured total dissolved solids, conductivity, and pH at a variety of sites on the Mill River, a waterway in New Haven which feeds into the Quinnipiac River. We found during sampling that several of the testing sites had lead concentrations above the level allowed for drinking water, and we also detected a small amount of copper at a few locations. Some of these contaminants were found at higher concentrations near a storm drain than at points further away from one. All of these results led to the conclusion that the water quality near the storm drain was overall worse than the water found upstream.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV MI EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

231

2023

Fair Category

LS

Project  
Number

3087

Title: Investigating the Presence of Paenibacillus larvae in My Family's Beehives

Student Name(s): S. Carrasco

## Abstract:

Honeybees are essential pollinators for agriculture and the sustainability of our ecosystem. With the help of other bees, they pollinate about a third of the food we eat. But honey bees have been dying off in alarming numbers since 2006. American Foulbrood is a deadly disease to honey bees caused by the spore-forming bacterium, Paenibacillus larvae. That's why when we discovered dead bees around our beehives and found symptoms that matched with American Foulbrood, we replicated previous experiments when researching this disease. Samples were collected from suspected beehives in our family apiary. Phosphate-buffered saline was added to each Eppendorf tube that contained the collected samples. It was then heat-shocked and centrifuged. The supernatant was then used to inoculate the MYPGP agar plates. 100  $\mu$ L of the supernatant from each sample was used to inoculate the surface of Petri dishes containing the MYPGP agar medium. The Petri dishes were incubated and examined for the growth of colonies. We conducted microscopic examinations of the bacteria and spore using Gram staining. Results were examined under a microscope. Biochemical tests such as the holst milk and catalase tests were also performed. From the experiments conducted, it was concluded that P. larvae is not present in our beehives and therefore we do not have AFB. We hope to extend our experiments in the future so we can determine what was affecting our beehives.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

256

2023

Fair Category

LS

Project Number

3088

Title: The impact of microbiota on COVID-19 mRNA vaccine efficacy

Student Name(s): Y. Zhou, T. Geng

## Abstract:

**Background:** COVID-19 is the largest pandemic in the 21st century, accounting for 6.8 million deaths globally and 1.14 million deaths in the United States. The mRNA -based vaccines have proven effective by reducing hospitalization and death rates significantly. However, the effectiveness of these vaccines may be affected by many factors, including age, existing medical conditions, medications, etc. Of note, it has been shown that antibiotic medications jeopardize the effectiveness of the flu vaccines. Antibiotics can eradicate disease-causing bacteria, but also bacteria beneficial to our body's immune system.

**Hypothesis:** Disruption of commensal bacteria due to antibiotic medications will reduce the COVID-19 mRNA vaccine efficacy.

**Experimental Design:** We treated a group of 5 mice with an antibiotic cocktail (ampicillin, neomycin, vancomycin, and metronidazole) and another group with water (control). We injected mice with a COVID-19 mRNA vaccine in the hind leg muscle, on the 1st and 14th day, collected stool and sera on the 1st and 30th day, quantified stool bacterial DNA by quantitative Polymerase Chain Reaction (PCR) and anti-Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) spike immunoglobulin G (IgG) by Enzyme-Linked Immunosorbent Assay (ELISA).

**Results:** We observed that antibiotics eliminated ~99.99% of the gut bacteria, and the serum IgG against SARS-CoV-2 spike protein was reduced by 42% ( $p=0.002$ ) in the antibiotics-treated mice compared to control mice.

**Conclusion and Limitation:** Antibiotic medications may decrease the efficiency of the COVID-19 vaccine. This is an animal study with a small sample size and an extreme antibiotic medication.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

245

2023

Fair Category

LS

Project  
Number

3089

Title: How Algal Biofuel Can Be Implemented At A Reasonable Price Point In The US

Student Name(s): W. Kearns Duran

## Abstract:

With fossil fuel use at the forefront of climate change, a cost effective alternative fuel must be implemented. Algal biofuel presents the greatest replacement as the cultivation requires minimal care and the plant contains high lipid content to be refined into fuels. This fuel is then able to be used in any conventional vehicle or application where oil based fuels are currently used. The study is being conducted as a meta analysis collecting previously researched information and economic sources for the costs of algae biofuel production. This scientific and economic data will then be ranked in accordance with its efficiency and effectiveness as well as the monetary cost related to construction and operation of various strains, cultivation methods, and lipid extraction methods. The analysis will then compare the values and observe which best balance efficiency and cost for an effective implementation in the US. This implementation would most likely follow with Chlorella or Scenedesmus strains of algae which are cultivated in an open pond system being refined with confined jet impinging mixers. The analysis would provide a possible framework for implementation in the US, but also provides a ranking metric for application in various regions. If scientific efficacy and cost structure are measured, any developer could use the ranking to balance maintenance costs in certain regions to create higher yields or ensure production safety. The study will create a tool which can be used to show the viability of algae biofuel application in the US.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS ET EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3090

**Title:** THE INDIRECT EFFECTS OF PHYTOHORMONES ON THE COMPOSITION OF COMMUNITIES OF INSECTS INTERACTING WITH *Quercus alba* (WHITE OAK) IN THE FORESTS OF CONNECTICUT

**Student Name(s):** K. Tierney

**Abstract:**

When an insect attacks a plant, specific phytohormones are released in response. These phytohormones regulate the emission of Volatile Organic Compounds (VOCs), which insects use as olfactory cues. How do these VOCs change the insect communities interacting with these plants? This study explores how different phytohormones, especially salicylic acid, and jasmonic acid, change the suites of VOCs emitted by the plant thereby changing the composition of insect communities interacting with the plant in Connecticut forests. To address this question, Professor Singer's lab, from Wesleyan Universities Biology Department, applied phytohormones to white oak trees in Old Lyme, Connecticut. There were three experimental groups of phytohormones: Salicylic acid, Jasmonic acid, and the control (ethanol and water). Sticky traps were placed on the trees and collected five days later. After collection, a quantified the abundance of individuals in each taxonomic order from 12 sticky traps (four per group) and recorded them in a spreadsheet. Wilcoxon analysis showed that phytohormones have no significant effect on the composition of insect communities. However, Coleoptera and Diptera show a marginally non-significant trend of greater abundance in the hormone treatments compared to the control. This information is important to know because there is little information on how phytohormones and VOCs mediate plant-insect interactions outside of controlled environments. By experimenting in natural ecosystems, we can better understand how cellular processes and ecology go hand-in-hand. Further study of this process will be needed to determine if phytohormone VOCs affect insect communities in more specific ways.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

AS EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

228

2023

Fair Category

LS

Project  
Number

3091

**Title:** Prioritizing candidate disease genes for de novo variants by integrating phenotype information with protein-protein interaction networks

**Student Name(s):** S. Xu

**Abstract:**

As genome sequencing technologies improve, there is an ever-increasing demand to develop statistical methods with improved sensitivity and accuracy. Using increasingly available whole genome and whole exome sequencing data, these methods can identify additional risk genes. This is especially crucial for research regarding complex human diseases, where statistical methods can direct the focus of clinical trials and improve efficiency. Here, we propose a novel statistical method that integrates a protein-protein interaction (PPI) network with disease-specific phenotype information to prioritize candidate genes for de novo variants (DNVs). Our method was tested using simulation studies, and the results showed that utilizing disease specific phenotype information allows for more sensitive and accurate risk gene identification. When applied to real congenital heart disease (CHD) data, our method prioritized many genes that were previously lower ranked but had strong phenotype associations. Of the top 25 ranking genes, 17 were ranked higher than they were before integration of our disease-specific network. Twelve (12) of the top 50 known genes were previously associated with CHD. Genes in the top 25 that were not previously associated with CHD but had strong connections to the disease included RBFOX2, POGZ, CCR2, and NAA15. Our study shows that incorporating phenotype information may allow additional disease-associated genes to be considered that previously would not have been, and our method can be generalized to other diseases.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

CBIO

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project Number

3092

Title: What Sport on Campus is Most Likely to Get Athlete's Foot?

Student Name(s): L. Elie

## Abstract:

Although there are preventative methods for Athlete'sFoot like shower shoes. There are no preventative methods that cater specifically to each sport. In order to suggest specific preventive methods to athletes I wanted to figure out what sports on campus are most likely to get Athlete'sFoot. In order to do this I tested students for Athlete'sFoot. I tested 2males and 2females across the following sports: Basketball, Hockey, Squash, Swimming, Running, and people who don't play sports. This resulted in the participation of 24 students at the Loomis Chaffee School ages 14-18. The students were tested using a 20% potassium hydroxide (KOH) wet mount. Students used a swab kept in a centrifuge tube containing 1 milliliter of 500 milliliters of distilled water and 4.25 grams of NaCl saline solution. The students swabbed in between each toe. Their swab was placed back into the tube. Then students participated in an interview. In the lab, the swab was rolled onto a microscope slide with KOH. The sample was placed under the microscope to look for segmented hyphae. The results were that no students had Athlete'sFoot. Skin cell presentation was greater with Basketball athletes versus others participants. Students not in sports had barely any skin cell presentation. In the interview 17% stated that they had Athlete'sFoot at Loomis, 25% of males said they do not wear shower shoes, and 70% of participants vocalized their bare feet are exposed in public spaces. There should be specific preventative methods and actions for all sports to avoid Athlete's Foot.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME CB MI

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- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project Number

3093

**Title:** Effects of Increased Rainfall on Permafrost Stability and Methane Emissions in Eastern Canada over the Next Century

**Student Name(s):** V. Balamurugan

## Abstract:

Over 1,500 gigatons of organic carbon in a state of suspended decomposition are stored in all known permafrost locations on Earth, with permafrost defined as a subsurface layer of soil that remains frozen for at least two consecutive years, and deposits are mainly located in the Northern Hemisphere and Antarctica. Due to climate change, organic carbon inside permafrost has an increased probability of being exposed to humidity and warm air, leading to the release of greenhouse gasses (such as methane, carbon dioxide, and nitrous oxide) as it decomposes. This leads regions such as Eastern Canada to evolve from net carbon sinks into net carbon emitters. This project will investigate the relationship between increased Arctic rainfall and permafrost stability through the analysis of relevant climatic factors, and also will analyze how different Representative Concentration Pathways will affect permafrost stability over the next century. The hypothesis tested in this study is that increased temperatures and rainfall over Eastern Canada simultaneously increase the probability of permafrost thawing, which then increases the carbon emissions of the region. This is projected to be seen in the statistical analysis test results for the collected data. The mentor provided aid in formulating methods for collecting and analyzing the climate data, and also helped with troubleshooting errors that had arisen while tackling the research question. The result of my research corroborated evidence that supports a correlation between permafrost instability and increasing rainfall + air temperatures in the Arctic, with this being projected to worsen over the next century.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV EA

