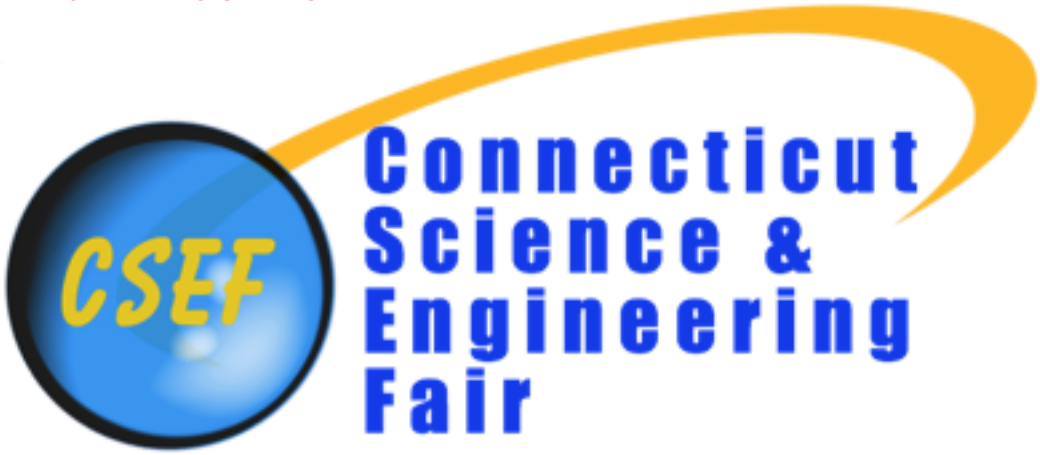
72nd Annual Fair



March 9 - 14, 2020

Student Abstracts

Fair Categories

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

Special Categories

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

Special Category Composites

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
220	LS	3001

Title: DEVELOPMENT OF VIBRIO SP. DETECTION IN CRASSOSTREA VIRGINICA FOR THE CONSUMER MARKET

Student Name(s): C. Hickey

Abstract:

DEVELOPMENT OF VIBRIO SP. DETECTION IN CRASSOSTREA VIRGINICA FOR THE CONSUMER MARKET

Charlotte Hickey

Bridgeport Regional Aquaculture Science and Technology Education Center

Bridgeport, CT

Kirk Shadle

Teacher – Bridgeport Regional Aquaculture Science and Technology Education Center

The consumption of raw shellfish is a popular activity in the United States and continues to grow every year. Due to the changing climate, sustainable foods such as shellfish become more incorporated in the American diet in particular. According to a study conducted by the National Oceanic and Atmospheric Association (NOAA) Fisheries, Americans consumed "4.8 billion pounds of seafood in 2016" (California Aquaculture Association Staff et.al, 2017). With any food product comes the potential for contamination by food-borne diseases, especially the consumption of raw seafood. Usually when food is unsafe for consumption, there is a telltale indication such as a foul scent, discoloration or visible damage to the tissues. In the case of Vibrio, a problematic pathogen that infamously affects shellfish such as oysters, there is no indication of its contamination status on a consumer level. The goal of this project

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EN BI 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	Fair Category	Project Number
234	LS	3002

Title: Biologic Prescribing Patterns Among Mount Sinai Psoriasis Patients: Results of a Retrospective Chart Review

Student Name(s): A. Choy

Abstract:

Objectives: Psoriasis is a painful and chronic inflammatory skin condition that not only impacts the quality of life of patients but is also a socioeconomic burden due to the cost of treatment, particularly with biologic treatments. The purpose of this study is to understand biologic prescribing patterns among Mount Sinai psoriasis patients and assess its relationship to insurance policy, which may limit treatment access.

Methods: This study reviewed randomized, de-identified charts of psoriasis patients in a nine physician academic practice at Mount Sinai (New York, United States) with the following insurers: Aetna, Blue Cross Blue Shield, Empire Blue Cross Blue Shield, Medicare A&B, and United Healthcare, treated with the following biologics: secukinumab, etanercept, adalimumab, infliximab, brodalumab, ustekinumab, ixekizumab and guselkumab. A chi-square test was performed to compare prescribed biologics by insurance company.

Results: Ustekinumab was the most prescribed biologic treatment across all the insurance plans. There were also disproportionate prescriptions of certain biologics for patients under particular insurance plans. Etanercept, brodalumab, and infliximab were the least prescribed biologics.

Conclusion: Results highlight certain patterns in the prescribed biologics of Mount Sinai patients. Prescribed biologics tend to vary by different insurers. However, ustekinumab was the most frequently prescribed biologic among all insurers, though it is not the most efficacious biologic based on PASI responses. Future research should be conducted to assess how differences in insurance policies (e.g., cost to patient) affect biologic prescribing.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
246	LS	3003

Title: Effect of Region of Interest Segmentation on Regional Analyses of Trabecular Bone Morphology

Student Name(s): D. Zhou

Abstract:

Osteoarthritis is a common joint disease, affecting millions of people worldwide. In osteoarthritis research, micro-computed tomography (μCT) imaging has been established as the gold standard in assessing bone morphology such as trabecular and cortical bone. However, current assessments of bone morphology using uCT imaging largely ignored differences in measurement when comparing different types and sizes of region of interest (ROI), often leading to inaccuracy and inconsistency in measurements and assessments. My project aims to determine the differences in trabecular bone measurements among various ROIs using μCT images of mice tibias. In my research, three different types of ROIs were used: whole medial compartment, 1 mm circle, and 0.6 mm circle. Four key measurements were analyzed for the three ROIs using BoneJ: trabecular thickness, trabecular number, trabecular spacing, and bone volume fraction. Data was analyzed for significance with one-way ANOVA test and Tukey Kramer post-hoc test. My research found that three of the four measurements changed

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

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4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
242	LS	3004

Title: Increased Prevalence of Gastrointestinal, Cardiovascular, and Immunologic Conditions in Hospitalized Patients with Ehlers-Danlos Syndrome: A Case-Control Study

Student Name(s): R. Brooks

Abstract:

This study investigated the prevalence of gastrointestinal, cardiovascular, and immunologic conditions in hospitalized patients with Ehlers-Danlos syndrome (EDS), a group of rare, inherited connective tissue disorders. Small studies have suggested a potential link between EDS and these conditions, but this is the first large case-control study to be performed to date. It was hypothesized that an EDS diagnosis would be associated with a higher prevalence of gastrointestinal symptoms, cardiovascular autonomic dysfunction, food allergies, and cardiovascular complications compared to the general population of hospitalized patients. It was also hypothesized that EDS patients would have higher odds of mortality and likelihood of having a longer than average length of hospital stay (> 4 days). Cases and controls (matched 1:2) were acquired from the 2016 Nationwide Inpatient Sample. The study population included 6021 individuals (n=2007 EDS). On multivariate logistic regression analysis adjusted for confounders, EDS patients had significantly higher odds of having GI symptoms (Odds Ratio [OR] = 3.53, Confidence Interval [CI]: 3.08-4.03, $P < 0.0001$), cardiovascular autonomic dysfunction (OR = 4.20, CI: 3.44-5.14, $P < 0.0001$), food allergies (OR = 3.92, CI: 2.57-5.98, $P < 0.0001$), and cardiovascular complications (OR = 5.76, CI: 4.17-7.96, $P < 0.0001$). EDS patients were also 76% more likely to have a longer than average length of hospital stay (OR = 1.76, CI: 1.54-2.02, $P < 0.0001$). These findings will enable physicians to exercise proper precautions in treating EDS patients and provide rationale for EDS to be considered in patients with unexplained GI, cardiovascular, and immunologic manifestations.

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

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☐ vertebrate animals ☐ controlled substances

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
212	LS	3005

Title: Impact of Ammonia Concentration on Arthrospira Platensis Lead Absorption

Student Name(s): J. Lam

Abstract:

To combat the leaching of lead into groundwater, this project is to test the ability of Arthrospira platensis for bioremediation to absorb lead while being exposed to differing concentrations of ammonia. Leachate is effluent produced from all landfills and has high levels of ammonia (over 2.0 mM) as well as lead, a toxic heavy metal, and it can seep into groundwater from landfills, and the usage of oxidation ponds to rid leachate of heavy metals is impacted by the ammonia concentration in it, since ammonia is also toxic to many species of algae. A. platensis was grown in four solutions containing 100 ppm lead and 0, 1, 2, and 3 mM ammonia respectively for two weeks. There was no algae visible to the eye by the end of the two weeks in any of the solutions, and so none was removed from the solutions. That means that, according to the results of this experiment, A. platensis is unable to grow in the conditions it was exposed to in this experiment and would therefore be unable to be used for bioremediation in leachate, or that it needs more than two weeks to show growth visible to the eye. This information can be used to construct future experiments involving the growth of A. platensis.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS EM 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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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
247	LS	3006

Title: Challenging the Belief of One Cerebral Hemisphere Dominating the Other in Specific Daily Functions

Student Name(s): L. Lawson

Abstract:

Through years of science and research, it has been established that the brain is the central control system of the human body. Constantly, the brain receives and delivers signals to other organs through the nervous system and secreted hormones. Additionally, it holds all thoughts, memories, feelings, and perceptions of the world around us. Some have indicated the two cerebral hemispheres that make up the cerebrum have specific functions that pertain to logical and creative tasks, leading to the assumption that individuals are dominant in a specific hemisphere. This has been a timeless debate. The motive of my project was to challenge hemispheric specialization. I hypothesized that through a task-driven survey I would debunk the assumed and find that collectively the hemispheres work together (sometimes one hemisphere playing more of an active role) to complete a task. Through research, I created six tasks geared towards using the “left” and “right” brain to have participants complete. In one task meant for a specific hemisphere, those who perceive themselves as being such (on average) excelled more than others. On the other hand, both left and right brain participants average the same for tasks where collaboration flourished. Thus, the results supported the initial hypothesis, meaning that in some cases certain hemisphere dominates the other but also they work together to complete certain tasks. With this in mind, this research is valuable. These results could help further understand the brain and maybe solutions for patients suffering from Huntington's disease, dementia, Alzheimer's.

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
227	LS	3007

Title: A Novel Nootropic Therapy as a Functional Neuroprotective and Neurorestorative Stimulant to Hypocretin-producing Neurons in Relation to Managing Narcolepsy

Student Name(s): M. Dauk

Abstract:

Narcolepsy is a life-long sleep disorder that causes uncontrollable drowsiness and tiredness, characterized by up to a 90% hypocretin deficiency leading to a cascading deficiency of key brain chemicals serotonin and dopamine among narcoleptic patients. The hypocretin deficiency is realized through a biochemical imbalance within the Lateral Hypothalamus. It is proposed that a neuroprotective and neurorestorative nootropic will prove effective in treating Narcolepsy to reduce this hypocretin deficiency and thus the subsequent deficiencies in serotonin and dopamine.

The model organism Drosophila melanogaster demonstrates a decrease in activity levels when serotonin is released after responding to a potential threat. This serotonin release can be measured through behavioral activity via the Rapid Iterative Negative Geotaxis Protocol. The nootropic is applied to the flies' system through a 1 ppm solution of the nootropic in their food. The activity of the Drosophila was measured at different time increments along with analyzing irregularities in flying patterns. The testing group was seen to have a lower mean climb times and more sporadic movements compared to the control.

This research proves a viable support treatment coupled with current serotonin elevating medications, such as antidepressants, for narcolepsy. Antidepressants are utilized as a treatment for their serotonin reuptake inhibitors. The nootropic also gradually increases neuroplasticity which heightens the interest to explore the avenue of using it alongside modern medical treatments for Narcolepsy in future applications.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
245	LS	3008

Title: Optimize a method for parathyroid cell primary culture

Student Name(s): A. Undrakonda

Abstract:

The purpose of this research project was to optimize a method for parathyroid cell primary culture. Each person has four parathyroid glands that secrete something known as PTH, this stands for parathyroid hormone. Parathyroids control the calcium levels in the body, too much PTH secretion is called hyperparathyroidism and can lead to osteoporosis and kidney stones, and too little PTH secretion is known as hypoparathyroidism, which can lead to impaired kidney function, heart failure, and malformed teeth. At the University of Connecticut Health Center, I am currently analyzing the growth of mice parathyroid cells within a culture. The mice at UCONN health Farmington are genetically-engineered to have fluorescent parathyroid glands. Cells are split each week, assuming flaks have reached a 75 to 100 percent confluency. In order to split the cells certain procedures must be followed, I am provided with a 75 cm2 flask. The first part of the procedure is to remove and discard culture medium. Then we have to briefly rinse the cell layer with 0.25% Trypsin 0.53 mM EDTA solution to remove serum that contains trypsin inhibitor, each of the parathyroid mice cells is placed in a media known as Trypsin-EDTA, to ensure proper growth. Cells that are difficult to detach may be placed at 37°C incubator to facilitate dispersal. Add 6.0 to 8.0 mL of complete growth medium and aspirate cells by gently pipetting. Results are calculated by measuring the confluency of each flask, to examine the growth.

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

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	LS	3009

Title: Pharmacokinetics of Ceftriaxone Applied to Osteomyelitis

Student Name(s): T. Wilkes

Abstract:

The pharmacokinetics of antibiotics are crucial in understanding how a drug works within a patient. In order to make sure that the drug arrives at the site of infection, the pharmacokinetics, or how the drug moves within a patient's body, are significant. Osteomyelitis, a common bacterial infection causing inflammation of the bone, is seen in patients that have contracted diabetes or have had traumatic injuries. Post-traumatic osteomyelitis was of interest in this research, but other types include vertebral, prosthetic-joint, and septic arthritis osteomyelitis. This infection is caused by Staphylococcus aureus, a bacteria that is commonly treated with β-lactam antibiotics. Cephalosporins are an antibiotic class that is frequently used in order to treat osteomyelitis. Research by A.C. Popick et al was viewed in this project. This study determined plasma protein binding (the percent of antibiotic binding to blood plasma) via an experiment that utilized a membrane in between two cells to separate antibiotics and donated blood plasma. HPLC (high-performance liquid chromatography) and Beer's law were used to correlate absorption and concentration of the antibiotic ceftriaxone. The concentration of free vs. bound drug was found for different types of patients. Results demonstrated the binding of ceftriaxone in baboon, cat, rabbit, and human plasma were highly bound at lower concentrations, decreasing at higher concentrations. For canines, the lower concentrations had much lower binding percentages. Data was used to determine concentrations needed for varying age groups. Future research could be proposed; analyzing the effects of patient history or possible risk factors.

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

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
123	LS	3010

Title: The Effect of Nectar Distribution on Fecal Deposition in Bumble Bees: Implications for Disease Transmission

Student Name(s): L. Scura

Abstract:

Bumble bee fecal-oral disease transmission is accomplished through the deposition of feces on a flower and the consumption of it by another bee. Nectar distribution results in a possible difference of foraging techniques and an unknown distribution of feces that has yet to be tested. The purpose of this study was to evaluate the effect of nectar distribution on fecal deposition in association with pathogen transmission. Bumble bees were allowed to forage on a treated native plant with clumped nectar treatments and evenly distributed nectar treatments. There were more feces on flowers with evenly distributed nectar than clumped. Understanding the dynamics of disease transmission is critical to the survival of pollinators and holds implications for how pollinator habitat could affect disease spread.

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

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
206	LS	3011

Title: Analysis of the Antimicrobial and Antiproliferative Effects of the Coelomic Fluid of Eisenia Fetida on E. coli and Yeast.

Student Name(s): E. Davis

Abstract:

Earthworms are substrate feeders and thus have a relatively high uptake of bacteria, protozoans, and fungi from the outer environment. In response, the coelomic fluid in the coelom of an earthworm is equipped with various cellular and humoral defense mechanisms to eliminate pathogens and control the growth of microorganisms. This innate immunity is a potentially rich source of novel treatments because of the unique composition and broad antimicrobial activity of coelomic fluid. The purpose of the project is to analyze the antimicrobial and antiproliferative effects of the coelomic fluid of Eisenia Fetida on E. coli and yeast. During the study, coelomic fluid is collected through low voltage electro stimulation. The antimicrobial effects are analyzed by saturating an antibiotic disk with coelomic fluid and placing the disk on a culture of E. coli. The zone of inhibition is measured to analyze the activity. The antiproliferative effects of the fluid are evaluated by introducing coelomic fluid to a yeast culture in broth. A cell count is obtained periodically to measure the suppression of the yeast caused by the coelomic fluid. The suppression indicates antiproliferative activity of the coelomic fluid. Thus proving that the bioactive properties of coelomic fluid can be used in the field of anticancer cell proliferation.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
247	LS	3012

Title: Beclin1 Expression in Metastasis of Osteosarcoma Patients

Student Name(s): N. Patel

Abstract:

Osteosarcoma is a type of childhood and adolescence cancer that arises from the cells that form bone. Osteosarcoma rapidly progresses to metastasis, which are aggressive secondary tumors that form away from the primary tumor site. During the process of metastasis, the primary tumor sends out pioneer cells to invade both local and distant tissues. Although metastasis is a major issue in osteosarcoma cancer treatment effectiveness, not much is understood about its bio-determinants. One cellular function that may contribute to metastasis is autophagy. Autophagy is the process of controlled degradation of damaged cytoplasmic components or proteins by the cell. Autophagy is considered to be a key survival mechanism that can also play a role in tumor metastasis. Beclin 1 encodes a protein that is a component of the phosphatidylinositol-3-kinase signaling pathway that plays a central role in the regulation of autophagy in the cell. Beclin 1 has been shown to play a role in metastasis in other types of tumors. My hypothesis is that if Beclin 1 plays a critical role in osteosarcoma metastasis, then more cells in the osteosarcoma metastasis should express Beclin 1 than in the primary tumor. To test this, I used immunofluorescence to count the average number of Beclin 1-positive cells in matched primary and metastatic tumor samples. By measuring if a statistically significant different number of cells express Beclin1 in the primary and metastatic tumors, I determined the correlation between Beclin1 expression and metastatic potential in the osteosarcoma tumors.

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

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
230	LS	3013

Title: The Effects Of Fabric Color and Amount of Washes on its Ability to Absorb UV Light

Student Name(s): A. Song

Abstract:

The experiment was designed to test how clothing color and how the amount of times fabric has been washed will affect the amount of UV radiation that the clothing can absorb. The goal of the experiment was to find the best colors to protect us from the harmful UV rays emitted by the sun and see if washing the clothing would affect its ability to absorb UV radiation. In the experiment, we tested ten different colored fabrics. During the experiments, a UVA sensor was used to measure how much UV light from an ultraviolet source would get past the fabric while confined in a cardboard box. What we observed was that the colors black and red were very effective when it came to absorbing UV light, letting only around 13-16 mW/m^2 of UV light get through the fabric. On the other hand light purple lets close to 100-120 mW/m^2 of UV light get through. For example, after three different washes, the red seemed to stay around 36 mW/m^2, neither dropping or increasing. Similarly, for the green on its second and third wash, it stayed exactly 40 mW/m^2 both times. In conclusion, our hypothesis was disapproved, because even though the white fabric was not good at absorbing UV light, and washing the clothing did not seem to affect its ability to absorb things.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
257	LS	3015

Title: A Novel Computer-Aided Autism Spectrum Disorder identification Method Based on Transfer Learning from VoxResNet and therapeutic method based on embedded system.

Student Name(s): D. Hong

Abstract:

Autism Spectrum Disorder(ASD) has been a heated medical issue for academia. Traditional therapies include methods such as Pivotal Response Treatment, but the novel digital treatment methods have long been restricted to screen practice, and some are still heavily based on manpower. To solve this problem, this paper proposes an ASD identification system by establishing a deep learning model based on VoxResNet, known for processing volumetric data such as the resting-state functional Magnetic Resonance Imaging(R-fMRI). Using data provided by Autism Brain Imaging Data Exchange(ABIDE), such a model achieves an accuracy of 85.71% for R-fMRI from a single site. In addition, a web server established through the Flask framework allows end-users to access the system. In addition, the paper proposes an embedded system that offers behavioral training for early-aged ASD patients to cultivate their communication skills. It consists of Arduino and several three-axis accelerometers for the collection of data generated by gestures. Feedback is given to patients regarding the quality of their gestures in a given context. Using behavioral training, the system provides a more spontaneous method for one to express one's thoughts as opposed to verbal language training. This offers an opportunity for therapists to encourage ASD children to better express themselves through a more intuitive communication channel. Towards the end, this paper also includes a design of tests and trials to evaluate the efficacy of the whole automatic system.

Keywords—ASD; R-fMRI; VoxResNet; ABIDE; Transfer Learning; Web Server; Embedded System, three-axis accelerometer, self-designed algorithm, Arduino.

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

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	LS	3016

Title: Using Artificial Intelligence to Uncover the Connection between RNA Gene Expression and Cancer

Student Name(s): N. Shell

Abstract:

Cancer is the second leading cause of death worldwide, with 9.6m deaths in 2018. Early detection, accurate diagnosis and treatment can lead to dramatically improved outcomes, with 5-year prostate cancer survival rates increasing from 30% to almost 100%. Unfortunately, existing tests can be time-consuming, expensive and invasive, yet specific diagnosis remains critical as treatments can vary significantly by subtype. This research focuses on the development of quick AI based tests for lung cancer, prostate cancer and leukemia, based on the relationship between cancer subtypes and mRNA gene expression. These tests can leverage the revolutionary advances in single-cell transcriptomics using "sample barcoding" or "multiplexing" that significantly reduce the time and cost of RNA transcription. Novel approaches including Bulk RNA Barcoding and sequencing (BRB-sec) could reduce costs by a further 96%, providing broad access to RNA gene expression data for diagnoses from this research's tests. Using RNA gene expression data, these tests incorporate two supervised and one unsupervised machine learning algorithm, coded from scratch and chosen to maximize accuracy. I utilized Random Forest on the prostate cancer to generate decision trees that output an initial and final determination based on the output of the majority of the trees, yielding an 86.57% accuracy rate. The lung cancer test uses K-nearest Neighbors: splitting data into training and inference datasets, yielding a 90% accuracy rate. The leukemia test is also coded with K-nearest Neighbors, yielding a 88% accuracy rate. K-means clustering was experimented with, but with lower accuracy rates.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) CS AT 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	Fair Category	Project Number
243	LS	3017

Title: Creating a Wearable Device that Reduces Stress by Using Vibrational Pulses

Student Name(s): S. Munim

Abstract:

Stress is a reaction that can negatively affect many people. Using vibrational pulses can lower stress by calming the user of the device. Research finds that a slow heartbeat pulse being emitted to the wrist has a calming effect on the physiological sense of the participant. The device that was created helps reduce stress for people that are negatively affected. To test the device, participants received vibrational pulses from the device while doing a stressful task. Participants read a 6 page article and wrote a summary about it in a five minute period. One group of participants were given the vibrational pulses, while the other group was not. After the 5 minute period, a State-Trait Anxiety Inventory (STAI test) was given to the participants to test their anxiety and stress levels. The STAI test had 20 questions from a scale from 1-4, and the summary was corrected based on a percentage rubric. Analyzing the STAI test and summary task, the preliminary data suggests that the group which received the vibrational pulses from the device was more concentrated and attentive while performing the task. The greater implication of this device will be to have a heart rate sensor attached to have the vibrational pulses send automatically and at a desirable frequency for the user. The device may also be implemented into a watch, and an application for other devices that already exist may be created to make the technology available to more people.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
241	LS	3018

Title: Non-Invasive Augmentation of Modern Depression Phototherapy through Targeting of the Suprachiasmatic Nucleus via Spectroscopic Techniques

Student Name(s): C. Decker

Abstract:

Modern society possesses the proper ingredients to instigate depressive symptoms in a wide range of individuals, with approximately 7% of the US population experiencing at least one major depressive episode per year, costing the nation $210 billion annually from treatment and a loss in productivity. Phototherapy is a cost-effective innovation which has been applied to treat depressive symptoms in recent years, however its effectiveness remains limited. This research investigates increased effectiveness of phototherapy, via engineering of a new light panel, that is user-switchable between traditional white light (WL) and student-engineered targeted-spectrum (TS) illumination (426/530/560nm). With respective spectral luminosities of 2.7/1.7/1, the TS light panel was constructed from wood, custom Arduino control, LEDs, and reflective backing. Subjects were exposed to 30 minutes of lighting each morning, for 2 weeks per lighting configuration, for a total testing period of 7 weeks. Four times daily, participants were asked to gauge their own happiness, focus, and energy, expressed through a Likert scale (0-10) via an online survey. Results were expressed as change in Likert scale per metric (ΔL). TS consistently outperformed WL, with 100% and 260% improvements in morning and afternoon happiness, respectively, a 66% improvement in both morning and afternoon focus, and a 30% energy improvement throughout the day. Improvements in feelings of happiness, focus, and energy for white light therapy are on-par with those reported in literature, but the use of a specialized spectrum far exceeded these values.

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

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
241	LS	3019

Title: Building a Biosphere

Student Name(s): P. Williams

Abstract:

Plants are self sustaining and extremely regenerate, while producing vital gases for human and self survival, so an experiment was brought about. If a biosphere, or an atmosphere made up of living organisms, is created and maintained, then would it be able to produce enough CO2 to sustain itself from the available O2 in the water provided? These inquiries were tested by building a biosphere using an air tight container, pond water, aquarium gravel, loamy soil, and plants. The CO2 emissions were recorded using a monitor that gave live readings in ppm and the O2 levels were calculated from the CO2 readings. Though only tested for about 10 weeks, informative results were still produced. An average of 0.49% carbon dioxide was emitted per day, with a high of 1.0% and a low of 0.1%. For oxygen, an average of 10.6% was maintained each day. In the Earth's atmosphere, carbon dioxide makes up only about 0.04% and oxygen 21%. Humans can endure much higher levels of CO2 but the Occupational Safety & Health Administration determined that 0.5% is the limit for safe exposure. In the short period of testing, the CO2 levels exceeded 0.5% the majority of the time but began to even out towards the end. With this information, it can be reasonably predicted that the biosphere would eventually average out to be closer to a non-threatening level of carbon dioxide and therefore be able to maintain itself and human life.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) BI PS 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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
258	LS	3020

Title: Metal Oxide Nanoparticle Suppression of Coffee Rust Using an Alternaria, Stomata-Sporulating Model Fungus

Student Name(s): E. Sosa

Abstract:

The coffee industry is valued at $100-billion worldwide, as coffee is one of the most consumed beverages globally. Coffee agriculture is an important contributor to the economies of South America, which are hindered by increasing infection of their crops by Hemeleia vastatrix fungus (coffee rust). Coffee rust sporulates through the stomata, depleting the coffee plant of its nutrients, decreasing coffee yields, and killing the plant within ~2years. To date, a method to pre-treat coffee crops to suppress the growth of coffee rust remains elusive. In this research, 500ppm CuNPs, MnNPs, and ZnNPs were investigated as foliar pre-treatments, to promote overall growth of Arabica coffee plants, and suppress Alternaria sp. (a safer, similarly stomata-invading fungus) infection. For healthy plants, CuNPs provided a growth benefit of ~13.4%, via absorption into the leaf vascular structure. Conversely, for Alternaria, which was discovered to kill coffee plants after 4days via underleaf biofilm growth, foliar pre-treatment with ~5ml of 500ppm CuNPs acts to prevent the formation of fungal mycelia that eventually invade the leaf stomata, and thereby acts to prevent the secondary, subsequent biofilm formation. As a pre-treatment, CuNPs act to inhibit all forms of fungal growth that lead to stomatal invasion and obstruction of CO2/O2 exchange, leading to plant overall health, and a similar 11% increase in growth. Due to the similarities in coffee rust and Alternaria growth mechanisms, it is suggested that CuNPs would be useful as a pre-treatment to promote 11 -13% increase in coffee crop growth, while prohibiting the progression of Hemeleia vastatrix.

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	Fair Category	Project Number
255	LS	3021

Title: Role of type 3 inositol 1,4,5-trisphosphate calcium receptor gene demethylation in pathogenesis of cholangiocarcinoma

Student Name(s): A. Mangla

Abstract:

Inositol 1,4,5 trisphosphate receptors (ITPRs) are a family of endoplasmic reticulum Ca2+ channels that mediate Ca2+ signaling, important for processes such as apoptosis and cell proliferation. Recent findings demonstrate that changes in the expression of ITPR isoforms are associated with human diseases ranging from fatty liver disease to cancer. ITPR3 is emerging as the isoform that is particularly important in the pathogenesis of various human diseases, including cholangiocarcinoma.

The research aimed to investigate the mechanism responsible for the over-expression and subsequent mislocalization of the ITPR3 receptor in human cholangiocarcinoma.

The primary method of protein regulation addressed in the research was methylation, the binding of a methyl group to a specific gene promoter. Using bisulfite methylation assays, PCR, and sequencing to find the methylated -CG pairs of the ITPR3 sequence in human cholangiocarcinoma, we concluded that cancerous tissue characterized 95% de-methylation. Immunohistochemistry also found an overexpression of ITPR3 in tumor samples in comparison to normal samples.

Methylation inhibits protein expression by blocking the promoter. However, if the gene promoter is de-methylated, there is a higher correlation between overexpression of that

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

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
195	LS	3022

Title: Utilizing Habitat Suitability Indices for the Discovery and Protection of Endangered or Threatened Herpetology Based Species

Student Name(s): E. MacKenzie

Abstract:

The research starts with three public locations within Fairfield County being chosen due to a number of consistent variables.Before surveying it is important to be mindful and careful of the surrounding nature, also to abide by the state laws provided by DEEP regarding endangered species. Each area is then closely surveyed and studied, looking at the amount of biodiversity they have and share. After all the data on types of vegetation, flow of water, shade versus sun proficient areas, animal tracks, ground make and consistency, and noticeable wildlife is collected from each environment, they are all compared to find similarities or differences. Then a second survey requires the return and review of the environments in person to specifically look for herpetology based species of wildlife, amphibians and reptiles. With most of the species found and observed in each environment we are able to look at their relevance towards other species that are possibly more endangered or threatened. After looking at the types of herpetology based species in each environment educated guesses can be made about certain endangered or threatened species. Then a third search commences to search for species that are assumed to be there.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
258	LS	3024

Title: Plant Growth Enhancement & Fungal Disease Suppression via Copper, Zinc, and Manganese Nanoparticle Foliar Sprays

Student Name(s): A. Patti

Abstract:

Sensitive crop regions are constantly under environmental stresses that foster plentiful plant disease. Basil plants, for instance, have been victims of Fusarium oxysporum (F.o.) wilt for decades, where growth conditions have stimulated progression of this disease, and subsequent crop destruction. A simple and effective treatment that would eradicate F.o wilt, while promoting overall plant growth, is needed. Metallic nanoparticles (NPs) have shown to improve plant health and overall crop yield, due to systemic movement through the plant's root system, where the nutritional value of metallic nanoparticles is fully realized. This research investigates whether the "foliar-spray" application of NPs of copper, manganese, and zinc (as oxides) increases the growth rate and crop efficiency of healthy O. basilicum plants, and inhibits the adverse effects of F.o., to ultimately devise an easily-applied, simple, and effective treatment to promote increased crop growth. Pre-grown (3") basil plants were first transferred to ~0.8L pots using ProMix-BX soil, which was pre-inoculated with 1-2ml of 1g/L-F.o in water. Each plant was then treated with ~2ml foliar spray of the respective nanoparticles. After 6 weeks growth, all three MO-NP treatments produced significant increases (>120%) in biomass, relative to diseased plants; ZnNPs were the most favorable, at 180% increase in biomass relative to untreated, diseased plants. Combined Cu-Zn NP treatment enhanced diseased plants' biomass by 29% and provided a 40% increase in height. Most importantly, diseased-plants outgrew healthy controls by 21%, highlighting the treatment's ability to fully suppress F.o., so that infected plants grow beyond normal, healthy conditions.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	LS	3025

Title: Structural Morphology of a Novel Actinobacteriophage Through the Analysis of the Major Capsid Protein

Student Name(s): A. Chopra

Abstract:

As the most abundant biological entity in the ecosphere, much still remains to be learned about bacteriophages. Understanding the structural diversity of bacteriophage will further increase the knowledge of the origin of viruses, hopefully leading to the creation of a comprehensive phylogenetic tree to describe their evolutionary history. The goal of this research is to build on the database of known actinobacteriophages by analyzing the structure and amino acid composition of the major capsid protein in the capsid head.

There are two major sources of data that need to be collected for this study. As the main goal of the research is to discuss the structural diversity of actinobacteriophages, a three dimensional map of the capsid head needs to be compiled to understand the morphology of these viruses. The amino acid sequence of the proteins that make up the capsid head of the phage also needs to be determined to help build an accurate model of the proteins in the capsid.

The chosen host, Microbacterium foliorum was infected with phage samples from local soil. Through a procedure of serial dilutions and dialysis, the phage samples were prepared for cryogenic electron microscopy to analyze the structure. The double stranded DNA genome was extracted and sequenced using Next Generation Sequencing to determine the amino acid composition of the major capsid protein.

Using the purified bacteriophage, we obtained a high resolution three dimensional map of the bacteriophage capsid. We are currently modeling the amino acids of the major capsid protein into the map.

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

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	LS	3026

Title: The effect of grafting on the sugar content of cherry tomatoes.

Student Name(s): K. Flint

Abstract:

The purpose of this project is to test whether or not grafting has an effect on the nutritional value and composition of produce. To test this 4 different types of cherry tomatoes were purchased as seeds, and 2 of each were planted in biodegradable jiffy-pots for later transplant. These pots were filled with a set amount of miracle grow potting soil, and 8g of fertilizer. The seeds were planted ¼" deep, and watered with an original 60ml of water. Afterwards they were placed together in a tray and placed in an in-house growing chamber to keep a constant temperature above 70 degrees, also inside the growing chamber was placed an 800ml beaker of water to produce humidity. Later, to water the tomatoes, the tray was filled with ¼" of water every day, and ½" of water on the weekends. When the tomato plants bear fruit, 4 tomatoes of each plant would be blended separately, and a sample of the juice would be placed on a Brix refractometer in order to test the average sugar content of the tomatoes. After that control data is taken, 1 branch of each plant would be cut off, and grafted onto the spot where a branch was cut of a different plant in order to hold multiple trials at the same time. Unfortunately, because the materials for this project arrived later than anticipated, at this stage the plants have just begun to grow. As such, the actual grafting will occur at a later date.

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

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
253	LS	3027

Title: Lumbricus Terrestris's Effect on Climate Change: Carbon Source or Sink?

Student Name(s): L. Kane

Abstract:

Climate change is the most pressing issue of our time. Earthworms play an important role in the climate system, as organisms that act as both a sink and source of carbon. Studies have shown that earthworms sequester more carbon into the earth than they release, however this research has been largely inconclusive. As global temperatures rise, boreal forests are experiencing sudden growth of earthworm populations. If earthworms do increase emissions, a positive feedback loop could be created. My experiment aimed to add evidence to elucidate this emerging issue.

My research simulated two environments, one at 14-15°C and one at 24-25°C, corresponding to average temperatures of the Regional Municipality of Wood Buffalo, Canada during April, and slightly higher than those in July. I constructed air-tight boxes filled with soil and earthworms. The boxes had resealable holes for oxygen tubes, CO2 and O2 probes, and pressure-maintaining instruments. Then, I assessed changing CO2 and O2 levels using Vernier gas probes.

Although I used soil that had established sequestration, CO2 levels increased throughout the experiment, moving in daily wave-like patterns, trending upwards. This provides a short-term look into a soil environment correlating with present day boreal systems. Considerably more CO2 was produced in higher temperatures, ~120% on average. At the end, colder boxes averaged 33,685 ppm while warmer boxes averaged 40,466.5 ppm. Because the experimental period was short, results are preliminary, however still significant: indicating that a sudden increase in earthworm habitat and populations may exacerbate the effects of global warming.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
209	LS	3028

Title: The Effect of Sulfur Dioxide on Puncture Resistance, and Mass of a Snail's Shell

Student Name(s): A. Farrior-Parcak

Abstract:

This lab came about to find out how acid rain affects the snail shell in two ways: weight (in grams), and puncture resistance. To establish this lab, the acid rain solutions were made and used on the snail shells; they took a 1M Sulfuric Acid solution with a pH of 1, then put 2.5 mL of it into a 300 mL beaker of water with a pH of 7, this made the water now a pH of 2 (Solution A). For the next solution, 25 mL of Solution A and added it to 300 mL of water, it then turned the water to a pH of 4, which was the intended pH for mimicking acid rain (Solution B). To separate the snail shells for testing, shells were put in labeled zip lock bags. To treat the snail shells, 40 mL of "Solution B" was added to select bags of snail shells to ensure consistency; each test was run six times, three times before acid was introduced, and three times after acid was introduced. Most shells only dropped in weight by .1-.3, after the acid was introduced, the shells were rougher and felt different after the acid. This means that the acid affected the shell's weight and its texture

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

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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	Fair Category	Project Number
230	LS	3029

Title: Machine Learning Algorithms for HAB Detection

Student Name(s): E. Boyce

Abstract:

For the past 25 years, hazardous algae blooms have been growing more rapidly and reproducing more readily due to excess nutrients caused by water pollution and warmer temperatures. As communities developed from cyanobacteria, HABs contaminate fresh and salt waters with cyanotoxins, causing rashes, asphyxiation, respiratory paralysis and liver failure in both marine and terrestrial animals. A user friendly application could help the general public in protecting themselves through one of the most universally owned objects today. Development of an app for smartphones to identify different types of algae, correctly determining their strand through the means of a simple photo was performed.

Two tests were grown in freshwater medium of five sample cultures including: Anabaena, Tolypothrix Distorta, Eucapsis, Merismopedia, and Fischerella. The app's database was taught to know the different species based on training from the photos of their growth. As unidentified photos were entered into the database, they were processed by the code to pick up on colorings and growth patterns of the algae. The highest predictability between the concept and the photo reads as either a positive or negative result compared to the correct strand, which are then recorded as data for frequency of correctness. The application resulted in approximately 80% accuracy, most confusion falling between Tolypothrix Distorta and Fischerella readings. More training would allow for more variability between the concepts, providing more accurate predictability going into the future.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
249	LS	3030

Title: Allelopathic Effects of Invasive Red Macroalga (Grateloupia turuturu) for the Mitigation of Harmful Algal Blooms

Student Name(s): L. Given

Abstract:

Allelopathy is the release of secondary metabolites known as allelochemicals by one species to inhibit the growth of a competitor. Due to rising ocean temperatures and eutrophic conditions from land runoff, harmful algal blooms (HABs) are increasing in frequency and severity. HABs cause tens of millions of dollars annual loss in fishing industries, mass die off of marine organisms, and serious human illnesses like paralytic shellfish poisoning. Most suggested methods to mitigate HABs raise concerns of expense, impracticality, or further harming the environment. Allelochemicals can be derived from macroalgae, a natural and abundant source, reducing both potential cost and environmental harm. Additionally, allelopathy has been suggested as a mechanism for invasive species in non-native habitat to outcompete native species. Thus, Grateloupia turuturu, an invasive red macroalga, could use allelopathy to mitigate the growth of HAB-forming microalgae. G. turuturu biomass was collected in Bridgeport, CT, and the allelochemicals were extracted. To establish non-target microalgae impacts, the allelochemical extract was tested on bioassays of Isochrysis galbana and Tetraselmis. The overall cell growth was measured using a hemocytometer and spectrophotometer. After 48 hours, the average rebound rate was 12.31/10,000 cells for the control cultures whereas the rate was 24.54/10,000 cells for cultures with the allelochemical extract. Overall, cultures with the allelochemical extract had a 99.32% growth increase when compared to control cultures. This demonstrates that allelochemicals are selective and positively benefit non-target microalgae populations. Therefore, allelopathic macroalgae could be used to mitigate HABs without impacting non-target species.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): EM EN PS

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
258	LS	3031

Title: Determining the Effect of Lipids on the Aggregation of Alpha-synuclein Protein to Prevent the Formation of Lewy Bodies in Parkinson's Diseases

Student Name(s): G. Nemec

Abstract:

Parkinson's disease (PD) affects nearly one million Americans and has no cure. PD is a neurodegenerative disorder that predominantly affects dopamine-producing neurons in a specific area of the brain called the substantia nigra. Alpha-synuclein aggregation, or Lewy bodies, in the brain plays a role in PD since the aggregation is harmful to neurons. It is hypothesized that several of the lipids tested in this study will reduce alpha-synuclein clumping. In this study, various lipids were combined with alpha-synuclein and tested to determine the effectiveness of lipids to prevent aggregation of alpha-synuclein. After mixing the lipids and alpha-synuclein in a phosphate buffer, the amount of light transmittance was monitored and recorded using a spectrophotometer over time. These results were then utilized to determine if a certain lipid could possibly reduce clumping within the brain and slow or cure Parkinson's disease. After testing all of the lipids and testing the percent transmittance every five minutes, it was concluded that alpha-synuclein and fish oil created the greatest decrease in transmittance, decreasing from 96% to 80% over the time period tested, therefore potentially not being effective at reducing the level of clumping. The pine needle oil, however, increased in transmittance the most, from 93% to 100%, therefore potentially being effective at preventing aggregation. These results confirm the potential for lipids to reduce clumping of alpha-synuclein, and also indicate that alpha-synuclein clumping may be able to be altered, which can possibly lead to a reduction in the physical and mental effects of Parkinson's disease.