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

259

2023

Fair Category

LS

Project  
Number

3094

**Title:** Testing Plant Communication via Plant/Non-Plant Volatile Organic Compounds (VOC) when under Herbivory stress

**Student Name(s):** J. Habshey

**Abstract:**

This study was to establish the effect of airborne defense chemicals (Volatile Organic Compounds) on neighboring plants' defensive response to herbivores, and the effect of non-plant originated VOC on a plants' response. Existing research on the effect of plant and non-plant VOCs on herbivore defense is limited. To test the hypothesis, tanks were split into 3 sections with Mallow plants in each. Caterpillars were fed on the plants in the middle section for 5 days. On one side, a solid plexiglass wall to prevent VOCs from traveling to the plants while on the other a screen, so VOC could travel to the plants. After the 5 days the barriers were removed to determine which plants could better defend themselves from caterpillars. This setup was repeated in three other tanks - butane, propane, and propylene were added to test if they interfered with communication. The plants were rated at the beginning and end of the second phase on a scale from 1-no damage to 5-total damage. The t-test was performed to compare non-exposed to pre-exposed showed no significance with a p-value of .359776, .4246805, and no difference, for the control, propylene, butane and propane. However, the non-exposed plants in the control tank experienced less rapid damage, as shown by a less steep slope, than their counterparts with non-plant VOCs introduced. Although the evidence for plant communication via VOC is insignificant, the presence of non-plant VOC was correlated with more damage, indicating that they should be monitored to ensure less damage.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

PS EM CB

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3096

Title: The Effect of Pet Allergens on Asthma

Student Name(s): E. Levine

## Abstract:

The prevalence of pet allergens has exponentially increased in both urban and rural communities. Current studies have proven that severe pet allergies can lead to the development or worsening of other conditions, one being asthma. The following research seeks to prove the correlation between pet allergies and asthma. If patients' allergies are worse than they will have worse asthma symptoms. A fourteen question survey was created that asked ENT patients about what proven allergens they had, symptoms, and what medications they used to combat them. The results were then computed into a google spreadsheet and assessed. Overall, approximately 60% of the patients were allergic to pets --cats or dogs-- and of this group 70% expressed allergies proven through testing. Some symptoms overlapped, congestion and itchy eyes, but many did not seem to have developed asthma on the high levels that were expected. Some of the more uncommon side effects to these allergies were nasal polyps and hives on the skin when coming in contact with the pet. In addition, patients who did not have clinically proven allergies to pets still experienced symptoms. Many patients used a rescue inhaler, but only in great moderation. Ultimately, this study proved that there is a slight correlation between asthma and allergies. In order to retrieve stronger results, more patients should be surveyed. Perhaps the participants should have a recent allergy test before taking the survey as well in order to prevent people who experience allergic symptoms to pets from answering that they are not.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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 vertebrate animals       controlled substances

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3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3097

Title: The water cycle and bacterial resistance to antiseptics

Student Name(s): T. ASLAN

## Abstract:

**Background:** Pollution is a major cause for water scarcity, that in turn limits access to safe drinking water. In this project, I tested and compared the resistance to various antiseptics of environmental bacteria found in water samples from different stages of the water cycle (well, rain, river, lake, and tap water).

**Hypothesis:** My hypothesis was that, if various antiseptics are applied to water samples from different sources, then environmental bacteria from tap water will be the most resistant and the bacteria from underground/well water the least resistant to antiseptics because of different levels of exposure to everyday manmade antimicrobial agents.

**Methods:** I used the Winkler Method to measure dissolved oxygen in water samples from five sources: well, rain, river, lake, and tap. I next inoculated 10 agar plates with samples from each of the five water sources. Sterile blotter paper disks topped with 5 different antiseptics and control, were inserted in the four quadrants of each plate. Zones of inhibition (ZOI) were measured on days 1, 2, 3, 4, 7, and 9, and were classified as either resistant, intermediate, or susceptible.

**Results:** The tap water plates produced the smallest and fastest decaying inhibition zones overall compared to well, rain, river, and lake samples. The well water plates exhibited the largest and most stable ZOIs over time.

**Conclusion:** My hypothesis was correct, showing that bacterial resistance to antiseptics varies depending on the water source, with more pristine water sources performing better than those exposed to everyday manmade antimicrobial agents.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME MI EV

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

218

2023

Fair Category

LS

Project  
Number

3098

Title: The Impacts of the Permanent Implementation of Daylight Savings Time in Connecticut.

Student Name(s): E. Conway

## Abstract:

The purpose of the research project is to analyze the future impacts of a permanent implementation of daylight savings time in Connecticut. The Sunshine Protection Act was a bill that passed unanimously in the Senate but failed to be voted on last year in the House. If passed, this bill would result in year-round daylight savings time and eliminate the “fall back” time change. Conclusions in research show positive outcomes in the economy, benefits to health, and a decrease in energy usage. Most research was done through internet sources where studies were revised and evidence was compiled. In the case of public health, eliminating the time change will decrease the number of heart attacks and lessen the number of lives lost due to vehicle collisions. Permanent daylight savings would also decrease energy consumption during winter months. Finally, it would prevent the decrease seen in spending during Standard Time. In conclusion, permanently switching to daylight savings time for Connecticut residents will have lasting benefits. This research can be used to inform Connecticut politicians and other states about the benefits of bills passed in favor of permanent daylight savings time. Further research should investigate the effects of a permanent switch to daylight savings time in Connecticut schools on students’ mental and physical health, as well as school energy consumption.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

266

2023

Fair Category

LS

Project  
Number

3099

**Title:** Eco-Friendly Removal of Eutrophication-Initiating NH<sub>4</sub><sup>+</sup> from Water via SAP-Enhanced, Activated Food Waste Biochar Adsorption Films

**Student Name(s):** A. Lin

## Abstract:

From 1980 to 2018, global agricultural ammonia emissions increased by 78%. Ammonia emissions react with water in the atmosphere, turning into ammonium ions in aquatic ecosystems and contributing to water acidification and eutrophication. Over time, the low-oxygen waters from the algal blooms cause toxicity effects, a decrease in biodiversity, and can eliminate essential aquatic organisms. Due to high adsorption capacities, food waste biochars synthesized from fruit pericarp and nut husk remove ammonium ions efficiently. Research supports that biochar ozonation increases cation exchange capacity (CEC), and ultrasonic activation enhances adsorption abilities. The addition of eco-friendly, itaconic-acid-based superabsorbent polymer (SAP) improves porosity and remediation efficiency through high swelling capabilities. This research seeks to employ activated/ozonated biochar (AO-biochar) and SAP in a polycaprolactone (PCL) structure for the creation of an optimal NH<sub>4</sub><sup>+</sup> adsorption film that can be employed in flowing water systems. Separate testing of AO-biochar and SAP achieved, respectively, 23.91/11.1mg NH<sub>4</sub><sup>+</sup> remediated per gram of active ingredient in 20 hours, measured via ATR-FTIR spectroscopy. When 0.15g of AO-biochar/SAP adsorption film (16cm<sup>2</sup> surface-area) was immersed in 300mL of NH<sub>4</sub><sup>+</sup> solution with a robust initial concentration of 50mg/L, NH<sub>4</sub><sup>+</sup> concentration was reduced to 0.36mg/L over 50 hours, corresponding to 100mg NH<sub>4</sub><sup>+</sup> remediated per gram of film. Subsequent reuse trials demonstrated a maximum adsorption capacity of 220mg-NH<sub>4</sub><sup>+</sup> remediated per gram of film. The AO-biochar/SAP adsorption film is 1000µm thick, floatable, and stable, with no structural degradation into running water sources. Once contaminant-saturated, the film can simply be removed from the water and disposed of.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN EM AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3100

**Title:** Developing a machine learning model to preoperatively evaluate patient outcomes for complex orthopedic fractures

**Student Name(s):** S. Irshad

## Abstract:

Distal femur fractures (DFFs) are fractures of the thigh bone. Currently, DFFs are a major health problem, especially for the elderly, creating urgency to improve surgical outcomes. Current research has focused on creating patient specific implants, but have not shown to be more effective. Standard implants, such as the intramedullary nail and lateral locked plate, remain as gold standards. Additionally, there is little research on which standard implant is optimal for patients based on their specific characteristics. Surgeons' choice of implant is made with limited input regarding how patient characteristics would influence surgical outcomes. Therefore, the purpose of the study was to use machine learning to predict which treatment (intramedullary nail vs lateral locked plate) would be most optimal for patients for DFFs based on patient specific characteristics. A database containing postoperative data of DFF surgeries was obtained. The most important characteristics that impact surgical outcomes were researched and the patients were sorted in these categories. Surgeries were labeled "failure" if the recovering patient had infection, mortality, nonunion or malunion of the fracture, or implant failure. Surgeries that had decreases in ambulation (patient's ability to walk) were classified as "undetermined outcome." Surgeries with neither of these symptoms were labeled "successful." K-medoids analysis was able to determine specific combinations of patient characteristics associated with either success or failure. Silhouette analysis determined that 15 clusters created the most distinct patient groupings. This research can help surgeons make more informed decisions on the optimal implant for patients, helping improve outcomes of DFF surgeries.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

AT CS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

232

2023

Fair Category

LS

Project  
Number

3101

Title: The Effect of Placebos and Nocebos on Pain Perception

Student Name(s): A. White

## Abstract:

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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

218

2023

Fair Category

LS

Project  
Number

3102

Title: The Effect of Robotic Architecture on the Perception of Trustability of Social Robots

Student Name(s): A. Barczak

## Abstract:

Robots are becoming prevalent in society, in homes, being companions for children, and forming physical relationships. Social robots are becoming more frequently targeted to children. Research shows the human brain possesses an ontological category catered to artificial-looking robots, but not ones appearing "somewhat human." The trustability of various robotic architectures requires further research, specifically the impacts of physical appearance on the perception of trustability. For the purpose of this research, trust will be defined as outlined in the article, Trust in Robots: Challenges and Opportunities as "... a belief, an attitude, an effective response, a sense of willingness, a form of mutual understanding, and as an act of reliance." Three youtube videos will be chosen of three separate social robots with differing architecture. Strategically chosen keywords that connote attitude will be pulled from the comment section. I will create/use an already available algorithm to extract the keywords and emojis and compile and organize data to form a conclusion on a large, global population's perceptions of the trustability of social robots. The expected results are that robotic agents appearing "robot-like" will be perceived as more trustable than ones appearing human-like. Implications of this research will lead to a higher understanding of the effects of different facades and architectures on the perception and trustability of social robots.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

244

2023

Fair Category

LS

Project  
Number

3104

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

**Student Name(s):** A. Bahel

**Abstract:**

Telehealth appointments are a practical alternative for varying patient populations—targeting those who may not be able to take a day off work. It also motivates people to consult their medical provider as the amount of obstacles reduces. There is a crucial need to understand how patients can balance their financial obligations, along with prioritizing their health. The purpose of this project is to determine the availability for telehealth consults, in a timely manner, for musculoskeletal patients with differing insurance plans. To investigate the study questions, the secret shopper method was implemented. A list of surgeons from the American Association of Hips and Knee surgeons was compiled for 15 states based on medicaid reimbursement rates. A call script was created surrounding a patient needing a telehealth consult for a total knee replacement. The following information was collected from the operator: 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 1 was made with a medicaid patient and after two weeks a second call was made for a patient who has Blue Cross Blue Shield. Overall, 4% of centers offered telehealth for the initial consultation during all calls. Current trends show that less than 50% of surgeons accept Medicaid. All in all, this study aims to increase equity for patients across differing socioeconomic levels, as surgeons may be more attentive to patients across all insurances.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

BE MA ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

243

2023

Fair Category

LS

Project  
Number

3107

Title: Transmissible Spongiform Encephalopathies: A Possible Treatment

Student Name(s): B. Cardamone

## Abstract:

Prion Diseases, or Transmissible Spongiform Encephalopathies are one the remaining great mysteries of science. Their cause and pathology is not well understood, and the scientific community is divided among different theories and hypotheses. They have no known cure, nor any effective treatments, giving them a 100% mortality rate. Over the course of a few years at the very best, rapid neuronal death leads to dementia, and eventually a shut down of the body, as the brain loses its ability to function. Due to the rapidity of the symptom onset, which can happen in a few months, early diagnosis is almost impossible, but recent advancements are being made in identifying biomarkers which could be used for diagnostic testing. These advancements have also brought light upon the larger issue of treatment. With the possibility of treating patients prior to brain damage, the hope for survival and recovery can be increased. This paper will summarize previous attempts at treatments, as well as our general knowledge on these diseases.

I propose here a new technique for the treatment of TSE's and possibly for other neurodegenerative diseases, which, although it has been thought of before, has not been given the recognition it warrants. Said treatment is quite simple, and not remotely novel, namely, antioxidants; Various studies have indicated that oxidative stress plays a large causative role in many neurodegenerative diseases, including TSE's. Therefore, it would be reasonable to assume antioxidants would have a therapeutic effect on these diseases.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB BI ME

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- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

254

2023

Fair Category

LS

Project  
Number

3108

**Title:** Determining an Ideal Surgical Treatment of Distal Femur Fractures in Osteoporotic Patients Based on Finite Element Analysis of Different Plate and Screw Scenarios

**Student Name(s):** A. Babajanyan

**Abstract:**

In the elderly, almost all fractures of the distal femur require surgery because of the difficulty of stabilizing the fracture long enough for the bone to heal. Surgical screws and plates are the current standard treatment for fracture fixation. However, the poor placement of surgical hardware or the malfunction of the implant necessitates an improvement in the treatment of distal femur fractures. Finite element (FE) analysis uses calculations, models, and simulations to understand how objects behave under various physical conditions. This project aimed to determine the most effective configuration of plate and screw placement on a distal femur fracture in the treatment of osteoporotic elderly patients. Using both “virtually constructed” models and “patient-specific” models derived from actual patient CT scans, a FE analysis was performed to determine areas of high-stress concentrations, strain, and displacement in both the implant and bone. The goal was to find a fixation scenario that minimizes stress at the fracture site. Twelve models including “healthy”, “osteoporotic”, and “patient-specific” models, were tested for different configurations of solid and hollow screws in a femoral fixation plate. Data trends illustrated that solid screws placed in a proximal configuration in an implant were associated with lowered stresses and strains. Patient-specific data confirmed these findings. Solid surgical screws, in a proximal configuration, are recommended for optimal healing of the fracture. This research has the potential to inform surgical planning and lead to improved healing in osteoporotic elderly with distal femur fractures, saving patients from additional surgery, and limiting pain and expenses.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

ME EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

180

2023

Fair Category

LS

Project  
Number

3109

**Title:** Will statistical modeling of hurricane data since 2000 find whether the increasing trend of Sea Surface Temperature has a correlation with Accumulated Cyclone Energy and/or Power Dissipation Index?

**Student Name(s):** L. Restrepo

## Abstract:

As the years keep passing by, atmospheric temperatures continue to increase. Many fear the consequences of the temperature rise in the atmosphere. This study aims to look into how hurricanes been monitored throughout history, a possible increase in Power Dissipation Index (PDI) and Accumulated Cyclone Energy (ACE) over time, and a possible relationship between them and Sea Surface Temperatures (SST) with PDI and ACE. Data from each hurricane between the years 2000-2022 in the Atlantic Ocean was collected from the Hurricane Archives and the HURDAT from NOAA. The data was all put into one excel sheet for each hurricane per year and then imputed into a statistical modeling system. Principal Component Analysis (PCA), Individual comparisons with linear regressions, Analysis of Covariance (ANCOVA), and Regression Plots were made to find any relationship between the variables. After creating all sorts of data tables and comparisons there will be trend lines that will explain the impacts of higher sea surface temperatures. With higher SST it is predicted that PDI and ACE will increase. On top of that, frequency and duration will also increase.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EA MA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LS

Project  
Number

3110

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

**Student Name(s):** S. Osowiecki

## Abstract:

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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV EM AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3111

**Title:** Delivery of Epicatechin via Bovine Serum Albumin Based Nanoparticles In order to Reduce the Growth of Escherichia Coli of Ocimum Basilicum

**Student Name(s):** M. Goldstein

## Abstract:

As the global population continues to rise, producing adequate nutritional foods becomes an ever-pressing issue. While the natural solution would be to increase the amount of produce grown, surmounting this issue is not that simple. Increased crop growth raises the risk of a foodborne pathogen outbreak exponentially. Through this research, a preventative measure was yielded. Bovine Serum Albumin (BSA) nanoparticles (NPs) were created to encapsulate (-)-Epicatechin (EC). The timely release of EC from within the BSA encapsulation (200 minutes) prevents the growth and reproduction of E. coli after it becomes present on the stem or leaf of the plant. Over a 25-day growth period, plants infected with E. coli demonstrated a reduced growth of ~14.4% compared to the control. Additionally, plants treated with EC encapsulated NPs and E. coli demonstrated a full recovery compared to the control group. Images taken by a Scanning Electron Microscope (SEM) proved that plants infected with E. coli no longer contained the bacteria, while plants only with E. coli still contained large amounts of E. coli. Similarly, Florence Microscopy demonstrates similar statistics, thus explaining that EC encapsulated NPs can adequately prevent the growth of E. coli on the leaf of a plant. Additionally, plants treated solely with NPs exhibited only minor growth discrepancies between that of the control, proving that the NPs can be used as a preventative measure. These 100% recovery statistics prove that Epicatechin encapsulated NPs serve as an effective preventive measure against significant E. coli outbreaks on a crop.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN EM AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LS

Project  
Number

3112

Title: Can Galleria Mellonella be Used to Biodegrade Plastic?

Student Name(s): Z. Agirman

## Abstract:

Different types of plastics accumulate around different ecosystems, which is detrimental for the long term health of the Earth. Currently, there are more than 46,000 pieces of plastic per square mile on the Earth's surface. This is due to overconsumption of plastic. A commonly found plastic is known as polyethylene, which has difficulty decomposing. Polyvinyl chloride, typically found in cling wrap, is also abundant; being lightweight makes it more susceptible to traveling further distances. Plastic pollution is a widespread global issue, which is why new solutions must be introduced. This research project addresses the issue and presents a possible solution to plastic pollution. Galleria mellonella, or wax moth larvae, are parasites to honey bees because they consume honeycomb as food. Through discovery, galleria mellonella have the potential of consuming plastic without having detrimental effects to their health. In experimentation, the efficiency of plastic degradation is tested by placing the same quantity of larvae in containers with different plastics; the plastics that were tested was low density of polyethylene from bread bags, polyvinyl chloride from cling wrap, and higher density of polyethylene found in sandwich bags. After a period of time, larvae with cling wrap had the most decrease in plastic mass, while the other studies didn't showcase significant changes. Results reveal that the larvae can break down certain plastics more effectively. Experiments in the future can be done to prove if the larvae will break down plastic more quickly when the plastics are dipped in honey/pollen for maximal plastic decomposition.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

177

2023

Fair Category

LS

Project  
Number

3113

Title: Procedure for Starting Mycelium to Digest Plastics

Student Name(s): E. Schwartz

## Abstract:

“What can be accomplished when oyster mushrooms are used degrade plastic?” was the question I decided to research. Although I did not get to test on plastic just yet, in the future I can do so, especially with the start in growing mycelium that I already have. It is already known by the University of Colorado that oyster mushrooms can degrade plastic. I have found multiple sources to back up this claim. For my tests I used different mushroom specimens in agar plates and let them sit for a week in an incubator. The results I expected were that a noticeable amount of mycelium would grow. These results did and did not come true; more molds grew on the plates than mycelium, however, some mycelium did end up growing on the plates. If this experiment is repeated, there should be some changes made to the procedure and the decontamination process. Growing mycelium is one of the most important steps in using it to digest plastic, so this experiment is just one small step leading in that direction.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

249

2023

Fair Category

LS

Project  
Number

3114

Title: Which Genre of Music Promotes the Most Substantial Neuroplasticity?