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

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	Fair Category	Project Number
239	LS	3032

Title: Impact of Pesticides on the Nutritional Value of Food Plants

Student Name(s): L. Doyonas

Abstract:

There is an overwhelming amount of articles and studies about how pesticides can harm the human body and their dangers to human health. However, they don't show the whole picture; Pesticides are harmful, but there are safety regulations on how much pesticide residue is allowed in harvested and sold crops. The objective of this study is to prove that an important thing to remember is that pesticides often kill biodiversity, non-target vegetation, and non-target pests, causing even the 'good' critters to die.

This project was conducted by using Brix %, the use of light to determine the ratio between sugar and nutrients. The project compared the differences between conventionally grown plants, plants are grown with chemical pesticides, and plants are grown in an area where there are no pesticides or spray used to grow plants. In addition to this, organically grown plants were tested to see if natural pesticides, pesticides produced by plants, are healthier for the environment compared to chemical pesticides.

In this experiment, the conventional plants had lower Brix %s than the pesticide-free plants and the organic plants. The organic plants that were tested had a better Brix % than the conventionally grown plants but were not as nutritious as pesticide-free plants. The pesticide-free plants, grown at the Giving Garden, had the highest Brix %.

The data collected by this experiment revealed that pesticide-free plants and organic plants are healthier than conventionally grown plants.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS EV 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	Fair Category	Project Number
208	LS	3033

Title: Study of the Anti-Cancer and Anti-Mitotic Activities of Acetylcorynoline Purified from Corydalis longicalcarata Rhizomes

Student Name(s): Y. Wang

Abstract:

My research was based on acetylcorynoline, which was extracted from Corydalis, and I focused on exploring the mechanism of inducing cell death using acetylcorynoline. My experiments included immunofluorescent staining on spindles and kinetochores and performing Time Lapse. Conducted double-staining using Antibody H3ser10P to identify cells in early mitosis and ß-tubulin to locate spindles and spindles poles, the treated cells showed abnormal arraignment of spindles and microtubules in both 6 and 24 hours after treatment with acetylcorynoline. On the second immunofluorescent staining using Antibody CREST for the localization of kinetochores, treated cells had a normal distribution of kinetochores in a low concentration of acetylcorynoline. However, scattered localization of kinetochores was shown when the cells were treated with a higher concentration of the drug. In both experiments, polyploidies were induced in 48 hours after treatment, which is the result of arresting mitosis. The result of Time Lapse showed that the prophase in cells after treatment was significantly longer than the control group cells. It also showed the failure of cytokinesis. From these experiments, acetylcorynoline showed the ability to arrest mitosis and causing cytokinesis failure, which is responsible for the induction of polyploidy. These features from acetylcorynoline may contribute to the anti-cancer activity, which has never reported before.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) CB BI 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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
203	LS	3035

Title: Molecular imaging of tumor metabolism with Positron Emission Tomography (PET) using 18F labeled glucose and Magnetic Resonance Imaging (MRI)

Student Name(s): J. Shatalov

Abstract:

The purpose of this experiment was to show that Positron Emission Tomography (PET) has the potential to more accurately evaluate tumor recurrence after surgery and radiation treatment. MRI provides important anatomical analysis of the brain tumor location and soft tissue characteristics, whereas PET utilizes quantitative data of cell metabolism. In my project, I analyzed MRI scans from patients before and after radiation therapy to the region of resected tumor. Imaging analysis was performed on different MRI sequences and compared imaging characteristics of tumor to normal brain. Metabolic comparisons were made using FDG PET with tumor uptake of radiolabeled glucose measured as SUV values and compared to normal brain parenchyma. The result of our study was that analysis of metabolism within the tumor resection bed provides critical information on location of tumor recurrence after radiation therapy, while standard MRI was not able to distinguish posttreatment changes from tumor recurrence. Using FDG PET, we were able to accurately predict tumor recurrence, while MRI provided us anatomic map of where to look for recurrent cancer. In conclusion, the use of PET and MRI in combination allows for increased accuracy in predicting tumor recurrence after surgery and radiation therapy by combining information from anatomical and quantitative sequences.

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

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
242	LS	3036

Title: The Effects of Blue Light on the Eye Structure and Cognitive Function of Drosophila Melanogaster

Student Name(s): A. Ewing

Abstract:

The average human spends approximately four to 11 hours viewing electronic screens daily which may have severe impacts on the human body and getting more attention. This research observed the impact of blue light on cognitive functioning and eyesight of Drosophila melanogaster, an applicable model to humans. It was hypothesized that blue light would slow cognitive function and lead to eye degradation in fruit flies. Group 1 fruit flies were exposed to 24 hours of full brightness blue light while group 2 flies were exposed to the same amount and time of red light from an iPad. Group 3 flies experienced the same conditions as group 1, but AREDS 2 vitamin, an antibody known to help prevent eye degradation, was added to the food. Group 1 flies suffered the most as flight patterns were more erratic with shorter flight durations than control flies not exposed to light, and were stationary and rested near the iPad screen by the end of the 24 hour period. Group 2 flies had flight patterns and durations relatively similar to the control. Group 3 flies had less erratic flight patterns, but demonstrated more mobility than group 1. Dissections of the brain and eyes of the flies may elucidate the extent of damage under the microscope. The results indicate that blue light is negatively impacting the vision and cognitive functioning of fruit flies, but reduced under the influence of AREDS 2 which could have similar effects on humans.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) ME BE 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	Fair Category	Project Number
154	LS	3037

Title: Inorganic vs Organic Fertilizer on Ocimum Growth

Student Name(s): E. Fielding

Abstract:

The main purpose of this project was to determine whether using organic or inorganic fertilizer to grow sweet basil (Ocimum) affected overall plant growth. Predicted findings were inorganic fertilizer having a greater positive impact on plant growth because of the amount of time given which seemed more practical for inorganic fertilizer to increase the growth (Gliptis, 2018). The findings for plant height showed that inorganic fertilizer had the biggest positive impact. Plant biomass was the greatest when basil was grown with organic fertilizer. With the findings, it was determined that inorganic fertilizer had a stronger impact on plant height, and organic fertilizer had a stronger root system with a heavy bottom biomass yield. On that note, it is inconclusive on which fertilizer had the biggest overall positive effect on Ocimum growth. The impact this project has on society might seem small, but it can lead to more natural fertilizers being made to decrease nitrification.

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	Fair Category	Project Number
210	LS	3038

Title: Effect of Hair Derived Fertilizer on Plant Growth

Student Name(s): B. Kelly

Abstract:

Effect of Hair Derived Fertilizer on Plant Growth

Hair waste facilities in urban centers around the globe fail to either properly secure the byproducts of hair decay, or to account for the environmental impacts of burning hair. A way to utilize hair waste is critical in reducing carbon footprints, and in restoring much needed nutrients into soil. This experiment tests the utility of hair as a component in fertilizer, as well as compares it to other environmentally friendly fertilizers. The expectation is that using hair will result in greater results in comparison to strictly top soil, however whether it can compete with Bat Guano has yet to be seen. Human hair was decomposed via varying concentrations of hydrogen peroxide, and planted into the soil along with their respective seeds. The experiment was conducted in an indoor science classroom, where timed full spectrum lighting was available for all plants for 12 hour periods. The plants used were Cherry Belle radishes planted in pairs of three in planting pots, and each pot was watered with 50ml of water every 24 hours. While data collection is not yet complete, preliminary testing suggests that scenarios where hair was used performed better than topsoil, and with increased degrees of degraded hair came increased plant growth.

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

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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
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☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
202	LS	3039

Title: Characterization of a Thermo-Responsive Crosslinker for Controlling Micelle Degradation

Student Name(s): N. Bassett

Abstract:

Currently, nanoparticles are being utilized for drug delivery due to their targeted and controlled release. Recently, Dr. Jessica Rouge and her team have used nanoparticles for drug encapsulation. These nanocapsules were used for targeted drug release, using a crosslinker that allowed for drug release in the presence of specific enzymes. For the purpose of this study, a thermoresponsive crosslinker was made in order to provide external control to the nanocapsule. The thermoresponsive crosslinker used in this study was synthesized and characterized to discover its thermoresponsive properties. This crosslinker is able to degrade at temperatures above 60 degrees Celsius. To prove the nanocapsule exists, a Transmission Electron Microscope (TEM) was used to image a sample for the nanoparticles presence. A Dynamic Light Scattering (DLS) machine was also used to conduct a particle size analysis test. To further investigate the properties of the thermoresponsive crosslinker, fluorescence spectroscopy was conducted to discover the optimal temperature at which the crosslinker degrades. These tests concluded that the crosslinker is able to degrade and break down the nanocapsule under certain temperatures, proving that it can be used for externally controlled drug release applications. The study conducted provided promising results and the synthesis of the thermoresponsive crosslinker was successful.

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

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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	Fair Category	Project Number
243	LS	3040

Title: Using DNA Barcoding and Invertebrate Primers to Detect Shellfish Contamination

Student Name(s): J. Washington

Abstract:

The study of finding traces of shellfish in foods or supplements that should not contain them is significant, especially for those who have shellfish allergies. When producers of products do not include information about the possible allergens, the product can become dangerous. It is hypothesized that there may be more shellfish findings in these products than what is being presented to the public. This study uses DNA barcoding and invertebrate primers to test for trace amounts of shellfish in products that should not contain them. DNA will be extracted, amplified, and sequenced from glucosamine, devil's claw, and fish oil supplements, as well as fish stock. Glucosamine is being tested because the supplement is extracted from shellfish. For the fish stock and other products that do not have shellfish on the label, invertebrate primers were used to detect the shellfish contamination. A shellfish sample was used as a positive control. Results from Trial 1 showed that in the Devil's Claw supplements the primary ingredient was rice, rather than the devil's claw plant itself. The glucosamine and fish oil supplements were not able to be amplified, indicating that there is no shellfish contamination. It is predicted that there will be shellfish in the fish stock that may contain shellfish, as well as the product which does not mention the risk of shellfish. The results for these samples are pending. It is intended that this study will create a safer environment for consumers with shellfish allergies.

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

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
259	LS	3041

Title: Subtypes of Renal Cell Carcinoma Can Be Accurately Classified Using Convolutional Neural Networks

Student Name(s): R. Heaton

Abstract:

Renal cell carcinoma (RCC) is a very common type of cancer found in mostly older individuals; over 14,500 deaths per year occur from the disease. Accurate subtyping of the disease is incredibly important for the prognosis and treatment of the patient; thus, it is imperative to be able to classify immunohistochemical staining images as accurately and quickly as possible. Through the use of machine learning, we created a method of image classification that materially mitigates human error and inconsistencies in diagnoses due to physician opinions. In this study, a convolutional neural network using a ResNet18 model was trained first on a set of three RCC subtypes (CC, CCP, ONC), and eventually on a set of seven subtypes (CHR-C, CHR-E, PAP-T1, URCC-LGE), of immunohistochemical staining images gathered from kidney cancer patients. These images were split into n number of random crops, then loaded into the network, where different parameters and methods of data augmentation were tested in order to minimize loss and maximize accuracy. The network with three subtypes was able to reach an image-wise, cross-validated accuracy of 97.10%, whereas the network with seven subtypes was able to reach an image-wise, cross-validated accuracy of 80.74%. With further optimization, these networks could be used at the clinical level to produce more accurate cancer diagnoses than human pathologists could offer, mitigating the need for "second opinions." Moreover, these networks could also be used in low/middle income countries in dire need of advanced health care, but where the availability of qualified pathologists is limited.

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):

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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	Fair Category	Project Number
220	LS	3042

Title: Alternative Natural Water Purifier

Student Name(s): E. Kadambaya

Abstract:

The purpose of this experiment is to determine which type of Activated Charcoal is the best at filtering contaminated water. The initial thought of the experiment (which is proven wrong) is if the Alternative materials (the Acticatived Coconut and Bamboo Charcoal) are used to filter unclean water, then the Alternative materials will filter the unclean water more efficiently because Activated Coconut and Bamboo Charcoal are cleaner sources of Activated Charcoal than Activated Coal Charcoal. After the variables are tested using homemade water filters and a drinking water tester, every Activated Charcoal substance produces similar results. Not only does the Activated Coconut and Bamboo Charcoal do as well as the Activated Coal Charcoal Substance, but Activated Coal Charcoal does better in filtering the Nitrites out of the contaminated water. Due to these results, the hypothesis is not supported. On the other hand, the experiment shows that Activated Carbon did not affect nor filter the Hardness, Lead, or the Pesticides of the contaminated water. Instead, Activated Carbon did affect and filter the Chlorine and Alkaline levels in the experiment. The experiment results can be used around the world because the different types of Activated Charcoal had similar results. This means that all types of Activated Charcoal can be used to filter contaminants in water such as Chlorine, Lead, Pesticides, and Alkaline levels.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EA ME 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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
210	LS	3043

Title: Single-Cell Transcriptomic Interrogation of Genetic Interactions through CRISPR-Cpf1.

Student Name(s): S. Ford

Abstract:

Genetic screens are revolutionary in their ability to analyze the comprehensive transcriptome of a cell; however, traditional screens are limited to relatively simple read-outs. CRISPR-driven transcriptomics and CRISPR screens are effective and economical methods for analyzing complex cell populations and systems, and provide for more diverse and thorough read-outs. Current methods of CRISPR screening coupled with transcriptomic profiling, such as Perturb-seq, MOSAIC-seq, CRISP-seq, and CROP-seq, are restricted to targeting only one gene for perturbation or are subject to issues involving lentiviral reproduction. Their use of a genetic "barcode" to associate guide RNAs with the construct causes mispairing and loss of viable constructs during lentiviral reproduction. To improve sensitivity and allow for multiple perturbations, we designed a construct without a "barcode" that utilizes the CRISPR-associated protein Cpf1, rather than traditional Cas9, because Cpf1 allows for multiple perturbations with the use of a single promoter, creating a less complicated and more viable construct. Our construct, termed RC128, successfully cut two genetic targets in the genes Nf2 and Cd43, and underwent reverse-transcriptase PCR, a transcriptomic profiling technique. Our high-throughput method of analyzing complex transcriptomes may help identify innumerable gene signatures, targets, processes, and interactions associated with individual or multiple perturbations in future research.

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	LS	3044

Title: Production of Biodegradable, Sustainable Plastic from Food Waste through the Polymerization of Lactic Acid

Student Name(s): A. Piraneque

Abstract:

A recent influx in the production of synthetic plastic polymers has resulted in increased amounts of plastic waste which has led to a plastic pollution crisis. Part of this problem's solution is finding a feasible plastic replacement or alternative. This replacement could be Polylactic Acid, a bio-plastic that decomposes quickly in specific conditions and can be obtained from food waste, which also addresses the issue that food waste is estimated by the FDA to be between 30-40% of The United State's food supply. This project began with two bowls of food waste, one mixed with Lactobacillus Acidophilus bacteria from a probiotic and the other mixed with FAGE 2% Greek Yogurt which contained a variety of live bacteria. These mixtures underwent Lactic Acid Fermentation, then the liquid contents were separated from the solid contents. Lactic Acid in this liquid content was separated from unwanted substances in the liquid using Ethyl Acetate. The Lactic Acid and Ethyl Acetate mixture was purified with Activated Charcoal and Anhydrous Sodium Sulfate. Afterwards, the purified mixture was distilled to obtain Lactic Acid alone. To determine the quality of the distilled Lactic Acid, the pH levels were compared to the pH level of 88% pure Lactic Acid. Once this process was demonstrated, the 88% pure Lactic Acid was combined with Sulfuric Acid and Anhydrous Calcium Chloride and boiled overnight to polymerize the Lactic Acid. This resulted in a low molecular weight polymer. This completed the process of demonstrating the possibility of producing plastic from food waste.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
207	LS	3045

Title: Determining the Efficacy of a Dexamethasone and Polyacrylate Hydrogel for Polypropylene Mesh to Prevent Post Surgical Abdominal Adhesion

Student Name(s): J. Macdonald

Abstract:

After surgery, scar tissue may connect parts of organs, causing severe abdominal pain, bowel blockage, or even organ strangulation. Current treatment for this problem is limited to invasive surgery. This creates many negative impacts to a patient's long term recovery. Presently, doctors use polypropylene hernia meshes to reduce strain and pressure on damaged tissue after surgery. An enhancement to this mesh is proposed to include anti-adhesive properties. This significantly decreases the potential for post-surgical adhesion. The glucocorticoid, Dexamethasone, has previously been proven to have anti-adhesive properties in the body. In this experiment, multiple Dexamethasone solutions are developed using methanol, and cross-linked hydrophilic polyacrylate copolymer beads are soaked in them. After soaking for up to 48 hours the beads are placed in distilled water. The elution rates of the Dexamethasone are evaluated through samples of the water taken over time and analyzed using UV spectroscopy for the presence of Dexamethasone. If the Dexamethasone proves effective at infusing into the polyacrylate beads, as expected, a hydrogel coated polypropylene hernia mesh could be used in order to exhibit anti-adhesive properties in the body. This would eliminate much stress for patients as they will have a reduced risk of developing an adhesion after having abdominal surgery.

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
240	LS	3047

Title: Studies on the effects and trends on the molecular breakdown of the components of the ozone layer caused by CFCs and other harmful substances

Student Name(s): M. Cheela

Abstract:

Ozone depleting substances are molecules or substances that have been introduced into the environment my man. Although some of the effects are known, ozone depleting substances cause fluctuation in concentration, making it difficult to predict trends. The purpose of this research is to analyze the trends in ozone concentration over the last few decades and to determine which ozone depleting substances are most harmful. Through this research, scientists can formulate plans to help control ozone depletion in the future. To arrive at the results, I used a list of overarching questions to guide my research. Once I compiled my research, I made sure to cross reference with other sources to ensure my results are valid. If there were any discrepancies, I redid that section of the research. Through my research I determined that the most harmful ozone depleting substance is CFC molecules. However, the consumption of CFC molecules has steadily declined over the past few decades. Recently, there has been a slight increase in ozone concentration. If these trends continue, then a large increase in ozone concentration should be observed. Additionally, by cross referencing low levels of ozone concentrations with high peaks of ozone depleting substances, I was able to determine which ozone depleting substance was most destructive. It was found that the class of ozone depleting molecules that were most destructive were CFC molecules. When high levels of CFCs were in the atmosphere, there were low levels of ozone.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EV BI 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	Fair Category	Project Number
252	LS	3048

Title: Breathe Right With Plant Insight

Student Name(s): J. Ciambriello

Abstract:

Indoor air pollution is typically greater than outdoor pollution, and sometimes, even more harmful. Immediate effects include irritation of the eyes, headaches, dizziness, and fatigue. However, some more intensively abiding symptoms include some respiratory diseases, heart disease, and cancer. The intention of this experiment was to identify the effects that a spider plant had on various indoor air pollutants. It was hypothesized that if butanol gas was isolated in a glass jar, then it would produce the highest temperature when compared to ammonia, CO_2, and normal air quality, because of its origin from biomass and fossil fuels. Throughout these tests, the purification of air was determined using various common indoor air pollutants: candle smog, Windex, human-produced carbon dioxide, and normal air. This was measured by the temperature of the jars before and after being heated (for thirty minutes) on a man-made surface for two hours at twenty minute intervals. These plants remove gases by absorbing them in their leaves and roots. The change in temperature was largest with the candle, and thus the most purification occurred. By completing this experiment successfully, there are many environmental applications that can be used by scientists and researchers. It is conveyed whether or not spider plants are effective in purifying the air, and it also shows which indoor air pollutant is least affected by the presence of such plant. Together, as a community and society, people will better the environmental health of their homes by removing volatile organic compounds, one leaf at a time.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): EM EV 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	Fair Category	Project Number
246	LS	3049

Title: Looking Downstream: Could Nano-Silver in Consumer Products Affect Pond Life.