Student Name(s): N. Anandha Kumar

## Abstract:

My project investigates which genre of music promotes the most substantial neuroplasticity. Music can induce neuroplasticity which holds the potential to make everyday lives easier. The purpose of this project is to explore which individual genre of music does that the best so that people can listen to that genre when needed and reap its benefits. To collect data for this experiment, I created my own spatial-temporal reasoning (STR) test, based on preexisting tests, with ten questions. Participants first took the test without any external influences, and the results were recorded. The average number of correct questions was 5.33 out of 10 questions. Then, each participant was told to listen to a specific genre of music (either classical, rock, or jazz) for ten minutes. The participants then retake the test and the results were recorded. Results showed that when listening to classical music, participants had an average of 1.9 questions higher than the initial average. When listening to jazz music, participants had an average of 1.07 questions higher than the initial average. When listening to rock music, participants showed little improvement when compared to their initial results, having an average of 0.1 questions higher. The findings show that classical music produces the most substantial neuroplasticity as it changes the brain to be more adept when it comes to tasks involving spatial-temporal reasoning. However, further research is needed to ascertain whether the findings were because of the individual genre, music as a whole, or some other external factor.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3115

**Title:** Music and the Imagination: How Compositional Techniques Used Within Film Scores Help Shape the Imagination

**Student Name(s):** S. Shettler

**Abstract:**

Music is essential to film as it can provide emotional, physical, and psychological context for an audience. Listening to music can elicit visual imagery, and compositional techniques can affect imagined movement. This study will identify compositional techniques within film scores that are most effective in conveying the actions in a scene. All participants will complete a questionnaire outlining their level of music and film interaction. Participants will then listen to a 15-35 second cut of music from an action chase, adventure, or battle scene, and write a description of what they imagine, including relative setting, movement, storyline, and emotions. These types of scenes were chosen because they cover a variety of emotional responses. Music from three different movies will be used for each type of scene. Participants are also asked to write which instruments they find are most effective in conveying the elements of their imagined scene. To determine how closely the participant responses match the chosen scene, the responses will be compared to a description of the scene and checked for accuracy. I will also examine correlations between a participant's level of music and film interaction and accurate scene response. To find the compositional techniques, I will analyze each cut of music and identify what techniques are utilized for the instrument the participants with the most accurate descriptions indicate is most effective in conveying their imagined scene. This study will help composers catalog important compositional techniques for film scoring, and further research about imagination and music in film scores.

**Technical Disciplines Selected by the Student**  
(Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

241

2023

Fair Category

LS

Project  
Number

3116

Title: The Impact of Pesticide amounts on the risk of Gastroschisis Infant Birth Defects

Student Name(s): H. Stowell

## Abstract:

Increased exposure to chemical pesticides has shown in the past a connection with the quantity of infant birth defects. The objective of this study is to examine the impact of pesticide exposure on the prevalence of birth defects, specifically Gastroschisis, a birth defect where there is a hole in the abdominal wall beside the belly button. The defect is believed to be caused by external factors in the mothers external environment. To determine if a correlation exists, data was collected from the Department of Health per state as well as the Department of Pesticide Regulation. The data was then input into VassarStats, to determine the level of significance. The comparison of the amount of pesticide application, Atrazine, and the rate of Gastroschisis found no statistically significant ( $p=0.20$ ) difference with high pesticide exposure by state. Further when comparing the rate of birth defects in counties in California with the amount (lbs) applied of pesticides in 2018 there was a strong correlation with a p value of .0003. Additionally when looking at the increase of pesticide exposure in California over a thirteen year period (1998-2012) the R-squared value .753, showed a significant correlation with a p value of less than .0001. The results demonstrate that increased pesticide exposure has a correlation with the prevalence of Gasterious seen over time and in areas with higher Pesticide exposure, therefore actions should be taken to limit the exposure of pesticides in high agricultural areas.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME BE BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

152

2023

Fair Category

LS

Project  
Number

3117

Title: What are The Effects Of Heavy Metals Seen In Tattoo Inks On The Body

Student Name(s): M. Rubio

## Abstract:

Tattoo inks have been seen as highly toxic. Over time more and more brands started using heavy metals in their tattoo inks because it lasts longer and shows up to be more potent. Overtime tattoo inks have become more and more toxic and some brands are now being banned because of the high toxicity. Metals that are so far found in tattoo inks which are not FDA or EPA approved are Boron(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. Scientists have been trying to find alternatives to the highly toxic tattoo ink and as of right now, they have found organic tattoo ink which has half of the components of regular ink and is FDA and EPA approved.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

256

2023

Fair Category

LS

Project  
Number

3118

**Title:** Development of a Rapid Alzheimer's Disease Diagnostic through Multilayered, Comprehensive Linguistic Analyses

**Student Name(s):** M. Lu

**Abstract:**

Alzheimer's disease (AD) and related dementias are the leading neurodegenerative diseases worldwide and cause more deaths than breast and prostate cancer combined. However, AD is often undiagnosed/underdiagnosed due to the high rate of uncertainty using current rapid diagnostic methods, cited as the primary reason for withholding diagnoses by 41% of primary care physicians. While intensive analyses of biomarkers or brain imaging can ascertain diagnoses, they are lengthy, costly, burdensome, and especially underutilized when symptoms are barely noticeable. Yet, if those with AD were diagnosed in the mild cognitive impairment stage, it would increase their overall quality of life and save \$7 trillion in long-term healthcare costs. This research develops a rapid diagnostic tool to detect AD through a comprehensive linguistic analysis of audio transcriptions of the Cookie-Theft picture description task adapted from the Boston Aphasia Diagnostic Exam. Data was obtained from the Pitt corpus and collected by the student researcher in live-participant interviews. Six primary variables and corresponding parameters provided the basis for the model, including the percentage of pronouns, past tense, and repetitions/revisions in speech, and the total number of words, unique words, and utterances per second. Each parameter was optimized based on correlations extracted from the training dataset. The model obtained 82.8% diagnostic accuracy on a simple test, and subsequently increased to 97.7% using a combination of parameters to create a series of multilayered dependency tests. In practice, patients will submit an audio recording of the Cookie-Theft description task and receive a diagnosis after a brief linguistic analysis.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

ME CBIO EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

254

2023

Fair Category

LS

Project Number

3119

**Title:** Analyzing the distribution of insertion, deletion, and substitution mutations in the gene encoding the Spike protein of COVID.

**Student Name(s):** J. Zafar

## Abstract:

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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CBIO CB ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LS

Project  
Number

3120

**Title:** Using CRISPR interference technologies to understand the role of *Staphylococcus Epidermidis* in the skin microbiome

**Student Name(s):** M. Archambault

## Abstract:

*Staphylococcus (S.) epidermidis* is the most abundant bacterium that lives in our skin's diverse microbiome. It is understood that it can be beneficial, harmful, or neutral depending on the strain, and the environmental conditions it is under, but further research is necessary to determine how strain level diversity and environmental conditions actually contribute to the phenotypic variation in *S. epidermidis*. In this project, we will be using CRISPRi technology to target and knock down specific genes in *S. epidermidis*, and then evaluate its essentiality and function with the loss of that gene under predetermined conditions to determine what genes correlate to what phenotypes under what simulated conditions. We will be engineering a new PAMless plasmid to use for our gene knockdowns that consists of a mutated and protein engineered version of dCas9, dSpryC, that circumvents the need for a protospacer-adjacent motif (PAM) when designing guides. A PAM is a NGG nucleotide sequence found in the genome of bacteria that is required to be located directly upstream of the gene being targeted with CRISPR. This PAM site requirement is especially limiting in *S. epidermidis*, as it consists of roughly 30% GC pairs. The PAMless plasmid will also ease our guide design in such a way that we can design multiple guides per gene at any location in the genome, hence expanding the amount of the genome we can now target. This research will not only help researchers better understand *S. epidermidis*, but also the applications and techniques of CRISPRi technology.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

229

2023

Fair Category

LS

Project  
Number

3121

**Title:** The Effectiveness of Chaga Mushroom Extract to Reduce Oxidative Stress in *Caenorhabditis elegans*

**Student Name(s):** I. Serra

## Abstract:

Oxidative stress affects humans globally and is caused by free radicals that come from air/industrial pollution and chemicals and have been found to have a role in the development of diseases over the past two decades. Oxidative stress can lead to a wide range of chronic illnesses including diabetes, neurodegenerative diseases, cancer, and cardiovascular diseases which according to Centers for Disease Control and Prevention causes the deaths of 659,000 people in the United States every year. The reduction of oxidative stress can be achieved through the replacement of antioxidative mechanisms and chaga mushrooms have been found to have a high antioxidative content and potential for reducing oxidative stress. The experiment consisted of culturing the nematode *C. elegans* and inducing oxidative stress into them through a heat treatment. Prior to the heat treatment the experimental groups received chaga mushroom extract. Trial one resulted in no survival among all four plates of *C. elegans* following the heat treatment. Trial two showed results of survival among all plates of *C. elegans*. Trial three showed results of decreased motility, paralysis, and death of the *C. elegans* on the H<sub>2</sub>O control plate and normal/fast motility of the *C. elegans* on the chaga extract experimental plates. The results of the third trial do align with previous research but further studies should be done involving cells and other model organisms to solidify these conclusions.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME MI CB

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

234

2023

Fair Category

LS

Project  
Number

3122

**Title:** Does the use of different types of soda sweeteners affect body weight as well as heart rate in teens?

**Student Name(s):** L. Murray

## Abstract:

Right now America is going through an obesity epidemic. One of the solutions to this problem is the development of low-calorie sweeteners (LCS). I want to know if LCSs or other ways of sweetening sodas are beneficial for teens. Most of the research that has been done on LCSs already has been conducted on adults, and I haven't been able to find research on the effects of LCSs on teens and whether or not they can help with weight loss. I also haven't found much on sucrose-sweetened sodas on their effect on weight. I want to figure out whether or not aspartame can help with weight loss as well as if sucrose is a healthier substitute for high fructose corn syrup. I will conduct this research with four different controlled groups: High fructose corn syrup, Sucrose, Aspartame, and water. Participants will be requested to drink one can of their designated soda for one month and will have a weekly check-in for their weight as well as resting and active heart rate. At the conclusion of the experiment, I expect that diet soda will have helped with weight loss as well as see a lower heart rate in the participants. However, I do not know what to expect from my sucrose group, as previous reports offer conflicting results on whether or not sucrose causes less weight gain than high fructose corn syrup.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

218

2023

Fair Category

LS

Project  
Number

3123

Title: The Relationship Between Virtual Reality Activities and the Effects of Cybersickness

Student Name(s): A. Vassell, A. Vassell

## Abstract:

Virtual reality has become increasingly popular for both professional and personal use. To use it effectively, it is important to understand the potential benefits and risks. Experts have conducted experiments to determine the average time it takes for individuals to experience cybersickness (motion sickness in virtual reality). However, the relationship between virtual reality activities and their side-effects has not been fully explored. Different activities require different levels of cognitive and physical engagement, which may lead to varying side-effects during and after virtual reality use. In this experiment, healthy individuals engaged in various VR activities and their physical and mental states were periodically recorded, along with their prior VR experience. Some participants play games and when through art galleries while sitting down in a chair. Others played games up and fully mobile moving around specific area. Results indicate a likely correlation between the activity performed and cybersickness level experienced by test subjects, while their mental state was based on personal enjoyment of the activity. When a t-test was conducted after collecting the data, the physical difference between relaxed and active gameplay was significant ( $p < .05$ ), while the mental relationship was insignificant ( $p > .1$ ). Further research on a larger sample can provide insight for virtual reality application developers to recommend time limits and other precautions to users.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE AT EN

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

243

2023

Fair Category

LS

Project  
Number

3124

**Title:** Utilizing the Nematocysts of *Cassiopea xamachana* as a Bioactive Antiproliferative Compound

**Student Name(s):** G. Kistner

## Abstract:

*Cassiopea xamachana* (Upside-down jellies) release cassiosomes, structures of mucus covered in an epithelial layer of nematocysts. These nematocysts are the stinging cells of jellies, which contain their toxins. It is proposed that these toxins may be used in an antiproliferative/antimicrobial role. To evaluate the antiproliferative/antimicrobial characteristics of these toxins, a series of trials with yeast and *E. coli* was conducted. The mucus was collected directly from the jellies, centrifuged at 5000 rpm for 30 seconds, and swabbed in a 1 cm diameter circle on plates of *E. coli*. The plates were then analyzed for a 1 cm diameter zone of inhibition. 0.1g samples of yeast were inoculated with 500  $\mu$ l of mucus. Total cell count calculations were determined using a Spec 20 (Lmax 600nm) every 10 minutes over the course of an hour ( $Y = 13,803,131.76x + 141,371.40$ ). Accumulating data suggests that the toxins found within the nematocysts of *Cassiopea xamachana* are tremendously effective at both killing and inhibiting the growth of *E. coli* and yeast cells. 0% growth was observed within the 1 cm diameter area on the plate of *E. coli* as well as a 66% decrease in yeast cell count when looking at untreated vs. treated yeast samples. This data proves that the toxins of *C. xamachana* are completely effective as antiproliferatives/antimicrobials, and are able to replace common cleaning products containing harsh chemicals that pose substantial health risks for human and animal health, as well as the environment.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN BI EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

115

2023

Fair Category

LS

Project  
Number

3125

Title: How does friendship influence leadership in plains zebras?

Student Name(s): A. Shi

## Abstract:

Friendship is defined as a close, affiliative, mutual, non-reproductive social bond between two unrelated individuals. Previous research shows that friendship may provide many fitness benefits such as collation support. Plains zebras are highly social animals that live in harems where unrelated females form social bonds. However, it's unclear what benefits friendships have in plains zebras. This study investigates whether or not friendship influences collation support as follow-in travel in plains zebras. Follow scores were created based on the number of whole harems follows and total initiations to compare with individual social bonds. The result shows that friendship influences leadership in plains zebras which could provide a better understanding of the function of friendship.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

217

2023

Fair Category

LS

Project  
Number

3126

**Title:** Discovery of novel therapeutic targets and pathways for acute kidney injury using proteomics

**Student Name(s):** J. Wang

## Abstract:

**Background:** Acute kidney injury is an abrupt decline in kidney function within hours or days. Currently, there is no effective therapy for this serious clinical disorder because the pathogenesis of acute kidney injury is not well understood. Furthermore, there is no effective treatment of acute kidney injury. As we enter the 'big data' era, proteomics analysis provides novel insights into the understanding of acute kidney injury development and progression and facilitate novel findings from basic research into the clinical practice.

**Objectives and Methods:** The objective of my study was to perform systemically proteomic analysis of the kidney to identify novel therapeutic targets and pathways for the diagnosis and treatment of acute kidney.

**Results:** A total of 6146 proteins in the kidney are identified, of which 3503 proteins are differentially expressed in the kidney after acute kidney injury. Gene ontology analyses reveal metabolic pathway is a key biological event after acute kidney injury. At 4 hours after kidney injury, 985 differentially expressed proteins and 290 dynamic network biomarkers were identified. Furthermore, HNF4 $\alpha$  was identified as a core member of the differentially expressed protein in predicting acute kidney injury prognosis.

**Conclusion:** This study provides novel insights into understanding the development of acute kidney injury and identifies novel biomarkers and pathways for the diagnosis and prevention of acute kidney injury.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

252

2023

Fair Category

LS

Project  
Number

3127

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

**Student Name(s):** L. Darby

## Abstract:

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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

259

2023

Fair Category

LS

Project  
Number

3129

**Title:** Creation and Simulation of Function of Claramine-Atorvastatin Coated Hyaluronic Acid Nanoparticles for Targeted Dissolution of Atherosclerotic Plaque

**Student Name(s):** J. Bernstein

## Abstract:

Atherosclerosis, the buildup of lipids as a plaque within the inner lining of the blood vessel wall, leading to reduced vessel flexibility, is the result of a cut in the layer of activated endothelial cells, allowing for the accumulation of lipids and foam cells within the artery. It is common and eventually causes myocardial infarction and strokes, making it crucial to treat. As typically prescribed statins do not always work, invasive surgery is left as the only other option. Thus a novel, targeted therapeutic of claramine-atorvastatin coated hyaluronic acid (HA) nanoparticles was created in this research. First, HA was conjugated to lithocholic acid to create an amphiphilic polymer that self-assembled in aqueous conditions in nanoparticles when sonicated. These CD44 (inflammation) targeting nanoparticles were then coated with claramine, a PTP1B inhibitor, atorvastatin, as well as FITC for visualization. To test the efficacy of these nanoparticles, THP-1 monocytes were differentiated into foam cells with lipopolysaccharides, PMA, cholesterol, and LDL. Once treated with coated nanoparticles, an 88x-decrease in cell proliferation was observed using a WST-8 assay, suggesting a decline in the creation of diseased cells and inflammation. Intracellular-fluorescence studies highlighted the nanoparticle's selectivity only for diseased foam cells, while they did not enter healthy monocytes. In a 3D-carotid artery bifurcation model containing agar/diseased cells plaque, serum/media cholesterol levels decreased post-nanoparticle therapy, highlighted by ATR-FTIR studies. Finally, it was determined that nanoparticles are stable in aqueous solutions, pointing to their integrity until they reach the CD44 receptor for phagocytosis and drug delivery.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ME EN AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

235

2023

Fair Category

LST

Project Number

3501

**Title:** Utilizing eDNA and DNA barcoding to establish a Population Densities in the Long Island Sound

**Student Name(s):** C. Choy, C. Quinson

**Abstract:**

The purpose of this study was to isolate and extract eDNA from two aquatic habitats containing specific population sizes of *Homerus americanus* and to establish a protocol for the use of eDNA in estimating population size. Environmental DNA (eDNA) is a highly sensitive and non-invasive method to gather population data that would be helpful in detecting invasive organisms before they become established. Most specifically, this methodology would be useful in getting ahead of an infestation of the invasive European Green crab. As a result of the hibernation cycle of green crabs, they were not available in the local water sources and fisheries. Thus, the *Homerus americanus*, the American lobster, was used in this investigation. A 650 base pair segment of the *Homerus*'s mitochondrial cytochrome c oxidase gene was extracted, isolated, amplified, and made visual through electrophoresis and UV dye. This was done first using a tissue sample from a lobster tail to establish a baseline control for comparison. The remaining trials used eDNA water samples obtained from tanks containing multiple lobsters and a tank housing a single organism. A final electrophoresis containing all the positive results was run in order to compare the brightness and amount of DNA present from each trial. Qualitative data showed more vibrant bands in the tank with more lobsters, however, estimated population density was only a correlation based on these results. A more specific quantitative methodology is still needed.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

EV AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

247

2023

Fair Category

LST

Project  
Number

3502

**Title:** Inserting pET21b(+) Gene from Ideonella sakaiensis into Vibrio natriegens for Potentially Environmentally Friendly Polyethylene Terephthalate Plastic Biodegradation

**Student Name(s):** E. Smith, J. Barnett

## Abstract:

This research aims to highlight the use of Vibrio natriegens for breaking down Polyethylene terephthalate (polyester). Vibrio natriegens is a fast-growing marine bacteria that grow at double the speed of the standard lab bacteria. The plasmid (pET21b(+)) allows the bacteria to produce an enzyme to break down polyester. This plasmid would allow the bacteria to break down polyester microplastics in the ocean. This was done by using the plasmid that was in the E.coli colony and extracting it for use. The V. natriegens are transformed with said extracted plasmid. Then it was used to break down polyester pellets, there was also a control of the original E.coli and the V.natriegens without the plasmid. Since V. natriegens is native to the ocean, this may provide a solution to the vast amount of plastic within the ocean. The plastic pellets were measured after drying for 24 hours. After testing with the E. coli, controls, and V. natriegens the results were inconclusive, the controls did not change much though the E. coli control did a margin, one slight decrease in the E.coli EB2 and a big decrease in EB4. The Vibrio only had one decrease which was significant, VA31, to note that VB41 could not be measured as it had been contaminated from dropping on the floor and did not want to run the risk of giving false results. The VA31 was more significant than EB4 which means that there is hope that the vibrio may decrease PET faster.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LST

Project  
Number

3503

**Title:** The Effect of a Calcium Chloride Solution on the Coagulation of Sodium Alginate for the Implementation in Cultures of Cyanobacteria

**Student Name(s):** T. Adeniran, M. Arnold

## Abstract:

Coagulation is the process of a substance becoming thick and forming “clots.” In a biological system like cyanobacteria, coagulation occurs when a coagulant causes it to form clumps in aqueous solutions. This project aims to investigate how coagulation can be beneficial in removing harmful cyanobacteria from aqueous solutions. Different amounts of calcium chloride were added to water in beakers to see which amount allowed for the most coagulation of sodium alginate. Afterwards, cultures of nutrient rich cyanobacteria were incubated at about 30 degrees celsius. Different amounts of aluminum sulfate were added to the beakers to see which amount allowed for the best coagulation of the cyanobacteria. On average, 2 and 3 grams of calcium chloride had the most coagulation of sodium alginate, while 0 and 1 gram had the least amount of coagulation. Based on individual trials, 1 and 2 grams allowed for the most coagulation, 3.59% and 2.75% of a six by eight 1 centimeter by 1 centimeter grid respectively. Additionally, on average, 1 and 2 grams of calcium chloride had the highest coagulation rates of 1 minute and 5 seconds, and 48 seconds respectively. Because the cyanobacteria didn’t cultivate properly, possibly due to temperature conditions or incorrect procedures, the results couldn’t be applied to the second experiment. If implemented in cultures of cyanobacteria, 1 and 2 grams of aluminum sulfate would most likely allow the bacteria to coagulate the best. This coagulation could ultimately promote the safe removal of cyanobacteria from aqueous solutions using innovative applications.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI BI EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