Student Name(s): K. Gadhachanda

Abstract:

Many consumer products that are essential to our every day life such as sunscreen, sportswear, and even toothpaste can contain tiny silver particles. These nano-silver particles are a billionth of a meter in size, and are toxic to various different types of bacteria and fungi. Because of the antimicrobial properties that these nano-silver particles have, they are in many consumer products. When these products are washed off and get emptied into a freshwater system, they have an effect on the ecosystem, and the freshwater organisms. This experiment investigated how a specific freshwater organism, the Daphnia Magna, responded to different levels of nano-silver exposure. The Daphnia Magna were exposed to four different concentrations of nano-silver in pond water, each concentration's trial was repeated three times for added accuracy. The Daphnia Magna were then observed over eight hours in their simulated "habitats" and every two hours, the number of Daphnia Magna that were alive and deceased was recorded. There was a clear decrease in the number of Daphnia Magna that were living and more were deceased in the "habitat" with the highest concentration of nano-silver particles. This concludes that freshwater runoff that contains nano-silver concentration is deadly to not only the environment, but the organisms that exist within the freshwater habitat. Developers of consumer products that use silver properties for its antimicrobial properties are damaging the environment and have to regulate the amount of silver that they are using in their products.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EV 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	Fair Category	Project Number
257	LS	3050

Title: Early Diagnosis of Pancreatic Cancer via Urinary Biomarkers with a New, Rapid, and Simple Lateral Flow Assay

Student Name(s): A. Galic

Abstract:

Less than 20% of patients' Pancreatic Cancer (PC) is discovered before spreading to other organs, making it nearly impossible to surgically remove, and attributing to a 7% five-year survival rate. Surgery can increase a patient's survival by ten-fold; however, without an available early detection method, the cancer is rarely diagnosed in time to remove it. This research sought to devise a rapid, one-step, and inexpensive PC lateral flow assay, to be performed during routine exams, based on a current study first highlighting the presence of three protein biomarkers, LYVE-1, TFF1, and REG1A, at high concentrations in the urine of PC patients. Presence of these proteins diagnoses patients with PC at over 90% accuracy. To detect these proteins, a three-channel configuration was designed, testing for each protein separately. Following a sandwich assay format, the protein is conjugated to both a reporter (Au-nanoparticles bound to antibodies), and an immobilized test line (antibodies held in place with bovine solution). For a positive result, the protein binds to both the reporter and the immobilized test line showing a highly concentrated, colored line. If the urine protein is absent, the colored reporters don't accumulate on the test line, showing a negative result. This assay card, made from nitrocellulose and filter paper, at $20/test, requires the application of 200µl of urine on the sample pad, where it flows simultaneously outward to all channels. Three colored test lines are formed within 2 minutes, without intervention, confirming the presence of PC proteins, and therefore a positive PC diagnosis.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EN 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	Fair Category	Project Number
211	LS	3051

Title: The Use of Trehalose as an Additive to the Antimicrobial Tetracycline to Increase Thermal Stability and Longevity

Student Name(s): M. Brander, . Brander

Abstract:

Throughout history, bacterial infections have been a frequent cause of premature death. In the modern age, although there are antibiotics that can effectively treat infections, many of these medications break down in heat. It's incredibly difficult and energetically expensive to keep antibiotics cool during transport, leading to little access. This lack of access has been known to contribute to millions of deaths worldwide. The sugar trehalose is commonly used in the food industry as a preservative. It is also found in many animal and fungi cells, where it protects them from dehydration and degradation. It is proposed that the addition of trehalose to the antibiotic will help preserve it over time and at higher temperatures. Research and experimentation is currently ongoing. Solutions containing 10mg/mL of tetracycline are exposed to a range of temperatures. Solutions containing the same concentration of tetracycline as well as 0.5M trehalose are exposed to the same range of temperatures. Both sets of samples are then analyzed using a spectrophotometer in order to determine the stability of the tetracycline. This research provides the basis to permit sub-optimal storage and transportation techniques while maintaining a usable concentration of tetracycline. In the future, further research should be conducted on the interactions between other classes of antibiotics and trehalose.

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
245	LS	3052

Title: Designing and Testing an In vitro 3D Model System for Preclinical Applications

Student Name(s): S. Viswanathan

Abstract:

For many decades, cell culture-based assays have been the standard platform for cancer drug discovery. Two-dimensional assays are not very predictive and testing drugs in animal models has remained the most reliable way to predict cancer drug efficacy. This project aimed to create a novel in vitro 3D system that allows cells or tissue fragments to grow like a tumor in an animal and can be utilized for cancer drug testing. The system consists of 1) cancer cells or tumor fragments engineered with luciferase, an enzyme that oxidizes its substrate D-luciferin to produce light 2) an optimized matrix with growth media and 3) highly sensitive imaging equipment. The system is able to retain cell aggregates and tumor fragments in a viable state for several weeks. Importantly, the tumor microenvironment which consists of infiltrating immune cells is preserved intact for at least 4 weeks after embedding into the matrix. This allows testing of modern immune targeting drugs that work by activating the immune system. Studies to show proof of concept were successful when testing cytotoxic agents and an anti-cancer immunology drug widely used in the clinic. Treatment with the immune-activating therapeutic antibody, anti CTLA-4 resulted in responses in 4/4 tumors fragments treated. Complete elimination of the tumor cells as evidenced by the loss of signal (light production) occurred in 2 of the tumor fragments. This platform is very sensitive and able to predict responses to drugs similar to animal models.

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):

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
249	LS	3053

Title: Testing For the Presence of Antibiotics in Poultry Products

Student Name(s): G. Coale

Abstract:

Antibiotics have been used in the past for every phase of the chicken-raising process, however, many poultry products today are labeled antibiotic free. The purpose of this study is to determine if those products are indeed antibiotic free. This is significant because antibiotics in poultry can lead to drug resistance in humans. It is hypothesized that at least 40 percent of poultry will contain antibiotics, even if labeled antibiotic free. To test for the presence of antibiotics in poultry, the PremiTest was used in several trials of popular supermarket brands of poultry. A positive control, the antibiotic penicillin, and a negative control, poultry known not to contain antibiotics, were used. The independent variable is the type of poultry product tested, and the dependent variable is the presence of antibiotics. Thus far, there has been some mislabeling detected, meaning antibiotics were found in products that were labeled antibiotic free. Antibiotics were also found in products that did not indicate whether the product contained antibiotics. Overall, 50 percent of the 22 samples tested thus far contained antibiotics, thereby supporting the hypothesis. This study will help raise awareness and educate consumers when buying different poultry products. There were, in fact, antibiotics present in poultry products that do not have antibiotic information on the label or that are labeled antibiotic free, demonstrating that the consumer needs to be aware of this issue. An avenue of research that could be explored next is how the products that are labeled antibiotic free are contaminated.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) ME EV 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	Fair Category	Project Number
259	LS	3054

Title: Efficiency of Natural Anti-depressants in comparison to Prescribed SSRIs on Drosophila Melanogaster

Student Name(s): M. Goldsmith

Abstract:

Medication for depressive-like disorders, including SSRIs, have been known to cause major controversial symptoms including suicidal thoughts and personality changes. Researchers have looked for alternative forms of medications or supplements to help boost an individual's emotional health instead of altering brain chemistry. One of these medications includes 5-hydroxytryptophan, a precursor to serotonin, which performs the same job on a lesser scale. In order to test the efficacy of the drug, research will be conducted to identify any positive responses to 5-HTP by drosophila melanogaster. The flies will be exposed to CUMS (Chronic Unpredictable Mild Stress-induced Inhibitors) such as starvation or sleep deprivation. The experimental groups, defined by the concentration of 5-HTP they received, encountered stress for 5 consecutive days with exposure to heat for four hours and cold for 30 minutes. This allowed for the behavioral changes to be more obvious. These behavioral changes were observed in the aggression assay, feeder test, open-field-arena test, and forced swim test. Though the results are not all the way complete, it is safe to assume that group 2, with 0.1% 5-HTP solution exposure had the least depressive-like behavior. This behavior entailed the most movement in the open field arena test and the greatest amount of strides in the forced swim test. Group 2 exhibited the most promising results by responding to stress inhibitors in the best way possible. In conclusion, 5-HTP, based on the results, helps with depressive-like triggers when given in small amounts and is a promising choice over SSRIs.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) ME BE 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	Fair Category	Project Number
254	LS	3055

Title: Enzyme Triggered Degradation Studies of a Nucleus Targeting Nucleic Acid Nanocapsule

Student Name(s): A. Aggarwal

Abstract:

In this study, a nucleus targeted nucleic acid nanocapsule (NAN) was designed to create a less toxic and more targeted delivery method for therapeutic splice switching antisense oligonucleotides (SSOs) needed to treat genetic diseases. Spinal muscular atrophy, the leading genetic cause of infant mortality, and atypical cystic fibrosis, affecting ⅓ of the US, are just some of the diseases caused by malfunctions in pre-mRNA splicing. SSOs are a promising treatment to correct pre-mRNA splicing, but while effective, current delivery methods require chemical modifications and are not targeted, resulting in large, toxic doses. A significantly less toxic and more cellular targeted method of delivering SSOs includes using self-transfecting NANs; however, there is no method for the NANs to target the nucleus. This study aimed to design NANs with a nuclear localization signal (NLS) embedded into an enzyme responsive substrate to target the nucleus. Using an NLS in the crosslinker allows the NANs to reach the nucleus using the nuclear import pathway. The crosslinker is designed with an NLS peptide on either end of a cathepsin B substrate to maximize the NANs that reach the nucleus. The NANs were successfully synthesized with the crosslinker and characterized for charge and size using dynamic light scattering, zeta potential, transmission electron microscopy, and gel electrophoresis. Furthermore, in vitro toxicity tests prove the NANs are non-toxic in 80μM concentration. Future studies include testing the NANs' nucleus targeting ability using confocal microscopy. If successful, this NAN will be a fundamental step towards treating patients with genetic diseases.

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

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	Fair Category	Project Number
244	LS	3056

Title: Bioremediation using Fungi

Student Name(s): A. Sharma

Abstract:

150 million metric tons of plastic polluted the oceans in 2019 alone and every year, an additional 8 million metric tons of plastics enter the oceans. Plastic pollution is one of the world's greatest problems and poses a danger to plants, wildlife, and even the human population. The answer may lie in nature itself; multiple strains of plastic-eating bacteria and fungi have been discovered in response to the rampant pollution. Waste plastics can be degradable through physicochemical processes such as photolysis and chemical hydrolysis because they are derived from petroleum. Therefore, the plastics can be digested by enzymes produced by algae, bacteria or fungi. The microorganisms release byproducts of carbon dioxide, methane, water, biomass, humus, and other substances. The objective of this study was to test the ability to degrade plastics of three types of fungus: Pleurotus ostreatus, Pestalotiopsis Microspora, and Schizophyllum commune. Under sterile conditions, the fungi were exposed to squares of plastic polyurethane and changes to the mass of the plastics were recorded. Additionally, the plastic polyurethane squares were exposed to UV light to cause breakage in the polymer chains in the plastic, allowing for easier degradation by microorganisms. In each of the trials, the results demonstrated a significant average decrease in mass after the fungi were introduced. It is likely that with more time, more change could be observed. The data suggest that future applications of fungi and other bio-organisms can be used to safely dispose of plastic pollution.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS EM 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
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	Fair Category	Project Number
257	LS	3057

Title: Antimicrobial Peptides and Antibiotics Produce Bactericidal and Bacteriostatic Effects on Wild-Type E. coli

Student Name(s): J. Winterlich

Abstract:

In 2016, there were approximately 10.4 million global cases of tuberculosis, with 600,000 cases resistant to rifampicin, one of the most powerful first-line drugs in use. Bacteria are becoming increasingly resistant to widely-used multidrug treatments; thus, the need for new antibacterial treatments is imperative for treating bacterial infections effectively. One promising solution to this problem is utilizing antimicrobial peptides (AMPs), which are part of the innate immune response to bacterial infection. However, little is known regarding the method of bacterial elimination employed by the human cathelicidin LL-37, the murine cathelicidin mCRAMP, or the synergism between AMPs and antibiotics. Because AMPs have a key role in the immune system response to infection, we investigated their efficacy against E. coli and potential synergism with three prevalent antibiotics. We sought to identify the minimum inhibitory concentration (MIC) at which LL-37, mCRAMP, and the antibiotics gentamicin, ciprofloxacin, and ampicillin each kill bacteria. We then combined LL-37 with several concentrations of each antibiotic to determine whether synergistic benefits were produced. LL-37 displayed a lower MIC than mCRAMP and each antibiotic, and we demonstrated that LL-37 permeabilizes bacterial membranes. Lastly, we found that there was little synergism between LL-37 and the antibiotics. Collectively, these data reveal that LL-37 is more toxic than mCRAMP and each antibiotic, but LL-37 produces little synergism with those antibiotics. With further investigation into peptide and antibiotic synergistic benefits, the likelihood of identifying a treatment for tuberculosis will increase and ideally reduce the number of fatalities caused by infection.

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	Fair Category	Project Number
254	LS	3058

Title: Bacillus cereus Endospores as Genome Carriers and Protective Storage Cells

Student Name(s): K. Murray

Abstract:

This experiment was performed to determine the influence of temperature and time on the preservation of genetic material in B. cereus endospores as storage of bacteriophage genomes directly relates to treatment effectiveness. Temperate based RNA degradation is the largest obstacle in treatment quality. Placing bacteriophages in controlled biological environments is one solution to improve preservation. When exposed to inhospitable environments, gram-positive bacterial cells form endospores. In an endospore, bacteria remain dormant in a protective proteinaceous layer until habitable conditions return. To test the resilience of B. cereus, a strain was suspended in Tryptic soy broth and exposed to high temperatures. Spore formation was induced through continued suspension and starvation spanning one week. Trials were formed for extended storage at 0 (control), 3, and 5 more days of storage. The suspensions of 3 and 5 days were heated to 80ºC-90ºC for 1 hour to degrade genetic material. The cells were then germinated, returned to regular processes and quantified through a direct microscopic count. Growth was compared with a comparison of plate conditions following 24 hours. When compared to the control, trials had bacterial quantities with 10-15% fewer cells. Growth of the trial suspensions on Tryptic Soy Agar exhibited little growth. The results of this experiment show little promise for utilizing B. cereus endospores for storage due to lower viability post-heating, highlighting issues in employing the species as storage cells for genetic material. Further investigation of gram-positive bacteria, like B. subtilis, is needed to determine the best spore-forming species to utilize.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) MI BI 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	Fair Category	Project Number
186	LS	3059

Title: Ensemble Methods for Population Classification Using Clark Consistency Graphs

Student Name(s): D. Kalangi, D. Aguiar

Abstract:

Geographic subdivisions, non-random mating, and other evolutionary processes produce distinct patterns in DNA variant structure that confounds associations between genetic variants and observable traits in genome-wide association studies. Typically, global methods to capture and correct for population structure, e.g. principal component analysis (PCA), may not effectively capture recent or cryptic population structure, which are defined on localized regions. In this work we develop algorithms that compute local population structure, such that local corrections can be made to reduce false-positive associations. Specifically, we develop an ensemble-based learning model for population classification using a graph representation of the differences between sample haplotypes. We construct multiple graphs on small windows of variants in training samples to create weak classifiers and then insert the haplotypes of test samples to compute local population classifications. The most common population assignment from all the classifiers becomes the global population classification of the test sample. We investigate the properties of our population classification model using genetic sequences from the 1000 Genomes Project and find that our method is both accurate at the global level and captures more local population structure.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) MA 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	Fair Category	Project Number
252	LS	3061

Title: Assessing the Risk of Tick-Borne Disease in New London County, CT and Fishers Island, NY

Student Name(s): E. Lerner

Abstract:

Lyme Disease infects about 329,000 people each year and has caused long-term symptoms in an estimated 1.9 million people. It is difficult to diagnose because at least 25% of patients don't develop its most distinctive symptom, the bullseye rash, and diagnostic tests frequently return false negatives. This experiment studied the local risk of Lyme Disease, and other tick-borne illnesses, by determining the rate at which ticks in New London County, CT and Fishers Island, NY carry diseases.

In the experiment, a one square meter piece of white flannel was dragged through tick habitats and checked regularly for ticks. Numerous safety precautions were taken including wearing a Tyvek 400 TY122S suit and thoroughly checking the body for ticks after exposure. Collected ticks were sent to the Nieto Lab for testing.

32% of the ticks collected on Fishers Island and 38% of the ticks collected in New London County carried Lyme Disease. This experiment, the first of its kind on the island, demonstrated that despite geographic separation, the prevalence on-island is very similar to neighboring counties. The data also supports the Connecticut government's most recent data; therefore, supporting that New London County has a high and increasing rate of tick infection. All collected ticks were deer ticks. The data also suggests that ticks are more active in the morning; this could be an area of expansion.

This experiment makes clear that the risk of contracting Lyme Disease is high in this region and public awareness is crucial to combatting its spread.

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

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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	Fair Category	Project Number
147	LS	3062

Title: A Drop of Light

Student Name(s): K. Joseph

Abstract:

The purpose of this experiment is to discern whether a bracelet can be made to notify when someone should reapply sunscreen using UV beads. The main objective of this experiment was to create a bracelet using UV beads that would change color once it was time to reapply sunscreen. If I create a bracelet using these UV beads, then I will be able to tell when to reapply sunscreen because the UV beads will help to show when UV beads are penetrating the sunscreen. I will be separating the beads into 4 groups and putting mixtures of different natural sunscreens to see if the goal will be achieved using them, then I will be crafting a bracelet out of the beads. Method 2 for the SPF 15 bracelet lasted the longest before the beads turned color. My hypothesis was not proven with the results of this experiment.

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):

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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	Fair Category	Project Number
240	LS	3063

Title: Testing Natural and Synthetic Substances for Effective Oil Spill Cleanup

Student Name(s): Z. Kassapidis

Abstract:

The issue addressed in this study is oil spill remediation to reduce negative effects on marine life. As oil latches onto birds' feathers, it impairs the waterproof characteristics of the feathers, exposing birds' skin to extreme temperatures. The goal of this study was to discover a novel oil-absorbing substance to be used for effective oil-spill cleanup. It was hypothesized that sorbitol could be a successful option. This study began with measuring a 3:1 water to oil ratio for each sorbent. A variety of both natural and synthetic oil sorbents were tested. Each sorbent was soaked in individual water/oil mixtures for five minutes. The remaining mixture was separated using a separatory funnel and a new water/oil ratio was calculated to determine success. The higher the water to oil ratio, the better the oil-absorbing power of the sorbent. After testing numerous sorbents, it was found that the three most effective substances included the sorbitol (ratio 5.63:1), nylon (ratio 7.67:1), and sorbitol in nylon (ratio 8.96:1). Combining the two most effective substances together, preferably sorbitol and nylon, and manufacturing them into a boat sleeve that lines the underside of ships, may play a major role in oil-spill cleanup. Sorbitol forms clumps when absorbing oil which will be caught by the nylon sleeve that also absorbs oil. Not only will the sleeve collect excess oil, but it was determined to also repel water for more oil absorption availability.

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

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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	Fair Category	Project Number
114	LS	3064

Title: Determining the Optimal Age for Gonadectomy in Dogs

Student Name(s): R. McGrath

Abstract:

The purpose of this correlational study was to determine the optimal age to spay a female dog and neuter a male, with the least complications, in order to still effectively control populations. A population of 128 different dogs from Connecticut and New York were used. Data was collected through an anonymous questionnaire. The dog's gender, breed, and age at the time of gonadectomy were recorded in addition to the occurence of the following specified conditions: cancer, urinary incontinence, immune disorders, orthopedic disorders, and behavioral issues. Dogs were split into five different age groups at gonadectomy for comparison. A correlation was found between gonadectomy performed before three months and a higher occurrence of urinary incontinence.

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

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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	Fair Category	Project Number
254	LS	3065

Title: Treatment of Pancreatic Cancer using Feraheme ® nanoparticles

Student Name(s): W. Nomani

Abstract:

The five-year survival rate of pancreatic cancer (PC) is approximately 3%, making it an unmistakably fatal condition. Since most PC are diagnosed at metastatic stages, PC is a challenge to treat. Traditional chemotherapies are associated with many risk factors, such as adverse effects on healthy cells. Thus, nanotechnologies (size of less than 100 nm) present a promising way to deliver chemotherapeutic agents to mitigate issues with free chemotherapy, such as an increased chance of infection, easy bleeding or bruising, and shortness of breath. One current treatment of PC includes the combination therapy of Gemcitabine and Paclitaxel. In this study, we non-covalently loaded Gemcitabine and/or Paclitaxel onto iron-oxide nanoparticles (Feraheme®) for the treatment of PC cell lines and measured cancer cell viability compared to untreated cells. We found that cells treated with these free drugs (unloaded drugs) had low viability compared to the loaded drugs. However, Feraheme® nanoparticles loaded with both Gemcitabine and Paclitaxel showed significant toxicity compared to the individually loaded particles; thus, they showed promise as a cytotoxic combination. The second aspect of the project explored the possibility of Feraheme® acting as a reactive oxygen species (ROS) generator. Since active iron can generate ROS in cells leading to cell damage, Feraheme® should work similarly. However, we found that Feraheme® does not enter the cancer cells, and thus does not damage the cell by itself as of yet. Regardless, nanoparticle therapies are still more desired than traditional chemotherapies for fatal cancers because they can effectively target and kill cancer cells.