240

2023

Fair Category

LST

Project Number

3504

**Title:** Potential Impacts from Anthropogenic Influences on Phenotypic Plasticity of Juvenile Horseshoe Crabs (*Limulus polyphemus*): Implications for Survivorship

**Student Name(s):** G. Spata, R. Blustajn

**Abstract:**

The value of horseshoe crabs has never been higher. They are highly valued in the medical field and their eggs are a major food source for various birds. Their decline in coastal waters has been well documented (Krisfalusi-Gannon et al., 2018). As we try to mitigate our impact on these sensitive creatures, an emphasis is needed on early larval development in our opinion. One chemical of critical importance is ammonia. This study was designed to evaluate the potential impacts of ammonia on first and second instar horseshoe crab larvae. Crabs were exposed to both ambient (1 mg/L) and elevated ammonia levels (3 mg/L) for 7 days and feeding rates, activity levels, growth and survivorship were measured. We expected to find that the horseshoe crabs exposed to higher ammonia would eat and grow less, and have higher mortality. Upon analyzing the results, larvae exposed to elevated ammonia consumed significantly less feed than control larvae (0.2g/day versus 0.4g/day;  $p = 0.035$ ,  $\alpha = 0.05$ ), were more lethargic, and had a 100% mortality rate. However, growth in the exposure bin was significantly higher (0.10 mm/day versus 0.05 mm/day;  $p = 0.022$ ,  $\alpha = 0.05$ ). The growth may be due to younger instars in the high exposure bin, a notion that needs further evaluation moving forward. Overall, these findings indicate that mismanagement of increasing ammonia runoff from things like wastewater management facilities can harm horseshoe crabs especially in their early life stages.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

AS EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

197

2023

Fair Category

LST

Project Number

3505

**Title:** An Investigation of the Effects of Phototoxic Sunscreen Chemicals on Montipora capricornis and Discosoma sp.

**Student Name(s):** R. MacNaughton, M. Yeager

**Abstract:**

The objective of this project was to investigate the effects of UV filter chemicals on Montipora Capricornis and Discosoma Sp corals. A handful of these UV filter chemicals are commonly found in sunscreens. Three different chemicals were selected for testing: oxybenzone, benzophenone, and zinc oxide. Additionally, the specific effects of the UVA and UVB wavelengths of the electromagnetic spectrum were tested by using an acrylic sheet in certain tests to isolate wavelengths at 280-370 nm. Our results confirmed those of multiple studies in recent years which conclude that oxybenzone is highly toxic to coral. However, the oxybenzone was only shown to be significantly phototoxic to coral when exposed to the UVA and UVB ranges. Benzophenone displayed a similar pattern in terms of the difference in toxicity depending on the light it was exposed to; however it was much less toxic as compared to its relative, oxybenzone. Zinc oxide, which has become a popular substitute for oxybenzone in “reef-safe” sunscreens, was also shown to be toxic to both species of coral; however to a lesser extent than oxybenzone. Additionally, zinc oxide appeared to perform virtually the same whether exposed to the UVA and UVB ranges or not.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

BI EV AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LST

Project  
Number

3506

Title: Using Zeolite Clinoptilolite to Reduce Methane Emissions From Food Waste

Student Name(s): M. Cook, S. Brown

## Abstract:

The issue of food waste poses a severe threat to the world as it is the third largest producer of methane emissions. Globally, 1.4 billion tons is generated annually, with China, India, and the United States being the top household food waste contributors. The waste accumulates in landfills where it reaches anaerobic conditions after one year and is broken down into methane, which releases into the atmosphere. Methane is a leading contributor to global warming, and is more dangerous than carbon dioxide (CO<sub>2</sub>), as it has 80 times the warming power in a 20 year scale. Global warming damages biodiversity, disrupts climate patterns, etc. Though CO<sub>2</sub> is the more well known greenhouse gas, methane produces a greater immediate threat. Zeolite clinoptilolite, a natural mineral that is cheap, abundant, and has no adverse effects to the environment, has the potential to convert methane into CO<sub>2</sub> before it spreads through the atmosphere. It can be mixed with a copper nitrate solution (a catalyst) to neutralize the methane through an oxidation reaction. This oxidation reaction can occur in thermal towers placed around landfills that use photocatalysis to significantly reduce the atmosphere's methane concentration. Methane concentrated air would be drawn in and react with the zeolite, copper, oxygen, and sunlight to be released as CO<sub>2</sub>. This is a cost effective and sustainable method to combat methane. Food waste is a global problem, and the implication of zeolite enhanced filtration systems would greatly reduce the negative impact that it poses to the environment.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

247

2023

Fair Category

LST

Project Number

3507

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

**Student Name(s):** C. Gannon, R. Murphy, I. Leao

## Abstract:

Determining a way to grow crops in Mars Regolith is important in terms of sustaining life on Mars. It is hypothesized that enhancing Mars Regolith with a polyacrylamide superabsorbent 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 from fruit peels (V2), PAM SAP (V3), fertilizer PAM SAP (V4), and organic nutrient PAM SAP (V5) were prepared. Stage II kept all groups constant while adding 25% volume of 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 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.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PH EA PS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

241

2023

Fair Category

LST

Project Number

3508

Title: Urban Hub Revitalization Project

Student Name(s): A. Ramos, B. Valdivia, K. Zayas

## Abstract:

Currently, brownfields pose safety risks and create heightened crime, vacancy, and vagrancy rates. They can also contaminate surrounding areas by leaching harmful chemicals before they are remediated. Remediation can be tricky and costly, so seeing it done is rare. This causes the community to lose opportunities to grow, connect and thrive. We will create a model of a revitalized local brownfield, known as the Remington Arms Factory and located at 812 Barnum Ave, Bridgeport, CT. The model will provide a vision for government officials, investors, and/or humanitarians to take on this project, combat those issues listed, and create a new self-sustainable community center. The net-zero center will offer a connection hub for the community providing soccer and basketball zones, a library, a soup kitchen, a farmer's market, and a community garden. The main sustainability feature consists of a large hydroponic farming system, but all pieces of the center will support other areas of the center to drive self-sustainable processes. The plan encourages job creation in the community, improved health for the community through more access to better foods and choices, and removes the negative impacts vacant brownfields have impaired communities with. With this project, we hope to draw attention to the problems associated with urban brownfields along with the opportunities a remediated urban brownfield can offer. Although the process of remediation can be complex, the benefits for both the environment and the community vastly outweigh the challenges.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM AT BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LST

Project Number

3509

**Title:** Isolation and Purification of Plant-based Flocculants for the Treatment of Microplastic Contaminated Water

**Student Name(s):** T. Pope, H. Ferguson

## Abstract:

The objective of this project was to investigate the feasibility & efficacy of plant-based flocculants. Recent research has raised concern that commonly used industrial flocculants like aluminum chloride may be carcinogenic. This project posed an alternative to the aforementioned by using polysaccharides extracted from the mucilage of certain succulent plants, aloe vera and okra. These polysaccharides were employed as flocculants in semi-turbid water samples from the Mianus River and Putnam Reservoir. The mucilages were withdrawn from macerated solutions of their respective plants via precipitation with 99% isopropanol. These mucilages were then dried and ground into fine powder. The powder was dissolved into deionized water at various concentrations. Twenty mls of each respective solution was added to 80ml of the Mianus & Putnam samples. After complete dissolution and ample time for flocculation, the -floc portion of the samples were vacuum filtered. The filter was inspected under a microscope and the number of microplastics (defined as polystyrene shards and fibers <5mm) were tallied for each solution. The study yielded microplastic counts for four 100ml flocculated solutions at each concentration for both water samples, totaling 48 data points. This data was compared to the level of microplastic contamination in the untreated control samples. At 1g/L aloe Vera and okra eliminated roughly 57% of the microplastics, and at 2g/L and 4g/L respectively, the flocculants eliminated 75% of microplastics. These flocculants were slightly less effective when compared to the 89% elimination rate of aluminum chloride, however, their use significantly reduces negative environmental impact.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BI EM EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

188

2023

Fair Category

LST

Project Number

3510

**Title:** Combating Drought With a Low-Cost, Biodegradable SAP Made out of Orange Peels and Avocado Peels

**Student Name(s):** K. Scott, A. Williams, A. Pelletier

**Abstract:**

In many areas, drought is a severe issue. Drought is a prolonged period of abnormally low amounts of rainfall leading to a shortage of water as well as damage to soil, crops, plants, etc. We wanted to see if using a series of super absorbent polymers added into soil and water would be successful to combat drought. In order to carry out this experiment, we used a method of super absorbent polymers in potting soil in order to observe which polymer would retain the most moisture for the longest period of time. We used six clay pots with the same amount of soil and water. One control, two with orange peels, one with pectin, one with cornstarch, and one with acrylic powder. We had two successful trials, and at the end of both trials all of the pots were dried out except for the pectin, meaning that pectin is the most effective in combating drought. Our plans for future experiments are to do the same experiment but with different polymers to see if we can find one that is just as effective in combating drought than the pectin.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

CB EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

203

2023

Fair Category

LST

Project  
Number

3511

**Title:** Potential Impact of Heavy Rain Events on Coastal Bacterial Populations: Modeling Human Impact in Close Proximity to Wastewater Treatment Facilities

**Student Name(s):** C. FitzGerald, . Xocipltecatl

## Abstract:

The influence of anthropogenic pollution to coastal waterways has been identified in literature as a concern, specifically to the balance of biodiversity in our coastal nursery habitats (Paerl et al., 2003). This has been magnified in recent years with growing impacts of climate change. In our opinion an understudied contributor in this connection is the role of discharge from municipal wastewater treatment facilities and how that results in elevated bacterial populations. Our replicated sites were used both north, south and directly parallel to the wastewater discharge on the eastern side of New Haven Harbor. Bacterial samples were collected, analyzed using IDEXX protocols, and compared against both tidal stage, recent rainfall, and flow rates from our local WWM facility. Over the course of this study we found bacterial levels significantly higher downstream from the outflow. The average upstream was 22.02 cphm versus downstream which was 205 cphm;  $p = 0.036$ ,  $\alpha = 0.05$ . With elevated rain and higher flows from the facility it often produced 10-20 times higher bacterial densities. This led to the conclusion that tides may have a bigger impact on anthropogenic discharge than previously believed. Further research shall be done since shallower or smaller estuaries may experience considerably greater tidal driven bacterial bloom consequences.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV MI EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