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	Fair Category	Project Number
257	LS	3066

Title: Creation of a Rapid, Non-Invasive Diagnosis for Specific Learning Disorders via Fixation Tracking in Gaze Interaction

Student Name(s): A. Nakanishi

Abstract:

Specific learning disorders such as dyslexia affect 15-20% of the population worldwide. However, with no universally effective method of diagnosis for these specific learning disorders, diagnosis can be a slow and unsure process. This research devised a pc-based diagnosis tool for those with reading disorders, including dyslexia, through fixation tracking in gaze interaction, using an eye tracker. Participating middle and high school students were asked to read three passages, while the tracker recorded their eye movements, and determined fixation numbers, durations, and progression of eye movements. The resulting data highlights measurable differences between typical and atypical readers. Dyslexic readers averaged 1.73 fixations/sec, while typical students averaged 2.17 fixations/second. Dyslexic readers exhibited an average fixation duration of 2.42sec, far more than typical readers (1.17sec). Tracking of fixation location was used to monitor the reader's eye movement, so that a best-fit regression and R^2 correlation could be determined for each line of text within the passage. Typical students' eye movement was linear across each line of text, with an R^2 correlation of >0.723. Eye movement of atypical readers, conversely, was irregular across the same text (R^2 of ~0.083). Fixation, duration, and linearity data were analyzed against each student's reported medical diagnosis, to derive selection criteria for atypical readers; fixations/sec 1.55 sec, and eye-movement R^2 correlation of <0.3. Blind prediction of each participant's medical diagnosis, using these selection criteria, yielded prediction accuracies of 91%, 94%, and 99.9%, respectively, highlighting the efficacy of this simple and rapid pc-based diagnostic tool.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) ME CS 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	Fair Category	Project Number
134	LS	3067

Title: Energy Production from Backyard Septic Systems

Student Name(s): A. Boudreau

Abstract:

Increasing population densities, as well as sea level rise in coastal areas is causing traditional septic systems to be overburdened and unable to dissipate pollutants. In addition to system backups, the results are high nitrogen content run-offs into water bodies causing explosive algae blooms and fish die-offs.

This experiment explores how we can increase the degradation of waste in septic systems so that less pollutants enter water ways. A fuel cell is introduced into the septic pathway and through the use of anaerobic bacteria, waste products are broken down at an accelerated rate while generating electricity in the process. Process efficiency can be optimized by changing bacterial concentrations as monitored through electrical generation. At full scale, this process can potentially increase waste degradation rates and act as a source of renewable energy.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) MI 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	Fair Category	Project Number
186	LS	3068

Title: Non-Syndromic Craniosynostosis in Triplets Associated with Development Delay

Student Name(s): M. Kim

Abstract:

This project was done in order to find the correlation between non-syndromic Craniosynostosis and developmental delay using the cases of non-syndromic craniosynostosis patients.

Craniosynostosis is a premature fusion of one or more of the cranial sutures, meaning that the baby's skull is closed before the full development of the brain. About 8% of the patients of craniosynostosis have familial or syndromic forms of synostosis, while the remainder occurs as a spontaneous isolated defect. The familial Craniosynostosis syndromes are typically transmitted by an autosomal dominant trait resulting in disruption of the fibroblast growth factor receptor pathway.

The cases studied in this project were 5 years old triplets with non-syndromic craniosynostosis.

The children have cortex atrophy as an outcome of the premature cranial bone fusion associated with language development, and learning and conduct problems. They were analyzed by MR(magnetic resonance), 3DCT (3D cranial tomography), EEG (electroencephalogram), 750K cnv microarray, and IQ test. The data suggests that the developmental delay correlates to craniosynostosis which is a consequence of cortex damage caused by cranial restriction from premature fusion of one or more of the cranial sutures.

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	Fair Category	Project Number
251	LS	3069

Title: Inter-Specific Competition Between Two Invasive Mosquito Species: Aedes aegypti and Aedes albopictus, over Multiple Generations

Student Name(s): J. Tajmajer

Abstract:

Zika, malaria, West Nile virus, dengue fever, yellow fever, and Chikungunya find their root at the various species of mosquito. Aedes aegypti and Aedes albopictus are two mosquito species primarily responsible for the spread of them. This project aimed to measure the changes in the frequency of Ae. aegypti and Ae. albopictus in response to their competition over various generations in the laboratory as well as to changes in temperature. Each generation and the number of Ae. aegypti and Ae. albopictus was recorded. Generation F0 began with equal frequencies of males and females. Every generation, adults were blood-fed and provided with an egg-laying substrate. Adult frequencies and sex were recorded and the subsequent generations were started from the collected eggs. Two generations were successfully bred before Ae. Albopictus was "extinct," and so a second round was conducted to verify the results. This second round bred two more generations, and the results mimicked those of the first round. These results were then found again regardless of temperature and in a "third stage" that controlled all variables. The experimental results awarded Ae. aegypti with a competitive advantage over Ae. albopictus in a laboratory setting, and point towards Ae. albopictus' extinction if Ae. aegypti were to migrate into Connecticut. This experiment enhances the knowledge of the competition between these two species and has enormous public health implications. This study also highlights the need for further research surrounding the interspecific competition of these important biological vectors and the impacts of their territorial disputes.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EV ME 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	Fair Category	Project Number
269	LS	3070

Title: Analyzing the Role of Sonic Hedgehog Signaling on Germinal B-cell Differentiation

Student Name(s): W. Zhang

Abstract:

The germinal center is a stem-cell like niche crucial to the creation and proliferation of white blood cells, including B-cells, that defend the body against unique and reoccurring pathogens. B-cells have the potential to differentiate into plasma B-cells, memory B-cells, and self-renewal B-cells, which each serve unique functions. However, the factors that regulate B-cell differentiation are unclear. This project aimed to analyze the role of Sonic Hedgehog (SHH) signaling pathway, a chemical process that results in a transcriptional change during protein production, on determining the fate of germinal center B-cells. It was hypothesized that SHH encourages B-cells to differentiate into a specific B-cell subset. To analyze this, lymph node tissue samples from twelve healthy mice were stained using the immunofluorescent staining procedure, and imaged under a widefield microscope. Reagents were marked for proteins and transcription factors that identify specific B-cell subsets and successful SHH signaling (determined by the presence of Gli-1), including Bc16, Ig, CD38, Gli-1. All B-cells within 50 m of germinal centers were analyzed for their protein expression, and the specific subset of B-cell and their SHH status were identified. Results demonstrate that while there was no predominant subset of B-cells correlating to B-cells that have undergone SHH, the majority of early plasma and memory cells express Gli-1. Additionally, findings from this project support and develop a model in which SHH is necessary to prepare cells to differentiate. Understanding B-cell differentiation helps scientists more accurately design vaccines and treatments to target specific cells acting in the immune response.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) CB 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	Fair Category	Project Number
194	LS	3071

Title: The Effect of the Electromagnetic Field on the Growth Rate of the Dracaena Trifasciata (Snake Plant)

Student Name(s): J. Liu

Abstract:

The experiment conducted evaluated how the electromagnetic field affects the growth rate of the Dracaena Trifasciata (Snake Plant) through a process called magnetotropism, which is the movement or plant growth in response to the stimulus provided by the magnetic field. Prior to the experiment, I hypothesized that the electromagnetic field would increase the growth rate of the Snake Plant. To begin my experiment, I filled three different plant pots with free-draining soil to optimize conditions for the Snake Plant, and placed a strong magnet in a plant pot labeled as "Group A", a weak magnet in a plant pot labeled as "Group B", and kept one control group with no magnets labeled as "Group C." Plant growth was observed and recorded continuously over a span of three months. Measurements of the three different groups of plants were taken from the base of the plant to the highest point. Experimental results showed that the group under the influence of a strong magnetic field experienced a higher growth rate than the group under the influence of a weaker magnetic field. Thus, evidently showing that the electromagnetic field increases the growth rate of the Snake Plant.

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	Fair Category	Project Number
247	LS	3072

Title: Oyster Sperm Production

Student Name(s): A. Butler

Abstract:

Previous research has shown how warmer ocean temperatures affect oysters' shells and vital systems. These temperatures result in increased shell production but have detrimental effects on embryonic and juvenile development. Oysters subject to temperatures greater than 30 °C have lower metabolism and survival rates. The purpose of this experiment was to test what effects warmer ocean temperatures caused by global warming would have on sperm production.

Four tanks were kept at constant temperatures of 5, 10, 15, and 20 °C. Five oysters were placed in each tank with the same diet of Chlorophyta and Paeophyta. Over the 2-month testing period, various oysters were dissected to track progress in sperm development. To measure this the gametes were sperm counted using a hemocytometer.

The oysters in the 20 and 15 °C tanks had evidence of sperm production and increased mass while the other oysters gained mass with no signs of sperm production. The 15 °C tank had an oyster with 1,750 sperm cells. The oysters held at 20 °C produced the highest sperm count of 13,800 total cells. The data demonstrated that sperm production starts after 2 months and is most prolific at temperatures above 15 °C.

NOAA has indicated that surface temperatures have increased approximately 0.13 °C per decade. If this trend continues it will aid sperm production at first but harm the new oysters during their developmental stages. These juvenile oysters will face overly high temperatures in the summer which will be detrimental to their growth.

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	Fair Category	Project Number
248	LS	3074

Title: Effect of Reproductive Maturity on Wing Loading in Spotted Lanternfly

Student Name(s): T. Andrews

Abstract:

The spotted lanternfly (SLF), Lycorma delicatula, is an invasive insect originating from China and Vietnam. Discovered in Pennsylvania in 2014, it has rapidly spread to other locations in the Northeast. It has been known to invade over 70 species of plants including vineyards, orchards, hardwood forests, nurseries and crops. If not controlled, it poses a significant threat to the environment and economy.Scientists study the wing loading of flying insects to gauge their ability to spread into new areas. It is presumed that the female SLF carrying eggs would exhibit a higher wing loading compared to females without eggs and males without spermatophores. For this study, data was collected and analyzed to determine the wing loading of the three groups. It was hypothesized that females carrying eggs would exhibit a higher wing loading than females not carrying eggs and the males. 30 dead specimens per group were selected from a collection and weighed. The wings were removed and a slide of the wings was made for each specimen. Measurements were taken of the wings using a digital microscope. The data was analyzed and used to determine wing loading. A large weight difference was recorded between the females carrying eggs and those not, and the males weighed the least. The weight significantly affected the wing loading of the females carry eggs, as was hypothesized. Knowing the high wing loading and limited flight capabilities during the time leading up to egg laying allows scientists to determine the most effective eradication strategies.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) AS EM 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	Fair Category	Project Number
251	LS	3075

Title: Investigating how pH and Nitrate affects the Density of Chlamydomonas reinhardi (+) and evaluating it through Statistical Analysis

Student Name(s): K. Tihaiya

Abstract:

Acid rain, common in urban areas, is caused by the emission of sulfur and nitrogen oxides, which interact with atmospheric substances to produce acids. Algae plays a major role in the ecosystem and it's important to understand how acidity affects them, but what if a nitrogen-containing acid is used? Chlamydomonas reinhardi (+) was used with TAP growing solution in various test groups with different pH levels. HCl and NaOH were used in one group and another group used HNO3 and NH4OH. However, the TAP already had high nitrogen concentration, which could have explained why HNO3 didn't have a major effect. Another experiment was conducted to observe the nitrogen effect with Chlamydomonas put into six groups, three using spring water and three using water from UConn's Mirror Lake. Within each set of three groups, there was an HNO3 test, an HCl test, and a NaNO3 test. NaNO3 was utilized to show how nitrogen affects the algae. After an ANOVA analysis, for lake water, there was no significant difference between HCl and HNO3 (p-value: .2), and between HNO3 and NaNO3 (.25). With spring water, there was no substantial difference between HCl and HNO3 (.06); however, there was a significant difference between HNO3 and NaNO3 (.025). NaNO3 didn't benefit the algae as much as HNO3 did, even though the former is neutral, which means that the nitrogen isn't in a usable form. Based on the results, there's no significant difference between what type of acid is used and its impact on algal growth.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EV MA 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	Fair Category	Project Number
248	LS	3076

Title: Predicting Droughts from Satellite Images using Novel Convolutional Neural Network Techniques

Student Name(s): A. Hindy

Abstract:

The objective of this project is to create a convolutional neural network that can predict the likelihood of a drought in the next 30 days by analyzing data from satellite images in order to help farmers in developing countries to mitigate the effects of droughts. The dataset, Landsat 8 Collection 1 Tier 1, provided by the United States Geological Survey, consisted of 86,317 training images and 10,778 testing images of various provinces in Kenya. The data was then preprocessed and reformatted into a standard 30x30 size and then fed into the model. The neural network consisted of 5 convolution layers with max pooling and padding and 5 standard layers with the softmax activation function. In order to test for the highest accuracy, 6 different models were implemented, using different activation and loss functions. Furthermore, the model featured an experimental dynamic learning rate, meaning the rate at which the model increased its accuracy during backpropagation randomly to increase accuracy. After initial testing, the models were trained on two datasets which included satellite images of Egypt and Sri Lanka. The most accurate model resulted in a 95% accuracy, proving that the neural network with an optimized learning rate is statistically accurate compared to other state of the art models. It was concluded that the model produces results that are highly accurate in predicting the likelihood of droughts from satellite images. Further study is needed to train and refine the network more, as well as using different activation and loss functions.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) CS AT 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	Fair Category	Project Number
197	LS	3079

Title: The effects of temperature change on Bromelain.

Student Name(s): B. Liu

Abstract:

The purpose of this experiment is to test the effects of temperature change on the effectiveness of Bromelain, an enzyme found in pineapples. This can be informative for chefs who want to utilize pineapple juice as a meat tenderizer. The procedure includes pureeing whole pineapples with the skin until there are 3 cups of pineapple puree. The pineapple puree is then separated into 3 seperate cups. Then 2 ounces of beef meat is placed into each cup, until all cups have a piece of beef in it. A piece of beef is set aside as a control group. Put one cup in the refrigerator, another in the freezer, and the last cup will be left out in room temperature. After 12 hours of waiting here are the results. The beef that was put in the refrigerator had similar qualities of tenderness compared to the one left out in room temperature. But the one that was placed in the freezer showed little change from its control. This experiment shows that the enzymes ability to break down proteins within the beef has been slowed down, or inhibited due to decreasing temperatures, while increasing temperatures will increase the enzymes effectiveness.

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	Fair Category	Project Number
196	LS	3080

Title: Kelp-ing our Oceans: Sustainable Natural Biopolymer Alternatives for Plastic Utilized in Oyster Reef Restoration

Student Name(s): S. Raymond

Abstract:

This test was designed to see if sugar kelp stalks can be used to replace plastic netting when being used to restore oyster reefs. When environmental specialists restore oyster reefs, they organize solid material into large rectangular prisms. The material often has many holes, in essence, like a supersized sponge. These prisms of material are called “cultch”. The cultch is surrounded by a plastic netting to hold its shape, which once placed in the ocean, is cut off and left in the ocean. This project tested the bending strength and puncture strength of 10 kelp stalks to see if they could be suitable replacements for the plastic netting. They were placed across a 3-foot gap and a 5 and 10-pound weight was placed on them in the middle of the gap. If the kelp held the weight for 3 seconds, it would pass for that weight. The kelp needed to pass a 15-pound test to be a suitable replacement, however, no samples passed the 10-pound test. This is likely because the kelp was kept in a closed bucket full of brackish water for 7 days and rotted due to lack of oxygen.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EM 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	Fair Category	Project Number
182	LS	3081

Title: The Physiological Responses of Freshwater Organisms to Acid Rain: The Effects of Relapsing Acidity Changes on the Heart Rate of Daphnia magna

Student Name(s): Z. Song

Abstract:

•Acid rain caused mainly by nitrogen oxide reflects harm onto living organisms. Even nature has its own rehabilitating ability to maintain its original pH, relapsing acidic precipitation would gradually decrease the environmental pH, which then affects organisms. In this research, experiments are conducted to imitate the frequent acidic precipitation and sporadic environmental rehabilitation in order to study the effects of such event on aquatic animals. Daphnia magna, of which the heart rate is easily observable, is chosen to be the research subject. It is used to attest to the cardiac stress caused by an acid environment. It is hypothesized that as the acidity of their living environment decreases over time, the heart rate of the Daphnia magna increases in response to the cardiac stress accumulated by the acidic water. Experiments are conducted, and the results corroborate the theory - Daphnia magnas show a striking heart rate as the aquatic environment acidifies. Even though their living environment restores its pH close to the original one, the relapsing acidification still increases the general heart rate of daphnia, demonstrating harmful effects relapsing acidification has on animals.

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	Fair Category	Project Number
248	LS	3082

Title: Association of Music Perception and Memory

Student Name(s): A. Northrup

Abstract:

Perception of music and its association with short term memory (STM) has been studied in patients with neurodegenerative diseases (NDD), which are more likely to occur in females. Last year, I performed a successful pilot study that found a moderate association between music perception and memory among adolescents. The goal of this follow-up pilot project is to describe this association among adolescent females and males, and to obtain preliminary effect sizes of the between-sex differences. STM was measured through Digit Span and Spatial Span. Music perception was measured through musical scene analysis tests: (1) timbre detection (Control), (2) local note detection (Pitch), (3) global note detection (Melody), (4) local tempo detection (Beat), (5) global tempo detection (Rhythm); and (6) Tune Recognition tests using ten famous songs pseudo-reversed. Among twenty participants, aged 15-18 years, 65% female, and 90% with background musical training, weak to moderate size correlations (ρ=-0.15 to -0.35) were found between STM and Pitch or Melody for both females and males. No correlation was detected for either gender between digit span and Beat, but higher digit span was associated with Rhythm in females (ρ=-0.38). Shorter reaction time was highly correlated with Tune Recognition in both genders for Pitch and Melody (ρ=-0.25 to -0.80). This association persisted for Beat and Rhythm only among females. The results suggest that a link between STM and different types of music perception can vary by gender in teens, and a larger study can explore this further.

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	Fair Category	Project Number
246	LS	3083

Title: Testing How Aloe Vera Affects Freshness of Fruits

Student Name(s): M. Cerrato

Abstract:

Aloe vera gel is known for its therapeutic effect on burned or irritated skin, but in the future, people could be eating the gel as a healthful additive to their fruits and vegetables. The purpose of this experiment is to analyze the aloe vera impacts the flaccidity nature of the fruit. My hypothesis was that aloe vera will preserve the taut nature of the fruits and prevent it from molding. Through this research, people can use this tactic to their advantage and prevent food waste. To find the results, I used questions to guide the experiment and to ensure accurate answers. I also bought various fruits such as raspberries, strawberries, bananas, and apples. I applied 1 tablespoon of Aloe Vera evenly on each fruit. I ensured that there is one set of fruits without aloe vera to act as a control group. I took pictures of each set of fruits every week until the end of the fourth week. I compared and contrasted these pictures in order to determine trends in the experiment. I observed that the fruit with 1 tablespoon of aloe vera remained fresh for an extended period of time compared to the fruit that did not have the gel on it. Through the research, I discovered that the gel, which does not appear to affect food taste or appearance, shows promise as a safe, natural and environmentally-friendly alternative to conventional synthetic preservatives that is unfortunately currently being applied to produce after harvesting.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS EA 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	Fair Category	Project Number
255	LS	3084

Title: Exploring a Novel Approach for Tackling Climate Change: Engineering Enzymes for Improved CO2 Removal and H2 Production

Student Name(s): L. Liu

Abstract:

Climate change is a major issue facing the world today. The overabundance of greenhouse gases, like CO2, is the main reason. CO2 is produced by the burning of fossil fuels, releasing sequestered carbon into the atmosphere. Finding alternative green energy sources and reducing CO2 in atmosphere are two ways to tackle this issue. Hydrogen fuel cells are a potential sustainable energy source. Generally, H2 is generated by expensive, heavy metal catalysts. Special enzymes known as hydrogenases accelerate the conversion of hydrogen ions (protons) to hydrogen gas with high efficiency. Formate dehydrogenases are a heterogeneous group of enzymes that catalyze the reduction of carbon dioxide to formic acid at low oxygen levels. In my research, I studied the effects of adding selenocysteine, a rare amino acid, into the FdsABG formate dehydrogenase and the Hyd-1 hydrogenase. By adding selenocysteine, my research aimed to (1) improve the activity of FdsABG for greater efficiency of conversion and (2) improve the hydrogen producing capability of the Hyd-1 while retaining its oxygen tolerance. I successfully transformed and grown cells to produce FdsABG and Hyd-1 with selenocysteine and confirmed the presence of selenocysteine in both enzymes with LC MS/MS. The activity of the selenocysteine-containing FdsABG was tested to be greater than that of the wildtype enzyme. The selenocysteine-containing Hyd-1 is more oxygen tolerant than the wildtype enzyme, but I have yet to test its activity. Adding selenocysteine has been shown to improve the performance of both enzymes and opens up new solutions for climate change.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
133	LS	3085

Title: Slide to Track Band

Student Name(s): K. Bergers

Abstract:

My prototype is focused on a problem that those with diabetes struggle with. Testing blood sugar everyday can be time consuming and stressful for those who have not yet developed a proper way to track which finger they last pricked on, in other words, which finger is next in the rotation. The Slide to Track Band solves this problem with a double layered band worn on either wrist, where it is convenient and easy to slide a rivet into a corresponding hole that marks the finger last used to test blood sugar. Using the same finger or spot multiple times can weaken blood flow and cause calluses, scarring and pain. This product has the ability to impact the thousands of people who face this as an everyday problem, starting with my cousin Hannah.

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

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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	Fair Category	Project Number
212	LS	3086

Title: Forelimb movement patterns are impacted by the ablation of motor neurons in the caudal forelimb area

Student Name(s): N. Kucher

Abstract:

It is estimated that one in six people have had a stroke worldwide. Strokes can cause damage to the motor cortex, which can cause motor deficits, leaving patients with a limited range of motion even after intense rehabilitation. These injuries can lead to a loss of skilled hand movements when the corticospinal tract becomes impaired. Studies have shown that there is an increase in motor function with rehabilitation, but it is unclear how movement patterns change after an injury. In the following study, we ablated motor neurons in the caudal forelimb area to determine how movement is affected after a loss of motor neurons. Mice performed a skilled reaching task before and after injury, and their movement patterns were studied using a machine learning system. We observed a change in functional movement, meaning that the movement patterns of the mouse were altered after an injury. These results indicate that injury to the motor cortex affects movement patterns, which expands our knowledge of how an injury affects movement patterns. These data will help create more specific rehabilitation regimens for stroke patients, which will allow for faster and better recovery in a shorter period of time, leading to a better quality of life after injury, and less time and money spent on physical therapy.

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

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	Fair Category	Project Number
195	LS	3088

Title: Potential of Ocean Acidification to Affect Physiology and Mortality of Marine Diatoms

Student Name(s): J. Agard

Abstract:

Ocean acidification was recently recognized and identified as a top ten global issue due in large part by it's strong connection to our actions. The global industrialization and increased carbon dioxide emission rate first studied in the 1950's is thought to be driving this acidification which threatens both commercial fisheries and the source of roughly 70% of the oxygen we breathe. Replicated studies were designed to evaluate the potential impact these emissions may have on marine diatoms across a gradient of pH values chosen to mimic different impact levels (8.0 down to 6.0; n = 5 per treatment; n = 15 total). Cultures were monitored for 24-48 hours and showed a clear pattern of increased mortality in diatoms as pH went lower ($p<0.05$). Although further testing would verify this pattern, this shows and highlights a very clear threat that our actions may pose to a vital resource within our oceans. The literature on this focuses heavily on the threats acidification poses to calcified marine organisms, whereas here is demonstrated a warning that other marine phytoplankton need to also have strong consideration in the research as diatoms alone produce nearly half of the oxygen we breathe.

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):

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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	Fair Category	Project Number
240	LS	3089

Title: Analyzing trends in Eastern Equine Encephalitis in order to understand why there are sudden outbreaks throughout the country

Student Name(s): R. Vipparla

Abstract:

Eastern Equine Encephalitis (EEEV) is a rare but fatal infection that results in neurologic symptoms and is often transmitted through mosquitoes. While EEEV outbreaks/number of cases have remained steady throughout the last decade, in 2019 the number of reported cases almost tripled. Due to the lack of research surrounding the disease, there was an abundance of uncertainty regarding the source of the issue. Prior to beginning this research, the initial hypothesis was "Because of Global Warming and sea levels rising, there is more freshwater available to give birth. Therefore, this increases the number of EEE outbreaks". However, this has proven only partially true. Conclusions regarding these abnormalities were able to have been proven through the analysis of prior research and by calling various agencies that specialize in the field. After viewing this information regarding EEEV life cycles, it became clear that mosquitoes are feeding on humans rather than primarily feeding on birds because of environmental changes and the death of many bird species. In addition, with the rise in the amount of global rainfall, there is more freshwater in the environment for mosquitoes to breed. With 2019 having the 2nd highest global temperatures, the number of EEEV cases have increased because warm air incubates viruses faster in mosquitoes. Rather than the popular belief that one factor is the cause of the influx in EEEV cases, this combination of extraordinary environmental conditions in 2019 was the cause of the surge.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): EV AS EA

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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
255	LS	3090

Title: Analyzing the Effect of Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) Knockout on Macrophage Polarization to Establish a THP-1 Model System

Student Name(s): S. Raissi

Abstract:

Cystic fibrosis (CF) is characterized by hyper-inflammation and its inability to efficiently resolve chronic lung infections, eventually resulting in death. The cause of the disease can be traced to a mutation in the Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) gene. Little is known how mutations in the CFTR gene affect (pro-inflammatory) M1 and (resolving type) M2 macrophages. Using the monocyte/macrophage cell line THP-1, we want to test our hypothesis that knocked-out CFTR will impair M2 polarization, and increase M1 polarization, causing the hyperinflammatory non-resolving phenotype. The presence of CFTR served as the independent variable, while the extent of polarization of M1/M2s served as the dependent variable. THP-1 cells were split into two groups: one with CFTR knockout using CRISPR, and one unaffected control group. The cells were differentiated to macrophages and polarized to M1 or M2 macrophages and M1/M2 specific (m)RNA expression data was collected using qPCR. Just as expected, the data for the CFTR knockout group showed an increased expression of pro-inflammatory cytokines and a decreased or stagnant expression of anti-inflammatory cytokines, indicative of M1/M2 polarization respectfully. These methods were carried out in Yale's pulmonology laboratory, under the supervision of Dr. Hasan Öz and Professor Emanuela Bruscia. The findings help establish a model system for the use of THP-1 cells as a replacement for blood monocytes when studying the effects of cystic fibrosis in future research efforts, as well as illustrate the impact of CFTR on different types of macrophages.

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

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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	Fair Category	Project Number
250	LS	3091

Title: Natural Enzyme Reduction of Saline Stress in Ocimum basilicum pilosum

Student Name(s): J. Lambrech, K. Nuzzo

Abstract:

This experiment was performed to analyze the positive effects of Pseudomonas fluorescens, a halophile, on the growth and development of basil plants in soil watered with excess dissolved salts. Many agricultural regions of the world being negatively affected by rising sea levels and excess road salt runoff see this problem firsthand and safe, generally noncontroversial solutions like this bacteria (at biosafety level 1) are needed. The extent of the bacteria's influence was measured by the seed's percent germination, root length, and soil weight for seeded basil and plant color and microscopic root and leaf health for already grown basil. Both types were watered with their respective solutions. Each type had 2 different salt sections to represent rock salt (NaCl and CaCl2) and ocean water (NaCl) with bacteria and no bacteria, plus a deionized water control. 1.25g of bacteria were added to the bacterial groups. During the time this experiment this was conducted, the added bacteria did not seem to show much correlation with improved plant health. For the seeded plants, none of the groups with any saline water, would show germination. For live basil plants, the rock salt groups showed equal degradation in color and shrinkage while ocean water groups didn't see much change. Microscopically, it did appear that the NaCl group with bacteria held more water, implying a small correlation, but nothing too noticeable. These bacteria have been shown to improve plant health in other studies, so sources of error like certain lighting and seed spacing may be present.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
235	LS	3092

Title: The Effects of Inhibition of Aurora A Kinase on Myxofibrosarcoma Cell Lines using the Novel Inhibitor LY3295668

Student Name(s): J. Strong

Abstract:

Myxofibrosarcoma (MFS) is an agressive soft tissue sarcoma with chemotherapy response rates of less than 30% calling on the need for better treatments. The Cancer Genome Atlas recently found that the majority of copy number alterations in Myxofibrosarcoma involve Retinoblastoma (RB) 1 mutated genes which code for RB tumor suppressors, making targeting the RB pathway a potential new therapy. Specifically, loss of function mutations in RB1 are commonly present in Myxofibrosarcoma cells and are highly sensitive to Aurora A Kinase inhibition. Therefore, we hypothesized that using the Aurora A Kinase inhibitor, LY3295668, would be synthetic lethal with MFS cancer cells that exhibit the RB1 deficient mutation. Myxofibrosarcoma cell lines established from patient tissue samples were validated by array comparative genomic hybridization. Cells were then treated with varying concentrations of LY3295668 from 1nM to 10 uM. Cells were then collected at days 0, 2, 3, 4, and 6. Western Blot analysis was performed for Phosopho-AURAK, RB, Phospho-RB, Cleaved PARP, Cleaved caspase 3, Cyclin A and Phospho-Histone H3. The optimal concentration of inhibition of Aurora A Kinase was seen with 10uM of LY3295668. This inhibition was noted in the RB1 deficient cells and not for the RB1 competent cells, confirming the efficacy of this inhibitor on the RB1 deficient cells of Myxofibrosarcoma. The RB1 inhibitor, LY3295668, successfully inhibits growth of MFS cells in vitro and may serve as a novel targeted therapy for Myxofibrosarcoma.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
261	LS	3094

Title: Carbon Nanotube Lab-on-Chip as a Rapid, Inexpensive, Lyme Disease Detection

Student Name(s): S. Pronina

Abstract:

In 2019, 300,000 cases of Borrelia burgdorferi (Bb) induced Lyme Disease were reported in the US alone. Without timely diagnosis, the disease expands to Post Treatment Lyme disease syndrome (PLDS), ultimately resulting in chronic delocalized symptoms such as encephalopathy, arthritis, erythema migraines, and other cognitive defects. And yet, current diagnostic methods are time-consuming, costly, and require lab access. However, a visual point of care Lab-on-Chip (LOC) could enable early intervention, limiting the long-term effects of PLDS. Carbon nanotubes (CNTs) have gained popularity for biosensor applications due to their low visible absorption and large specific surface area. This research applies functionalized carbon nanotubes to a chemiluminescent, immunological assay LOC for Bb IgG. The reusable LOC was CAD-designed, and laser-cut onto layers of polycarbonate and PMMA black acrylic (Yang, modified). The single-walled CNTs were functionalized through dispersion in H_2SO_4, HNO_3, sonication, and centrifugation in PDDA, and coated with B. burgdorferi antigen prior to validation through FTIR and SEM analyses. The interchangeable immunosensor was covered with functionalized and antigen-coated SWCNT spots, then subsequently attached to the LOC. Upon exposure to Bb IgG (high) concentrations that are characteristic of Lyme disease, HRP-bound DuoLux substrate produced a luminescent response that is visible using a Smartphone camera, with a 460nm cut-on filter. Results were validated using a fluorescence spectrometer, where fluorescent intensity correlated linearly with concentrations of Bb IgG. Combined Smartphone camera and spectral results highlight the LOC's reliability in detecting IgG levels that are typical of the earliest stages of Lyme, at a ~$25/test cost.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
253	LS	3095

Title: Enhancing Blood Glucose Metabolism For Concussion Patients Through Micronutrient Therapy

Student Name(s): M. Corrigan

Abstract:

A concussion is a brain injury caused by a blow to the head or a violent shaking of the head and body. After a concussion, due to either stress-induced or inflammatory response, blood glucose levels can rise, causing patients to suffer from hyperglycemia. Patients recovering find the process is hindered as these hormones are continually released, leading to symptoms such as altered brain pH, increased risk of cerebral edema, disruptions to the blood-brain barrier, and buildup of lactic acid. Insulin therapy was considered for use as a treatment, however, it caused adverse long-term neurological effects. Rather, micronutrients will be used, as increasing metabolic efficacy is the best course of action in reducing blood glucose. The micronutrients will be coupled with yeast to determine if they increase eukaryotic cells' ability to metabolize sugar, measured through CO2 output, O2 intake, and sugar uptake. The micronutrients used were Biotin, Niacin, Thiamine Hydrochloride, Vitamins C, E, and D. The metabolic efficacy of each individual micronutrient as well as synergistic permeations were measured. The baseline, yeast with no micronutrients, had a CO2 output to O2 intake ratio of 1.04 ppm. Biotin, the individual micronutrient that raised metabolic efficacy the greatest, had a ratio of 3.64 ppm. Vitamin D and Niacin, the most effective combination, had a ratio of 1.34 ppm. This research using micronutrients to treat hyperglycemia in concussion patients is the first of its kind. Having proven to increase metabolic efficacy, it can be expanded into treatment for Type 2 Diabetes in lowering A1C.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
190	LS	3096

Title: The Impact of Targeted Modifications of SNPs in rs265 and rs99 for iPSCs Using CRISPR/Cas9 on Obesogenic Gene Expression

Student Name(s): A. Muchhal

Abstract:

In this study, the genetic ramifications of modifying SNP rs 99 and SNP rs 265 in two enhancers are examined. As single nucleotide polymorphisms in enhancer regions have been linked to obesity, scientists examine the results of changing particular base pairs in the enhancers using CRISPR/Cas9 in iPSCs. Scientists found specific genes associated with the enhancers by examining fold change in the RNA seq, and--using GWAS databases--confirmed that the affected genes impacted obesity. By finding enhancers whose SNPs change genes that affect obesity, scientists were able to figure out if the enhancers increased or decreased a person's susceptibility to obesity by increasing or decreasing the transcription of genes that increase obesity. The RNA sequencing data found several significant genes and ultimately, rs 99 increased obesity expression and rs 265 decreased it. As a result, scientists have a better understanding of how obesity functions. As heart disease, caused by obesity, is the leading cause of death in America, an increased understanding of the disease could save many lives as scientists could use the information found in this study and use CRISPR/Cas9 to decrease Americans' susceptibility to obesity.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
228	LS	3097

Title: Studies on the various trends and reactions of cancer medications with regards to gene mutations to prevent undesirable side effects.

Student Name(s): S. Gudlavalleti

Abstract:

More than 131 million people, 66 percent of all adults in the United States, use prescription drugs. The purpose of this research was to understand the importance and know what genes cause people to react to drugs differently. Prior to beginning this research, the hypothesis was that due to differences in genetic sequencing, the patient's body will react to the medications differently because each patient has different sequencing and the medication will affect it differently. Although differences in sequences affect the reaction to the drug, it is much more specific than that. To come to my conclusions, I used multiple questions to guide my research. I used multiple sources to make sure the data I collected was accurate. Through my research, I was able to come to the conclusion that the drug that I researched affected a specific gene. The most important part is the path the drug takes when entering your body. The drug I use is part of a group called antimetabolites. I was able to conclude that the mutations in a gene called DPYD is the main reason why people taking Fluorouracil respond have undesirable side effects. This gene makes an enzyme called dihydropyrimidine dehydrogenase, or DPD. An enzyme converts one chemical to another. This is why it is important to know what gene the drug is affecting and how a mutation will affect it.

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

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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	Fair Category	Project Number
263	LS	3098

Title: Smartphone Detection of Cardiovascular Disease using Retinal Features of Fundus Photography

Student Name(s): E. Moore

Abstract:

Cardiovascular disease kills 17.9 million people globally per year. While cardiovascular disease is treatable if detected in its early stages, current methods to diagnose heart disease are sophisticated and costly. As the cost of insurance rises, in a society that trends towards fast-food consumption, the sudden rise in cardiovascular disease warrants a rapid, non-invasive, and pre-emptive detection system for heart disease, that is readily available, and inexpensive. Concurrently, researchers have discovered that the vasculature of the eye and the heart share several characteristics. Specifically, narrowing of retinal arteries, and dilation of retinal veins are important signs of cardiovascular risk. As such, retinal Arteriole/Venule (A/V) ratios may be useful in diagnosing heart disease. In this research, a Smartphone-based, indirect ophthalmoscope has been designed and constructed, using a newly (3D) designed and printed Smartphone case, with a +20D lens. In use, Smartphone fundus images are obtained, and shared/synchronized between the Smartphone and accompanying computer, via a Python-based CDR application, for interactive determination of the patient's A/V ratio. These A/V ratios are converted to the patient's risk for cardiovascular disease, ranging from Level 1 (Low risk, Normal) to Level 4 (Progressive Cardiovascular disease). Originally trained with 82 retinal images from the STARE dataset, the CDR app was validated via blind-testing of the same images, where each predicted Cardiovascular Risk Level was compared to the medically-derived diagnosis that accompanied the STARE image. The Smartphone Fundus-CDR system produced a 95.4% accuracy, highlighting the technology's usefulness as a rapid, pre-emptive screening for heart disease risk.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): ME EN AT

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
204	LS	3099

Title: Using Immunohistochemistry to Detect Expression of Chemoresistance Gene ABCG2 in Osteosarcoma Cancer Stem Cells

Student Name(s): B. Zhou

Abstract:

Metastases constitute the primary cause of morbidity in osteosarcoma patients. Current models propose that cancers are composed of bulk cells and stem cells. The cancer stem cells are thought to be responsible for tumor maintenance, recurrence, and metastasis. It would be useful to identify genes uniquely expressed in cancer stem cells since these could be targets for novel therapies. A gene that has been linked to cancer stem cells in other cancers is the chemoresistance gene ABCG2. I hypothesize that if osteosarcoma stem cells in the primary tumor give rise to the metastatic osteosarcoma tumor and ABCG2 is critical for the maintenance of osteosarcoma stem cells, then more cells in the metastatic tumor should express ABCG2 than in the primary tumor. To test this, I used immunohistochemistry to examine ABCG2 expression in paired primary and metastatic osteosarcoma tumors. I stained sections with a primary anti-ABCG2 antibody followed by a fluorescent secondary Qdot 705 antibody and counter-stained with the fluorescent nuclear stain DAPI. Photography with the appropriate fluorescent filters allowed me to visualize and count total and ABCG2 + cells. Statistical analysis revealed that more cells were ABCG2+ in the metastasis than in the primary tumor. This suggests that ABCG2 is a biomarker candidate for osteosarcoma metastasis and potentially for osteosarcoma cancer stem cells.

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

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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	Fair Category	Project Number
189	LS	3100

Title: Can different moods affect what we eat?

Student Name(s): I. Lopez

Abstract:

The problem of obesity in today's society is addressed in this project, as this project talks about the cravings people tend to have and that they consume as a way of coping with their emotions. The problem is most people use eating as a way to handle their emotions.From prior research this is because of the part of our brain known as the hypothalamus. The hypothalamus regulates and controls our emotions, as well as our hunger. The hypothalamus sends signals when we are feeling different emotions to our body signaling what it is our body wants, these are cravings. The hypothesis is when people are in sad moods, their appetite increases. To conduct this experiment, survey's were handed out and completed. Once responses came in they were compared and tallied in a chart. The results showed, when people were in an emotional happy and sad mood, they tended to consume sweet, unhealthy foods. When people felt stressed or bored they consumed salty and sweet foods. When people were mad they tended to eat salty foods or nothing. My hypothesis was supported by the data and results that were collected.

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	Fair Category	Project Number
252	LS	3101

Title: Using Pure and Copper-doped Zeolite Catalysts to Degrade Lignin Polymers Into Biofuel

Student Name(s): R. Lu

Abstract:

As we search for renewable energy sources to replace fossil fuels, biofuel presents a sustainable and clean alternative that is derived from dry plant matter. This lignocellulosic biomass is composed of cellulose, hemicellulose, and lignin. Lignin polymers have high carbon contents and compose around 30% of plant biomass, but are largely discarded in biofuel conversion due to lignin's complex and rigid structure. The purpose of this experiment was to determine the most effective and efficient catalyst to use in a reaction for degrading lignin polymers into biofuel.Lignin from poplar sawdust was dissolved in methanol and mixed with the catalyst. This mixture was heated to 200 degrees C for 4 hours, cooled, and then filtered through vacuum filtration. The solids were dried and massed to determine degradation rate, and the liquid oil was distilled and massed to determine the final fuel yield. Gel-permeation chromatography (GPC) data collected on the liquid oil was then analyzed to determine the average molecular weight of the samples, further signifying success of the reactions. All procedures were done by the student with supervision of a graduate student. Results showed that reactions done with pure HZSM-5 have significantly higher oil yields and degradation yields, and smaller average molecular weights than those doped with copper, contrary to previous studies supporting the beneficial catalytic qualities of copper in aluminum oxide catalysts. Further research should be done on pure HZSM-5 as a catalyst for biofuel reactions, in order to produce biofuel industrially as a potential replacement for fossil fuels.