250

2023

Fair Category

LST

Project  
Number

3512

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

Student Name(s): I. Crowley , R. McGrath

## Abstract:

Regular exercise participation is known to have both psychological and physical benefits; however, there is a limited amount of research on the effect of exercise on adolescents and research in this area often has inconsistencies due to the type, duration, and intensity of exercise. The focus of this study was to find what effect participation in high school athletics has on one's immediate mood after exercise, how factors specific to high school athletics impact one's mood following exercise, and the impact of how regularly one exercises on their mood. A modified version of the Profile of Mood States (POMS) was used to assess the immediate mood of participants following exercise. After parental consent was given, the baseline form, consisting of the POMS and questions specific to participation in high school athletics, was distributed to participants. Participants then received the post exercise survey, which was to be completed within 15 minutes of exercising over a two week period, three times each week. This survey consisted of the POMS and questions specific to the exercise done that day. The data was then compiled into spreadsheets to find relationships between the baseline and post exercise POMS results and the other survey questions. Overall, the results of this study will further the understanding of the impact exercise has on mood, which can be beneficial in managing anxiety symptoms by inducing the correct duration and intensity of exercise. This research can also help schools create an environment best suited to the wellbeing of student athletes.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

BE

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

251

2023

Fair Category

LST

Project  
Number

3513

**Title:** Determining the Relationship between Sound Frequencies and Settlement Rates of Pediveliger Oyster Larvae

**Student Name(s):** S. DeAngelis, J. Morningstar

## Abstract:

The purpose of this study was to determine the relationship between sound frequencies and settlement rates in pediveliger (eyed) oyster larvae in order to develop oyster recruitment methods for the restoration of oyster reefs. Speakers were waterproofed using a custom-constructed PVC housing unit. Sound treatments were created using the sounds of healthy and sick oyster reefs (Oyster Recovery Partnership) and “noise pollution” from commercial vessels (Discovery of Sounds in the Sea). Oyster larvae were sourced from the Cornell Marine Program. Using soundproofed buckets and specific sound treatment recordings, 4 testing groups (healthy oyster reef, healthy oyster reef with overlaid sound pollution, sick oyster reef, sick oyster reef with sound pollution) and a control without played sound were established. Once proper salinity, pH, and temperature were established, the oyster larvae were added at a concentration of 7,500 oysters per tank. In respective tanks, the oysters settled on 4, 1 square inch, textured clay settlement tiles over the course of 40 hours. At set intervals, tiles were removed from the tanks, and the number of settled, eyed-oysters counted using a dissection microscope. Data analysis indicates settlement rates were higher in the tank with healthy reef sounds (26 settled oyster larvae in 40 hours) and significantly lower in the tank with unhealthy reef sounds (3 settled oyster larvae in 40 hours), and that noise pollution has a relatively similar effect on larval settlement rates regardless of reef health, ultimately demonstrating the viability of utilizing healthy reef soundscapes to repopulate damaged oyster settlements.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

AS EM AT

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

246

2023

Fair Category

LST

Project  
Number

3514

Title: How Agricultural Runoff Affects Ocean Biodiversity

Student Name(s): B. Valle, G. Fuchs

## Abstract:

Over time ocean pollution has become increasingly worse. The leading cause of ocean pollution is agricultural runoff, mainly from the use of commercial grade pesticides. Our goal is to create an eco-friendly pesticide that effectively repels pests yet has no negative effects on the oceans biodiversity. The biodiversity of our ocean is important because it's a part of the oceans ecosystem, creatures thrive off of the microorganisms that live in our water. During this assay we used liquid cultures infused with two versions of pesticides, and then inoculated the cultures with the bacteria from the ocean water sample. A spectrophotometer was used to measure the absorbance value and compare against the concentrations of the pesticides. Using the data we collected we determined how the pesticides impacted the bacteria. The results we obtained proved our hypothesis correct. We grew cultures of sea water in a control Lb broth, with the commercial pesticide and homemade in percentage concentrations of 1%, 3% ,and 5%, the control was fairly consistent, the commercial pesticides at 5% had an average of 0.107 abs, 3% had an average of 0.239 abs, 1% had an average of 0.2989 abs. The homemade 5% had an average of 0.381 abs, 3% had an average of 0.492 abs, 1% had an average of 0.406 abs. In the future we plan to use marine broth in order to provide the bacteria with proper nutrients. Data showed our eco-friendly pesticide is a safer alternative for the ocean.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

239

2023

Fair Category

LST

Project Number

3515

Title: The effect of ash produced by wildfire on glacier melting

Student Name(s): H. Zeng, J. Chen

## Abstract:

Ohio State University Geology Professor Jason Box predicted a correlation between ice melting in Greenland with ash from distant forest fires in the spring of 2012 and was proved correct the following summer. This experiment aims to simulate the deposition of wildfire ash on glaciers to determine the effect of ice melting, which contributes to the rising sea level. The hypothesis tested is that increased amounts of ash or darker charcoal will increase the ice melting rate by reducing ice albedo. Ice slabs were placed under a light bulb for 30 minutes, with varying amounts of ash or charcoal (0, 0.15, and 0.25 g). Albedo measurements were taken with a photometer, and the extent of ice melting was observed. The temperature was monitored and water was collected. The result shows that pure ice had melting percentages between 24% - 25.2% with albedo ranging from 29.1-42.4%, while charcoal- and gray ash-embedded ice had melting percentages between 24.-30.2% ranging from 9.2-19.2%. Charcoal led to a particularly consistent greater melting and low albedo compared to other groups. Based on these findings, we concluded that albedo significantly impacts the melting rate. Moreover, results indicate that 'color' has a greater effect on lowering the albedo than the amount of ash, particularly when the ash coverage rate is virtually complete. Further experiments are necessary to determine the effects of wildfire smoke in the atmosphere and the long-term impact of ash on glacier melting.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

200

2023

Fair Category

LST

Project  
Number

3516

**Title:** The Effects of Cable Bacteria on Reducing Methane Production in Microbial Methanogen Populations

**Student Name(s):** J. Degl, H. Johnson

**Abstract:**

Municipal Landfills are responsible for a tremendous amount of methane emissions. The purpose of this experiment was to investigate the effects of cable bacteria on the production of methane by methanogenic bacteria in decomposing matter. It was hypothesized that the presence of cable bacteria will reduce methane production due to their ability to produce oxygen gas and reduce sulfides in the soil, both of which inhibit the survival of methanogens. Containers were filled with compost and organic waste and inoculated with cable bacteria with the exception of the controls. The containers were sealed around the edges with hot glue to seal. A natural gas probe with digital readout was used to detect and measure levels of combustible gasses (methane, octane and butane) in each of the containers. PPM tests were performed for each trial across 7 days. Initial data showed no correlation due to a sealing issue, but once addressed, trends in the data became visible. Final results indicate that cable bacteria had a significant effect on the ppm of combustible gasses produced. It was concluded that introducing cable bacteria to landfill sediments could significantly lower the amount of methane released, serving as an inexpensive and effective methane-mitigation strategy.

**Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)**

EM MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No



# CSEF Official Abstract and Certification

Word Count

241

2023

Fair Category

LST

Project Number

3517

Title: Eliminating Microorganisms

Student Name(s): K. Robinson, J. Sanchez

## Abstract:

We investigated eliminating microorganisms from produce in the home. All the produce was bought from the supermarket and passed through my family's hands. I did that to simulate the bacteria that can build up as it is processed. To eliminate the bacteria, I tested boiling water on a frozen and room temperature apple, a UV Lamp on a frozen and room temperature apple, Arm & Hammer - Fruit and Vegetable Wash, vinegar, and water. Out of all the methods we think that the UV Lamp will do the best job of eliminating the bacteria on the produce. Our thought process is that since its wavelengths touch all parts of the apple and have bacteria killing capabilities it should work the best. After the apples went through the cleaning process, they were swabbed and left to sit in an incubator at 37 degrees Celsius for a day. After 24 hours, the boiling water with the room temperature apple had the least number of bacteria. The boiling water with the frozen apple had the greatest number of bacteria. We found that boiling produce for 5 minutes eliminates the most microorganisms. Future experiments could use steam, instead of boiling water, which in theory will eliminate microorganisms quicker and easier due to its gas state and higher temperature. Ozone gas could also be employed as a highly effective method of killing bacteria. Microwaves could also be utilized as an antimicrobial because of its radiation and heat production.

Technical Disciplines Selected by the Student  
(Listed in order of relevance to the project)

MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LST

Project  
Number

3518

Title: Natural Filter system to improve plant growth

Student Name(s): D. Vergara, J. Dexter , E. Lopez

## Abstract:

Water pollution affects many parts of our ecosystem. It causes damage to plants and aquatic animals by reducing oxygen. Polluted water doesn't just affect the ocean it also affects our crops. For this reason, this project shows how polluted water affects crop growth, radishes were used because of their very short maturity time, approximately 28 days. The water source that was used for this project was from the Shetucket river. A gallon of the river water was filtered through a homemade column composed of a gatorade bottle, cotton, sand, charcoal, and different size stones/rock. The filtered water was the only source of water for container # 1 and the unfiltered river water was used as the only water source for the container # 2. Three trials were performed; watering three samples with filtered water and the other three with the polluted water, within five days the radishes that were being watered with the unfiltered source grew faster than the samples watered with the filtered water. This information led to the conclusion that the Shetucket River water quality was optimal for growth. A new water source was gathered from runoff roadways that were salt treated and after a heavy rain. The new source of water was used in the same conditions as container 1 & 2. Water quality testing was performed on all three water sources and the data can be viewed in a chart on the research poster. The final results will be communicated during the preliminary presentation for judging.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EA

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

202

2023

Fair Category

LST

Project Number

3519

Title: Testing the Effects of Light Pollution on the Growth of Oxypora and Discosoma Corals

Student Name(s): G. O'Hara , T. Spiess

## Abstract:

The purpose of this project was to investigate the impact of light pollution on Oxypora and Discosoma corals. The experiment employed common types of light sources - LED, Fluorescent, and Halogen - that are commonly found on and within docks, harbors, and hotels in tropical coastal regions, specifically the Caribbean. To test the effects of the different types of light sources, each light was paired with a separate tank containing a standard aquarium LED light and four fragments of Oxypora and Discosoma Coral. The LED aquarium light was designed to stimulate the day and night cycle. Additionally, the fourth tank was a control tank containing an aquarium LED light to simulate standard aquarium levels of lighting. The three common sources of light were turned on during the night cycle, simulating the lights coming from the commercialization of these areas at night. The experiment generated both qualitative and quantitative data that reinforced previous studies, which have shown that light pollution has a harmful impact on coral growth rates. However, the study did not identify any specific light source that was more damaging than others. Across all three test tanks and both coral species, the corals decreased in mass and size at roughly the same rate.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CB EV AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