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

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	Fair Category	Project Number
243	LS	3102

Title: Novel Wound Dressing Facilitates Rapid Detection of Infections

Student Name(s): M. Vedula

Abstract:

A method of quick and simple detection of wound infections has yet to become readily available as patients are left to their own discretion of whether to seek medical attention for a possibly infected wound. Biochemically, the bacteria in an infected wound destroy the extracellular matrix of one's skin, producing basic byproducts. Studies show that the pH of wounds infected by S. Epidermidis, S. Aureus, and Enterobacteria rise by a factor of at least one within a 24 hour period. Moreover, a pH increase consistently precedes the onset of clinical symptoms by at least 24 hours. The goal of this engineering project was to develop a wound dressing that uses pH to allow for the rapid detection of a possible wound infection. This project was executed by obtaining an autoclaved sample of S. Epidermidis in LB broth; this process was followed to mimic the exudates of an infected wound, which are a product of an inflammatory response and maintain the same pH as the wound. Meanwhile, I constructed five band-aids using a different band-aid and pH indicator for each. After, I micropipetted 100 µL to 1 mL of LB broth onto the band-aids and revised the construction based on the clarity of the visual color change. I determined that a Water-Block-Clear Band-Aid with a Hyrdrion 4.5 to 8.5 pH indicator strip is the clearest binary visual guide to determine when the pH of a wound signals infection.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) 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	Fair Category	Project Number
268	LS	3103

Title: Improved Design and Field Verification of Varroa destructor Control with a Dual-function, Thymol-Emitting Honey Bee Hive Entranceway

Student Name(s): R. Jain

Abstract:

In the last decade, one-third of all honey-bee colonies have vanished in Colony Collapse Disorder (CCD) due to the parasitic varroa mite. Varroa mites (vm) feed on honey-bee fat-body which when depleted, weakens the honeybee so pesticides cause death. Therefore, an effective method to remove vm from hives is urgently needed. To begin, a beehive entranceway was designed that released thymol "miticide" onto the bees upon contact and gaseous release. A 20x20x150mm entranceway with 14 alternating 9mm circular holes, was 3D-printed and coated with a 50/50-%w/w mixture of thymol/Hydromed-D. Under normal bee-behavior, GC-FID analysis of bee-body highlights as much as 28µg of thymol released onto the bee by contact-per-day. With a demonstrated 4-day exponential decay, the vm LC50 for thymol (56µg) is reached only four days after entranceway installation. Similar analysis for a (19.75x16x20in) hive revealed 5.44µg/L of thymol released into the headspace, to protect the larvae within the hive. In phase-two of the research, laboratory results were validated with field testing from hives located in states throughout the US. For hives where the entranceway was installed, %mite levels were reduced to ~0.29%, far below the 5% level indicating treatment. Mite infestation levels dropped >70% within 3-weeks post-installation, to a similar (negligible) ~0.20% mite levels, 25 times lower than treatment levels. In the newest design, soft bristles were attached to the innermost edge of each entranceway hole, to dislodge the vm wedged within the abdominal plates as the honeybee passes and allow for greater exposure to the thymol content.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EN 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	Fair Category	Project Number
236	LS	3104

Title: The Effect of Genetically-Altered Endothelial Cells on Breast Cancer Metastasis to the Lung

Student Name(s): A. Patel

Abstract:

In recent years, studies have demonstrated that the environment that surrounds a tumor plays a crucial role in the formation of metastasis. Mutated endothelial cells, prominent in the tumor microenvironment, have been linked to metastasis in the lung, and understanding how these cells affect the progression can provide a potential target of therapy. For this project, two groups of BALB/c mice were generated. One group served as a control, while the other group had genetically-altered lung endothelial cells with different protein expression. Both groups were then injected with GFP-tagged 4T1 cells, a metastatic mouse breast cancer cell line. After 28 days, the lungs were collected, fixed, and slides were stained with Hematoxylin and Eosin (H&E) to view cell structures and cell density. Immunofluorescence (IF) was conducted to evaluate the expression of GFP and Ki-67. 4T1 live cells were cultured in vitro, which confirmed GFP viability. Overall, the number of metastases that occurred in the experimental group was greater than that of the control. Furthermore, Ki-67 positivity was higher in the HET group than the control. This proves that endothelial cells under normal conditions play a role in preventing metastasis. However, once endothelial cells become influenced by chemical signaling of cancer cells, they can then aid in metastasis. Overall, this supports the claim that protein expression in lung endothelial cells is a potential target for preventing and treating metastatic breast cancer.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) ME 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	Fair Category	Project Number
252	LS	3105

Title: Removal of Micropollutants Using Cornu aspersum glycoconjugates

Student Name(s): M. Ogrinz

Abstract:

Micropolastics are small pieces of plastic of less than 5mm in length that pose health risks to both humans and marine life. They are present throughout the water column, absorb chemical pollutants, and offer surface area on which bacteria can grow and travel in water. Microplastics often enter and rise through the food chain as organisms confuse them for food. Glycoconjugates from Cornu aspersum were able to collect microplastics (polyethylene terephthalatei) in the range of 0.25 to 0.30 mm in diameter. Microplastics and dye were added to a mixture of glycoconjugates and water collected from Long Island Sound (LIS). Another mixture was created which consisted of distilled water and dye. Slides of both mixtures were created and viewed at the same magnification under a microscope before and after adding microplastics. Dark red-purple objects were only observed in the glycoconjugate-LIS mixture, which suggests the presence of the microplastics. However, colored objects did not appear in the mixture of dye and distilled water. While this is evidence that mucus from snails may be able to trap microplastics, mucus of the coral Acropora cervicornis should be investigated. Coral mucus floats, so if it traps micropollutants then it could be skimmed off the surface of the water to remove micropollutants. A secondary experiment looked at whether glycoconjugates could capture oil. The data collected suggests that it is feasible for glycoconjugates to be used in developing a safe, organic product for cleaning water as an alternative to toxic dispersants released at oil spill sites today.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
246	LS	3106

Title: Effect of Environmental Factors and Cloth Type on the Biodegradation of Synthetic and Natural Fibers

Student Name(s): S. Ramakrishnan

Abstract:

When clothes become old or too small to wear, they are either thrown out or donated, and they eventually end up in landfills, where they take a long time to biodegrade, which contaminates air and groundwater. In this project, the effect of time and temperature on the biodegradation of different types of cloth was examined. The biodegradation of different types of cloth in soil was assessed at 3 different temperatures. Degradation of cloth samples was measured after 1, 2, and 4 weeks. Cloth samples made of 100% cotton degraded 2.8 times faster than cloth samples made of 50% cotton-50% polyester which degraded 3.5 times faster than 100% polyester. The degradation was greatest at the highest temperature where cotton lost ~53% of its weight after 4 weeks compared to ~14% at 20°F lower temperature. Clothes containing polyester appeared to have less soil adhered to it especially when dry and had no biofilm likely because polyester is more hydrophobic than cotton. The impact of surface oxidation of the cloth samples through hydrogen peroxide treatment was evaluated. Surface oxidation using short hydrogen peroxide treatment did not change the degradation rate. Microbial fuel cells containing each of the three different types of cloth were constructed to understand if the rate of biodegradation can be assessed using the voltage and power of the microbial fuel cells. No clear difference was seen between them likely due to organic matter that may be present in the soil. Longer tests may show difference.

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

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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	Fair Category	Project Number
156	LS	3107

Title: Comparison of the Threat of Elevated Levels of Medical Runoff(Acetaminophen) on Mortality of Grass

Student Name(s): J. Williams

Abstract:

Runoff from unused medications in our local waterways has been identified as a much larger problem than first thought. Due to the lack in literature properly evaluating this issue, it has gone unchecked and needs further studies. This study was designed to evaluate the potential that medical runoff (Acetaminophen) on ecologically important and critically sensitive coastal invertebrates (Palaemonetes spp). Replicated trials were established at known background runoff levels (80 ng/L), as well as elevated levels (1000ng/L) and compared against unexposed samples. A clear pattern of 100% mortality in shrimp who were exposed to the runoff tylenol highlights a clear need to better manage this run off. The fact that it persists through multistage waste management and has a large potential to bioaccumulate (as shown by several other studies) strongly suggests the need for further studies to design more efficient removal techniques and better management strategies for medications that have been detected in local waterways.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
126	LS	3108

Title: The Effects of Silver Chloride on the growth of Green Bean

(Phaseolus vulgaris)

Student Name(s): G. Francois

Abstract:

This project was done to investigate if silver chloride, which is used in pesticides could be harmful to plants. Green beans were grown in three pots that have 5 seeds each. The plants were grown with water and different concentrations of silver chloride for 3 weeks. The control plants, which were grown in water, the water grew to be 31.75 centimeters tall. Only 2 of the 5 seeds germinated. Plants watered with 0.5% solution of silver chloride grew to be 17.53 centimeters tall. All 5 seeds germinated. Plants watered with a 0.6% solution of silver chloride grew to be 26.04 centimeters tall, but only 2 seeds germinated. This data supports the hypothesis that silver chloride may have a negative effect on the growth of green beans.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
228	LS	3109

Title: Inhibiting Quorum Sensing To Prevent The Formation Of Biofilm In Chronic Wounds Using Calendula Officinalis Oil

Student Name(s): E. Hong

Abstract:

Biofilm is a group of bacteria that adheres to a nutrient rich surface to grow safely within a thin film called the extracellular polymeric substance (EPS). Formation of biofilms have been growing concerns over the years due to the permeability of the EPS that are resistant to antibiotics. These formation of the biofilm is the result of bacterial quorum sensing. Quorum sensing is bacteria's ability to communicate by detecting the cell density, which enables the bacteria to perform certain tasks, such as developing biofilms. In recent years, the process of anti-quorum sensing has been gaining more attention as it is looked upon as an alternative to antibiotics. Calendula Officinalis flower has been found to hold anti quorum sensing ability in various types of bacteria. In this study, the Calendula Officinalis oil will be used to test the inhibition of biofilm by growing the biofilm on top of the semipermeable membrane that will allow them to receive the nutrients from the agar and relocate as needed. Once the biofilm forms, the membrane will be transferred to an agar with calendula oil within. The quantitative data is gained through colony-forming units (CFU) that would prove the anti biofilm ability of calendula oil. In the future, this oil could be used to make a cheap and easy ointment that could substitute for antibiotics without becoming resistant to the bacteria.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) MI BI 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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- ☒ 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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	LS	3110

Title: Tame the Triclosan: Reduce Your Impact

Student Name(s): M. McConnell

Abstract:

Triclosan is an antimicrobial used in select Colgate toothpastes at doses of 0.3%. Though effective in preventing gingivitis, it's shown to be harmful to animals. High exposure of triclosan can decrease thyroid hormones in animals, disrupt endocrines, and may lead to antimicrobial resistance. This experiment tested the minimum amount of triclosan needed in toothpaste to be an effective antimicrobial. If reduced concentration of triclosan can have comparable zone of in inhibition against streptococcus salivarius as 0.3% triclosan, then reduced concentrations of triclosan in toothpaste will be as effective as the .3% solution because triclosan is a strong antimicrobial. Concentrations of triclosan made were: .3%, .2%, .1%, .03%, .02%, and .01%. .2 mL of the culture was spread on the five agar petri dishes using the spreader. Sterilized filter paper discs were soaked in each concentration, with one plate having a negative control, water, and a positive control, chloramphenicol, a known antibiotic. After each soak, the tweezers were cleaned in ethanol. After 24 hours, the zone of inhibition, a circle with no growth, was observed around the discs. The diameter of each zone was measured, showing the effectiveness of each dose. After 24 hours, on average, water's zone was 0mm, and chloramphenicol was 28mm, for triclosan .3% was 22mm, .2% was 19mm, .1% was 15mm, and .03% was 12mm, .02% was 9.5mm, and .01% was 8mm. These results show that reducing the standard amount of .3% triclosan to .03% would still be very effective at inhibiting the growth of streptococcus salivarius.

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):

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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	Fair Category	Project Number
247	LS	3111

Title: Antimicrobials in the Natural World: Assessing their effectivity against E-Coli Strain K -12

Student Name(s): A. Hatfield

Abstract:

After years of misusing antibiotics, we have created a plethora of resistant bacteria. Now, new antibiotics that have less bacterial resistance must be studied and developed. This experiment tested the effectiveness of plant-based antimicrobials to find alternative antimicrobial agents. Through steam distillation, the essential oils of thyme, clove, oregano, and garlic were extracted. Other extracts containing antibiotic properties from vanilla, goldenseal root, and ginger root were extracted through methods other than steam distillation. For vanilla, the vanillin extract was derived from distillation, and goldenseal, as well as ginger, was dried, ground, then rehydrated. These extracts were tested on an inoculated petri-dish using the disk diffusion method. While the antimicrobial agents within the plant extracts cannot be tested, the essential oils and extracts do contain large quantities of these agents. This high quantity is displayed through the results of this experiment. Both thyme oil, clove oil, and ginger extract were proven to be the most effective of the plant extracts used in this experiment with kill zones of 0.5cm for the ginger extract, 0.7cm for clove oil, and 1.0cm for thyme oil. Compared to the kill zones of the controls (0.8cm for 91% isopropyl alcohol and 0.5cm for iodine) these extracts were extremely effective at inhibiting bacterial growth. Other extracts tested in this experiment had minimal to no success as inhibitors. These plants have a long history in medicine and may be able to resurface now to help us face our new problem of topical "superbugs".

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS MI 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	Fair Category	Project Number
255	LS	3112

Title: Evaluating Clinical Course and Outcomes in Patients with BRCA-Mutated Pancreatic Cancer at Memorial Sloan Kettering: A Retrospective Analysis

Student Name(s): C. O'Connor

Abstract:

Pancreatic cancer is an extremely challenging malignancy to treat, with a median survival time of less than one year for patients diagnosed with metastatic disease (stage IV). Up to 10% of pancreatic cancer cases result from inherited cancer predisposition syndromes, of which BRCA mutations are the most common. The identification of BRCA mutations are valuable, as carriers show increased responsivity to platinum therapies and PARP inhibition (PARPi) therapies. While researched extensively in BRCA-mutated breast and ovarian cancers, there has been relatively little retrospective evaluation of platinum and PARPi therapies in BRCA-mutated pancreatic cancer. To further characterize patterns of treatment response and disease progression in BRCA-mutated pancreatic cancer, patients with previously identified BRCA mutations were reviewed. Medication histories, genomic profiles, and overall outcomes were abstracted from institutional databases. Overall survival was estimated with Kaplan-Meier curves. 126 BRCA-mutated pancreatic cancer patients were identified; 66 patients had stage IV disease. The median overall survival time for patients with metastatic disease was 19.1 months (95% Confidence Interval 16.1, 25.8). 81% of stage IV patients who received platinum therapy had a partial response to treatment (a decrease in the extent of the cancer). 34% of stage IV patients who received PARPi therapy had a partial response to treatment and 36% had stable disease. BRCA mutation carriers constitute an important subgroup of pancreatic cancer patients. Improvement in median survival time for this cohort compared to national averages is notable, and outcomes are expected to improve with increasing integration of platinum and PARPi therapies into treatment paradigms.

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	Fair Category	Project Number
253	LS	3113

Title: Music and Memory: The Ideal Dosage of Music to Reduce Agitated Behaviors and Improve the Quality of Life of Patients with Alzheimer's Disease and Dementia

Student Name(s): C. Badagliacca

Abstract:

Alzheimer's disease is a degenerative neurological disorder that attacks and kills brain cells, causing loss of memory, thinking skills, language, and behavioral changes. Little can be done to prevent, cure, or slow the disease. However, music therapy targets areas of the brain left unaffected by dementia and increases cognitive function while decreasing recorded agitated behaviors. The objective of this study was to use the Music and Memory personalized listening program to implement personalized musical enrichment in various nursing homes while simultaneously tracking the participants' agitated behaviors using the Cohen-Mansfield Agitation Index (CMAI). It was hypothesized that there is an ideal dosage of personalized musical enrichment that produces optimal effects with reducing agitated behaviors and improving quality of life in Alzheimer's patients. This study implemented the Music and Memory program which provides individuals suffering from dementia with music playlists tailored to their personal music preferences. The CMAI is a widely-used tool that evaluates agitated behaviors of participants using a caregivers' rating questionnaire consisting of 29 agitated behaviors each rated on a 7-point scale of frequency. When CMAI data and listening data for individual Study IDs were analyzed, it was found that as participants received a higher dosage of music, they also showed a greater overall decrease in CMAI score, indicating fewer agitated behaviors. These findings demonstrate that there is a dosage of music that can provide an improved quality of life for Alzheimer's patients and, in the future, it can be applied to reduce their need for anxiolytic and antipsychotic drugs.

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	Fair Category	Project Number
212	LS	3114

Title: Mechanistic Study of Sustained Release Microneedles

Student Name(s): K. Anderson

Abstract:

In recent years, microneedle technology has rapidly grown in terms of applications, designs, and capabilities. Sustained drug delivery is a powerful potential application of microneedle technology. Therefore, with this study we aim to prove and validate the mechanism by which the sustained release of drugs from a novel microneedle device works. This was carried out through a series of experiments where macro-scale drug core prototypes were created to examine the border region of the encapsulation layer and the drug core. Observations were made about the degradation of these prototypes with the use of optical imaging as well as scanning electron microscopy. Results were then achieved by obtaining data from prototypes at different days throughout the degradation process to characterize the progression of degradation. This revealed a delayed zero-order release profile, which is highly desirable and did not include an initial burst release. Based on these results combined with previous data, it was concluded that the added encapsulation layer was a rate limiting factor and a combination of release mechanisms occurred in order to achieve the observed release profile. Understanding the mechanisms of this release is critical in further development toward a clinical application. With this knowledge, further studies may be conducted to investigate translational applications for these microneedles as well.

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):

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- ☐ 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	Fair Category	Project Number
245	LS	3115

Title: Potential Biofilm Disruption via Natural Enzymes

Student Name(s): E. Larkin

Abstract:

This experiment was performed to determine the efficacy of the natural enzymes protease and amylase on the degradation of the Staphylococcus epidermidis Biofilm matrix since degradation of the biofilm matrix will allow bacteria within to be exposed. The production of a biofilm has been determined by scientists to be a virulence factor in various bacterial infections, therefore investigating safe methods of degradation of the matrix can help remove and eliminate existing biofilm. Enzyme efficacy was examined under a light microscope at a magnification of 40x and 100x. After a 24 hour incubation period on tryptic soy agar at Staphylococcus epidermidis's optimal growth temperature of 37ºC, followed by an additional 24 hour incubation with a 1% amylase solution, significant degradation was visible. A visual analysis between the sample and a control (that had been incubated for a total of 48 without the presence of enzymes) exhibited that large clusters of the biofilm were significantly reduced in size after the introduction of the enzyme. In another trial, 100% bacterial protease solution was tested with an initial 24 hour incubation period followed by 24 hours of incubation with the enzymes. This test also demonstrated a reduction of a large mass of biofilm into smaller components with the introduction of the enzyme. This suggests that both amylase and protease have potential in biofilm matrix degradation, which can help with future developments of medicine that can reduce treatment time as well as cost of bacterial infections caused by biofilm formation.

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	Fair Category	Project Number
249	LS	3116

Title: The Influence of Light and Branch Diameter Size on Ash Tree and Emerald Ash Borer (Agrilus Planipennis) Larvae Performance

Student Name(s): A. Paul

Abstract:

Here, branch assays are used to examine how branch diameter and light may affect EAB development and ash resistance. The highest EAB density is in larger diameter (4-10 cm) branches, potentially because it protects against temperature extremes and has more phloem for feeding. Alternatively, thinner bark could have more chemical protection and photosynthetic tissue, allowing a greater response to larval feeding. Independent variables include the presence of light and branch diameter (2 and 6 cm). The dependent variables are ash tree performance (frass color) and EAB larval performance (survival, weight, epistome width, urogomphi length, instar, and gallery width). Six 2 cm and six 6 cm diameter branches were selected from a white ash tree and 3 pairs of EAB eggs were attached to each branch. Three 2 cm and three 6 cm diameter branches were stored in a growth chamber at 25°C set to a long-day light dark regimen (L:D, 16:8). The rest were stored in a dark growth chamber at 25°C. After five weeks, branches were debarked to reveal larval survivorship and galleries. Chi-squares and ANOVAs revealed no interaction between branch size and treatment, but larvae were more developmentally advanced in the dark. Little branches displayed the most resistance. Results indicate that more exploration is needed, but the ash tree defense mechanism is dependent on photosynthesis. This defense if manipulated can ultimately slow EAB population growth by increasing generation time (by slowing larvae development) and increasing its vulnerability to predators and other risks.