240

2023

Fair Category

LST

Project  
Number

3520

**Title:** Potential Role of Proximity to Creek Source Water on Population Dynamics of Eastern Oyster (*Crassostrea virginica*)

**Student Name(s):** E. Bigman, S. Roberts

## Abstract:

Potential impacts of climate change have resulted in an increasing focus on protection of coastal marshes. With this in mind, this study was designed to evaluate one of the best and largest protected coastal reefs in Connecticut. Replicated transects across the reef were studied to evaluate if proximity to the source waters correlated to population dynamics of local american oysters (*C. virginica*). It was expected that proximity to both source water and waterflow would impact survivorship and settlement as seen in analogous laboratory studies (Turner et al, 1994). Upon collecting and analyzing data, it was determined that significantly higher survivorship existed on the south side of the reef (82% versus 75%,  $p = 0.023$ ) and subsequently survivorship was also significantly higher in transects on the outside (west) of the reef versus inside (east) which was closer to river flow (86% versus 71%,  $p = 0.017$ ). In both comparisons, it was also observed that with recently settled oysters (<4cm) this significance pattern also happened ( $p = 0.022$  and  $p = 0.046$  respectively). Interestingly, slightly higher densities of oysters were noted in portions of the reef where survivorship was lower, indicating a possible role of competition for space and nutrients, but this needs further evaluation in heartier data sets. Ultimately, this study reveals that where oysters are on the reef does seem to matter, and coastal managers need to be aware of this to support the preservation and management of these fragile and important coastal ecosystems.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV EM AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

73

2023

Fair Category

LST

Project Number

3521

Title: Sunscreen wars

Student Name(s): M. Cruz, F. Barahona

## Abstract:

Our science fair project focused on the UVA aspect of sunscreen protection. Sunscreen ratings are typically rated for UVB. protection and all commercial samples were rated at 30 UVB levels. We discovered significant differences in their UVA absorption which could be related to skin damage and cause wrinkles. We attempted to formulate our own sunscreens using fruit and vegetable extractions to see if we could make a better sunscreen than store-bought sunscreens.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

CH

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

227

2023

Fair Category

LST

Project  
Number

3522

Title: Poultry-feather derived keratin as a medium in basil plant growth

Student Name(s): J. O'Connor, W. Gorman

## Abstract:

The purpose of this project was to test the effectiveness of keratin-derived-from-poultry feathers as a growth medium in hydroponic systems. Feathers were acquired from local chicken coops and cleaned using petroleum ether solution. Feathers were dried and blended to increase surface area for dissolving in sodium hydroxide. The solution was heated and stirred, and evaporated at 400 oC to isolate keratin precipitate. Extracted keratin was added to growth pods made of coco coir, at 25% and 50% concentrations. Pods were inoculated with basil seeds and placed in hydroponic systems for two weeks. The keratin's effectiveness was measured with two metrics: dry weight, and root length. The Dry weight was measured by drying the plants at 100 degrees celsius for 20 minutes and then massing. Root length was measured and used as an indicator of water absorption. It was concluded that keratin did not boost plant growth, however, at 25% keratin concentration the results indicated that keratin almost equaled the growth of the control. The control group had the longest roots and dry mass when compared to the 25% and 50% keratin concentration pods. The 50% keratin concentration was determined to not be effective in water absorption or plant growth according to the data. Further testing will need to be done to determine whether outliers and other variables affected the data observed in this study.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS CB AS

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

246

2023

Fair Category

LST

Project  
Number

3523

Title: Environmental Friendly Methods for Deicing Roads

Student Name(s): K. Hayes, A. Mayo

## Abstract:

In the United States deicing roadways, walkways is costly and the currently used material, rock salt, has a negative impact on the environment. The runoff of the rock salt can infiltrate into nearby streams, ponds, lakes, and groundwater. At high levels of concentrations, rock salt can have a negative impact on aquatic ecosystems; and even kill off the local flora, fauna, and aquatic animals. Alfalfa meal is a natural fertilizer that has been tested before on melting ice and snow with positive results, but has never been tested on how it affects the bacterial growth in soil. In this project alfalfa meal was tested against rock salt to see if the level of bacterial growth was affected. The following samples were analyzed in 4 day increments, including a baseline. Control - potting soil and ice, A - potting soil, ice, and 50 mLs of alfalfa meal, R - potting soil, ice, and 50 mLs of rock salt. A serial dilution was performed at each test day and the samples were plated, as well as an inoculation of liquid cultures. After incubating overnight @ 32oC the number of colonies were counted on the plates and the absorbance value of the associate dilution was recorded to calculate the CFUs in each sample. The final results at day 16 were as follows; The alfalfa meal samples had TNTC colonies and the rock salt samples had TFTC to determine the CFUs of each sample. This was a continued trend starting from the baseline results.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EV MI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

- human subjects       potentially hazardous biological agents  
 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

248

2023

Fair Category

LST

Project Number

3525

Title: The Effects of Traditional Medicine in Qur'an and Hadith on Escherichia Coli

Student Name(s): F. Abdulrahman, E. Smith

## Abstract:

In light of recent events, the cost of medicine has increased. As people in regions affected by supply shortages may be unable to afford conventional medicine, the question has risen as to whether holistic medicine may provide some benefit. With Islam being the fastest growing religion today, the students wondered as to whether the Qur'an and Hadith's influence on TAIM (Traditional Arabic and Islamic Medicine) indicate health benefits such as antimicrobial properties. This led to an experiment regarding the antimicrobial properties of 5% concentration of Acetic acid, Punica Granatum, and Zingiber Officinale on the K-12 lab strain of Escherichia Coli. The students predicted that 5% Acetic acid, Zingiber officinale juice, and Punica granatum juice would reduce Escherichia coli populations, with Acetic acid being most efficient at establishing a 20% zone of inhibition due to the lack of glucose. This investigation was conducted in 3 trials, each of which involved placing filter discs soaked with one of the selected variables in the center of a petri dish containing macConkey Agar and K-12 lab strain of Escherichia coli. Observations demonstrated that although 5% Acetic Acid did demonstrate antimicrobial properties, no bacterial growth was inhibited via Punica granatum and Zingiber officinale juice. These results may have been affected by the lack of access to extraction tools in a professional laboratory, providing further avenues of study in researching efficient methods of glucose extraction from plant materials, as well as the relevance in concentration of materials on its effects on bacterial populations.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MI ME BI

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

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# CSEF Official Abstract and Certification

Word Count

217

2023

Fair Category

LST

Project  
Number

3526

Title: The Nostoc Effect: Creating the Ultimate Biofertilizer to Mitigate Climate Change

Student Name(s): S. Trahanas, R. Ahn

## Abstract:

The purpose of this project was to observe the effects of Nostoc cyanobacteria on the growth of fescue grass and to investigate its viability as a carbon-sequestering biofertilizer in order to solve climate change. It was hypothesized that in a damp soil medium, in coexistence with fescue grass, the photosynthetic Nostoc would act as a nitrogen-fixing biofertilizer that sequesters more carbon dioxide than plants by themselves would normally be able to. The first stage involved the culturing of Nostoc filaments in four Erlenmeyer flasks under indoor LED growth light arrays in freshwater media. After about three weeks of growth, the most successful culture of Nostoc was used to fertilize two sealed atmospheric chambers containing soil and fescue grass seeds. An additional control trial with just grass and soil was also run. Every three days, changes in CO<sub>2</sub> and O<sub>2</sub> levels in each of the three chambers were recorded, and the atmospheres were opened in order to take height, mass, and soil nitrate level readings over the course of several weeks. Collected data was analyzed for statistical relevance, and it was concluded that the atmospheric chamber in which Nostoc was added affected atmospheric values in a positive way as well as serving as an effective biofertilizer evidenced by greater nitrate production and consistent healthy plant growth.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EN PS EM

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

125

2023

Fair Category

LST

Project  
Number

3527

Title: Sustainably Providing Vegetables in Accordance to Overpopulation

Student Name(s): E. Alexy, K. Lam

## Abstract:

Human population continues to rise which is leading to food scarcity. Although it is not a life threatening issue, it will be in the future. Vertical Farming provides a potential solution to this ever growing problem, this method provides a solution to dwindling space and growing demand for crops. A vertical farmer, with the help of a simulated environment, will be used to evaluate the most efficient form of fertilization in order to obtain the heaviest yield. Different forms of fertilizers will be applied to lettuce (Black Seeded Simpson Lettuce) after germination; they consist of Comfrey Tea Fertilizer, Perlite and Smart Gravel. Once harvested and weighed the method producing the heaviest yield will be appointed as the most effective method in such a small space.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM PS EN

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes  No

# CSEF Official Abstract and Certification

Word Count

244

2023

Fair Category

LST

Project  
Number

3529

**Title:** Utilizing Calcium Acetate as the Basis for Hydroponic, Structural Plant Proteins in the Absence of Light

**Student Name(s):** W. Nook III , J. Sieg

## Abstract:

The objective of this experiment was to bypass the Krebs Cycle during photosynthesis by substituting glucose with calcium acetate in order to build proteins in plants grown without light. Four hydroponic systems were utilized to grow Alfalfa, Heirloom Cherry Tomatoes, Lime Basil, Salad Greens, and Red Romaine Lettuce. Two had their lights removed and were surrounded by black foamboard. The remaining two systems had grow lights attached and on for 8 hours/day. In both the light and dark groups, one system was given fertilizer and one system given both calcium acetate and fertilizer. The calcium acetate in the dark was the main experimental group, while all of the others served as both positive and negative control groups. The results partially confirmed the hypothesis that the plants would grow given a mixture of calcium acetate, fertilizer, and water. The plants were able to grow in the dark given in both test groups, but grew with more flaccidity and less thickness relative to the control groups grown in the light. All plants in the dark exhibited reduced pigmentation due to lack of chlorophyll production, and the data indicate that the acetate was unable to compensate for this resulting in less than optimal growth in all dark-grown plants despite the addition of the acetate. A future study may include establishing a specific level of chlorophyll prior to removing the light source to better observe the impact of calcium acetate on plant growth in the dark.

## Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

PS EA EV

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

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 vertebrate animals       controlled substances

2. Student independently performed all procedures as outlined in this abstract.  Yes  No

3. This project was conducted at a Registered Research Institution.  Yes  No

4. Is this project a continuation?  Yes  No

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