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

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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
248	LS	3117

Title: Micronutrient Sourcing of Marine Macrophytes in Application of Enhanced Neonatal Dietary Supplement

Student Name(s): A. Moura

Abstract:

Mothers who are unable to breastfeed can affect their infant's nutritional intake and ultimately prevent them from developing properly. Infant formula — which mimics breast milk and is the best alternative to a neonatal nutrient source — can be costly and made up of artificial nutrients. It is proposed that by developing a neonatal dietary supplement which is most similar to breast milk, it will provide an affordable, safe, and nutritional product. The micronutrients were to be extracted from marine macrophytes Chondrus crispus and Kombu kelp by performing a bulk extraction and Iodine extraction in order for nutritional deficiencies to be eliminated. After performing the bulk extraction of Chondrus crispus by boiling its particles to extract the carrageenan, the product was tested on the Bruker S1 TITAN/Tracer 5', and 510 ppm of Calcium, 406 ppm of Iron, 236 ppm of Potassium, and 13 ppm of Zinc were detected; however, this indicates that no Iodine was detected and there was not a sufficient amount of these micronutrients present. When testing for the presence of micronutrients in Kombu kelp, the data from the extractions shows that Calcium, Iron, Potassium, Zinc, and Iodine are abundant. Although less than 10 ppm of Iodine were detected in the Kombu kelp, several trials have increased the amount. The neonatal dietary supplement will be a safe and nutritional alternative for infants to consume since the micronutrients are derived from Chondrus crispus and Kombu kelp, natural sources that do not contain GMOs, denatured proteins, and synthetic vitamins.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
169	LS	3118

Title: Limiting the Growth of Cancerous Cells With Vitamin B12 and CBD Oil

Student Name(s): C. Pruitt

Abstract:

CBD oil has been used on cancer patients to reduce pain, stimulate appetite, and reduce nausea. While going through treatment, patients experience nausea and a loss of appetite, making it hard to maintain a healthy weight. With CBD oil, it has been shown that these issues are reduced. CBD oil has also been researched to lessen pain. Cancer and the treatment for cancer (chemotherapy) both cause pain due to inflammation, pressure on internal organs, or nerve damage. CBD oil indirectly interacts with the CB2 receptors and may help widespread pain by reducing inflammation.

Vitamin B12 is a prominent supplement in many foods including fish, chicken, cereals and other whole-grain foods. These are a lot of the same foods that are recommended to cancer patients. It has been estimated that 30-40 percent of all cancers can be prevented by lifestyle and dietary measures solely. With vitamin b12 included in the diet along with other supplements, it is likely that there will be a 60-70 percent decrease in breast cancer.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
252	LS	3119

Title: A comparison of endoluminal and subcutaneous mouse models of rectal cancer.

Student Name(s): J. Strong

Abstract:

Colorectal cancer is the third leading cause of cancer-related death in the United States and the incidence of rectal cancer in particular is increasing. Traditionally, rectal cancer was studied by injecting cancer cells beneath the skin of mice in the subcutaneous space. However, this model lacks the anatomic framework of the rectum and may not be the best approximation of the disease in humans. Recent developments allow for the growth of human rectal cancer cells within the rectal wall of mice. The aim of this project was to assess the accuracy of this novel, endoluminal mouse model and compare it to a subcutaneous mouse model. We hypothesize that an endoluminal model will be more reflective of the patient's tumor architecture and thus more accurately reflect a patient's disease. Cancer cells were harvested from patient rectal tumors and organoid cell lines derived. Organoids were then injected into NOD-scid mice via the subcutaneous and endoluminal models and tumors were grown for 16-28 weeks. Tumors were then harvested, fixed, and stained with Hematoxylin and Eosin for pathologic comparison to the patient's original tumor. Endoluminal tumors formed glandular structures nearly identical to the patient's tumor while subcutaneous tumors formed more solid, disorganized structures surrounded by necrotic debris. This observation was also made in four unique patient-derived organoids using multiple mouse replicates. These findings indicate that the endoluminal model more accurately recapitulates the architecture of the patient's tumor and supports the use of the endoluminal model to predict outcomes and treatment in the future.

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

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- ☒ vertebrate animals
- ☒ controlled substances

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
256	LS	3120

Title: Design of a Lateral-Flow, Species-Specific Rapid Diagnostic Test for Malaria

Student Name(s): J. Trudeau

Abstract:

Malaria has been one of the most-deadly diseases to affect humans. According to data from the World Health Organization, 435,000 people died as a result of malaria in 2017 alone, with 219 million cases being reported worldwide. Current rapid diagnostics, targeted for those areas where the disease is most prominent, are limited, as they can only identify one or two of the four malaria parasitic species known to affect humans. As such, there is a clear need for a more-detailed, rapid, and simple malaria diagnostic that can differentiate and diagnosis the four Plasmodium species of falciparum, vivax, ovale, and malariae, to better identify a patient's condition, and provide improved treatment. In this research, such as Plasmodium-specific rapid diagnostic was engineered, based on pLDH and HRP-2 malaria ELISA chemistries. Using on lateral-flow design on strips of cellulose/nitrocellulose atop a Lexan polycarbonate backing, the new diagnostic contains three channels of detection; pLDH for the detection of P.ovale and P.malarie, HRP-2 for the detection of P.falciparum, and P.vivax-specific pLDH, for the detection of the same. Following iterative designs to include mid-channel capture antibodies to remove unwanted, cross species interferences, it was discovered that the minimum detectable limit for HRP-2 was 0.2-0.4ng, while for both pLDH channels, a detection limit of 0.04ng was achieved. All of these detection limits are commensurate with early-onset of each respective malaria disease, which will promote administration of the much-needed therapies, to prevent the progression of the disease to its most lethal stages.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
192	LS	3121

Title: How Does Neuroplasticity Affect the Recovery of the Paralysis of Stroke Patients and Slow the Effects Parkison's Disease?

Student Name(s): A. Thite

Abstract:

Neuroplasticity is the ability for a person's brain to change continuously throughout their entire life. The purpose of the project was to determine how neuroplasticity affects the recovery of the paralysis of stroke patients and how it slows the effects Parkison's disease. When a person endures a stroke or has Parkinson's disease, they can lose vital body functions due to brain damage. The hypothesis was that Neuroplasticity can rehabilitate the portions of the brain that are damaged, however it was proven to be false. Through analyzing the process of how neuroplasticity works, its true effects were determined. Neuroplasticity occurs as a person goes through physical, occupational, and speech therapy while they perform specific tasks with much repetition. Neuroplasticity helps the brain rewire the performance of functions to other, healthy portions of the brain. The rewiring, encouraged by therapists and rehabilitation specialists, compensates for the damage caused by a stroke. Additionally, brain reorganization occurs by developing new neural pathways to assist in the impaired functions caused by Parkinson's disease. Neuroplasticity starts through methods such as "axonal sprouting" and "neurogenesis", where healthy axons grow nerve endings to connect to neurons whose connections were damaged.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
253	LS	3122

Title: Testing the Optimum Delivery Method and Formula of Plant Probiotics and Probiotic Soil

Student Name(s): A. Adams

Abstract:

The current widespread use of fertilizers have been shown to cause negative impacts on surrounding wildlife. It has been demonstrated that probiotics are good at promoting plant growth, and can be used as a substitute to harmful fertilizers. This study focuses on discovering the best system for delivering probiotics to plants. Most store bought plant probiotics are mixed into soil, however it is hypothesized that other delivery methods may also be suitable or even superior. It was specifically hypothesized in the first phase of study that the probiotic spray would be the most beneficial. In addition, it was hypothesized that a novel probiotic soil was created with carefully selected ingredients and hypothesized to be superior to store-bought versions. There were two phases of probiotic testing. In the first phase, two types of plants with several methods of probiotic application were tested, including a dry coating, probiotic spray, and mixing probiotics directly into the soil. Two control groups were also included. Plant growth for each probiotic method was measured and recorded. In the first phase, it was discovered that the novel probiotic soil was most beneficial to the plants tested. The second phase focused on comparing the novel probiotic soil mix to a store-bought probiotic soil. In this phase the novel probiotic soil was shown to be more beneficial than the store-bought soil. This study provided information on the best ways to deliver plants probiotics and explores solutions and replacements for traditional fertilizers, which can be harmful to the surrounding environment.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
222	LS	3123

Title: Prevention of the Production of Saltwater Biofilms through the use of a Thermoplastic Elastomere

Student Name(s): T. Tower

Abstract:

Biofouling, the buildup of organic materials on the hulls of ships and other surfaces in water, costs, on average, one billion dollars per year for the shipping industry, meaning that methods of preventing biofouling are highly sought after. Previous research has shown that Silicone based elastomers are effective in preventing biofouling, but Silicone elastomers have issues affixing themselves to surfaces and are typically more expensive than thermoplastic elastomers. Thermoplastic elastomers, such as those found in the coating "Plastidip", are more effective for anti-biofouling purposes, and will thus minimize the buildup of organisms on surfaces in the water. Samples coated in the elastomer were suspended in a freshwater medium with the diatom Navicula and algae Microcystis, and then the density of organisms on the sample was measured by massing the differences between the samples before and after submersion. There were 0.00015 fewer grams growth of Microcystis on the coated samples compared to the uncoated samples, thus implying that thermoplastic elastomers are effective in anti-biofouling roles. There was no difference in the growth of Navicula between the coated and uncoated samples. More research on creating Thermoplastic Coatings to prevent biofouling is warranted because the production of such a coating is highly economically beneficial. This coating is less expensive than alternatives, easier to apply and remove, and less ecologically damaging than traditional coatings.

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

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
246	LS	3124

Title: Dual Targeting of ARK5 and CDK4 to Induce Cell Death in Triple-Negative Breast Cancer

Student Name(s): S. Desai

Abstract:

Triple-Negative Breast Cancer is a form of breast cancer that tests negative for estrogen, progesterone, and HER2 receptors, and accounts for over 7,500 deaths in the United States annually. There are limited therapies available, as hormone treatment is ineffective since the tumor lacks hormone receptors, which leads to more patients succumbing to the disease in relation to the number of diagnoses. There has been a modest response to selective CDK4/6 inhibitors, which are currently available as chemotherapeutic agents, however, the partial response could be the result of an incomplete targeting of kinases. AMPK-related protein kinase 5 (ARK5), is expressed in Triple-Negative Breast Cancer lines and is associated with both tumor proliferation and metastasis. In this study, we examined whether the dual targeting and inhibition of CDK4 and ARK5 using the drug ON123300 would result in a better therapeutic outcome in comparison with single CDK4 inhibitors. The treatment of the Triple-Negative Breast Cancer cell lines with ON123300 in vitro resulted in cell-cycle arrest closely followed by apoptosis. ARK5 inhibition led to the inhibition of the mTOR/S6K pathway along with the upregulation of the AMPK cascade, which resulted in the destabilization of the steady-state MYC protein and increased levels of SIRT1. This research provides preclinical evidence that ON123300 is unique from other drugs in inhibiting oncogenic pathways in Triple-Negative Breast Cancer and supports the development of dual CDK4 and ARK5 inhibition as a therapeutic approach to Triple-Negative Breast Cancer.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): CB ME BI

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- ☐ controlled substances

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
252	LS	3125

Title: COMPARATIVE ANALYSIS OF THE MITIGATION AND EMISSION RATES OF VOLATILE ORGANIC COMPOUNDS OF VARIOUS ORNAMENTAL PLANTS USING A MONITORED ENVIRONMENT

Student Name(s): P. Joseph

Abstract:

Often overlooked issues like poor ventilation and sub-par construction methods have caused (1) the proliferation of dangerous air-borne compounds inside public buildings and (2) the rise of indoor air pollution. Specifically, VOCs (volatile organic compounds) pose a great threat to human health as inhaling these particles can cause cardiovascular and respiratory diseases. Furthermore, VOCs react with nitrogen oxides (NOx) and carbon monoxide (CO) to form tropospheric ozone, a notable green-house gas.

This project aims to create a comprehensive study comparing the mitigation and emission rates of the Peace Lily, D. Marginata, and S. Trifasciata. It was hypothesized that the S. Wallisii would emit more VOCs during the emission phase, whereas the S. Trifasciata would mitigate a substantial amount relative to the other experimental groups due to having a larger surface area per leaf.

A repurposed grow tent was used along with an Arduino-programmed SGP30 sensor and DIY carbon filter to measure the total VOC and equivalent CO2 levels. Additionally, an aerosol paint with high concentrations of acetone, xylene, and ethylbenzene was sprayed during the mitigation phase. The emission results showed that the S. Trifasciata produced the most TVOCs contrary to the given hypothesis with peaks reaching ± 200 ppb, which is a marginally low concentration. The S. Wallisii constantly emitted < 100 ppb and the D. Marginata emitted < 40 ppb with 'on-off' cyclical rates. On the other hand, S. Wallisii had the highest mitigation rates and reduced the amount of TVOC in 16 ft³ of air in 5 minutes.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
260	LS	3126

Title: Effects of Ziziphus jujuba and Brief Mindfulness on Cellular and Adolescent Stress

Student Name(s): H. Kim

Abstract:

The increasing prevalence of mental illness among teens urges research toward an efficient method to reduce stress levels. The aim of the present study was (1) to evaluate the impact of mindfulness and jujube tea on adolescents' salivary cortisol and systolic BP levels, common measures of stress; and (2) to assess the impact of jujube on cellular stress.

First, 24 participants were divided into four groups: 6 participants consumed jujube tea before participating in a 15-minute mindfulness breathing intervention for 9 sessions; 7 participants participated in a 15-minute mindfulness intervention; 5 participants consumed jujube tea; and 6 participants counted. BP was collected each session before and after the intervention, while salivary cortisol and questionnaires assessing stress and mindfulness scores were collected on the first and final sessions. Next, three types of cells (MDA-MB-231, CPAE, and MAC-T) were cultured in media containing various concentrations of jujube and ethanol, and some were set to vibration on a rocker for 15 minutes. Cell viability tests were then conducted using Trypan Blue dye with a hemocytometer, and the CCK-8 assay.

Salivary cortisol and BP levels were significantly reduced following a brief 9-session mindfulness intervention; adding jujube tea amplified stress-reducing effects. Jujube proved effective in increasing cell viability under vibration compared to cells grown in ethanol-containing media. For CPAE cells, jujube was more effective at high concentrations; for MAC-T cells, jujube was more effective at lower concentrations.

Findings confirm existing literature on the positive effects of mindfulness and jujube tea on adolescent and cellular stress.

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

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CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
257	LS	3127

Title: Discovery of a Novel Therapeutic Vulnerability in Pancreatic Ductal Adenocarcinoma via an Unbiased High-Throughput Drug Screen

Student Name(s): M. Woo

Abstract:

Pancreatic ductal adenocarcinoma (PDAC) is predicted to become the second leading cause of cancer-related deaths in the United States by 2020 due to an innate resistance to common chemotherapeutic agents and limited knowledge about what drives tumor aggression. It was recently discovered that overexpression of keratin 17 (K17), a protein biomarker, results in accelerated tumor growth and increased patient mortality. This research discovered that K17 can be targeted therapeutically by an extremely effective, novel personalized cancer treatment. Several high-potential small molecule drugs initially identified in a high-throughput drug screen were then tested to reveal which candidates most specifically targeted K17-expressing cells (based on IC50 value, the drug concentration that inhibits half the cell sample). Podophyllotoxin (PPT), a microtubule inhibitor, was found to be more than twice as effective in inhibiting K17-expressing cells compared to K17-negative cells, overcoming the inherent drug resistance caused by high K17 expression. In validation experiments, flow cell cytometry revealed significantly increased cell death (apoptosis) in K17-expressing cells, showing that PPT mechanistically targets these specific cells. Further IC50 testing revealed that the new combination treatment of PPT and Gemcitabine (Gem, a common chemotherapeutic) is highly synergistic. It could greatly enhance treatment efficacy for the >50% of aggressive high K17 PDACs as compared to a current standard of care regimen, which combines another microtubule inhibitor, Paclitaxel (PTX), with Gem. In summary, K17 is a novel therapeutic target for a biomarker-based personalized treatment that can significantly improve the prognoses of hundreds of thousands of pancreatic cancer patients annually.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): CB ME BI

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CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
177	LST	3501

Title: The Utilization of Micro-bubbles as a Catalyst for Flocculation of Polluted Water

Student Name(s): T. Chang, C. Mackesy

Abstract:

The objective of this project was to determine the most optimal flocculation mixture, catalyzed by microbubbles, for use in treating nutrient pollution (nitrates and phosphates) in order to prevent or reduce incidences of hypoxia. Initial steps included establishing a mixture baseline, followed by multiple trials varying ratios of alum, chlorine, lime, and polyacrylamide which were added to collected water samples from local ponds exhibiting eutrophication. Prior to beginning flocculation, water samples were tested to determine nitrate and phosphate levels as well as absorption. Within each trial, collected water samples were added to each of two beakers: one the control and the other containing the flocculation mixture. After the flocculant mixture was added to the beaker, a microbubbler was used to disturb the water. A polymer was then added to stabilize the floc and the microbubbler removed after one minute. Mixtures were left overnight and then retested for levels of nitrates, phosphates, and absorption. Analysis of initial data indicates the optimal flocculation mixture reduced both turbidity and levels of phosphates, however, nitrate reduction data was not statistically significant.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
241	LST	3502

Title: potential of ocean acidification to interfere with predator prey relationships of coastal Invertebrates (carcinus maenas)

Student Name(s): R. Hoffman Blustajn, G. Spata

Abstract:

The stress that the growing global population places on the environment has been the focus of several studies and recognized and one of the top global issues we face. The carbon dioxide emitted from combustion motors used, from power plants to automobiles and homes, has been linked as a major contributor to the problem of ocean acidification. An understudied aspect in the literature, in our opinion, is its impacts on the predator prey interactions in the coastal ocean nurseries which are vital for recreational, ecological and commercial fisheries. The need to have thriving nurseries has long been a focal point for fisheries management research. This study aimed to evaluate the potential for ocean acidification to impact the predator prey interactions that are the backbone of these nurseries. Replicated trials exposed Asian Shore Crabs (Hemigrapsus sanguineus) to prey (Palaemonetes spp) under both ambient (pH = 8) and acidified (pH = 6) ocean water conditions. Predator response time was monitored and results showed consistency in acidification producing a significantly faster response time ($p<0.05$, $\alpha=0.05$). Whether or not this is a physiological response or a behavioral response to environmental stress should be the subject of further studies, however, it highlights a greater need to further evaluate the implications that ocean acidification will have on trophic dynamics down the line. We suggest here that these results and future studies on this be used to better inform our management decisions on human impact in the ocean.

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

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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	Fair Category	Project Number
243	LST	3503

Title: Using Microbiome Analysis to Determine the Effectiveness of a Unique Ceramic Water Filter

Student Name(s): G. DiBiase, K. Ulmer, A. McCloskey

Abstract:

It is estimated that 780 million people in the world are without clean drinking water. This study will help solve the problem of impure drinking water in developing countries by creating and testing a novel porous ceramic filter. It is hypothesized that this affordable and easy-to-use filter will reduce the number of bacterial species in a sample of pond water, thereby also reducing bacterial species in polluted drinking water. Several specialized porous filter pots that could filter water through its microscopic holes were created. Not only did the water filter through the porous ceramic, but the pot's capabilities were enhanced by additional features incorporated within the pot. We tested effectiveness by filtering pond water through the uniquely designed porous filters and then used e-DNA filters and microbiome diversity analysis to determine the reduction in bacterial species. Levels of alkalinity, hardness, nitrates and phosphates were also tested before and after filtering, and reductions in alkalinity were detected. Our results from the microbiome analysis suggest that one clay pot with specific enhancements had the greatest success in filtering bacteria. There were 5,414 bacterial species in the unfiltered pond water and 1534 bacterial species in the water after it was filtered through the pot with these enhancements. Therefore, bacterial species were reduced by approximately 72%. This study demonstrates an easy and affordable solution to reduce bacteria from drinking water in areas of the world that are in the greatest need for water purification.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EV 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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
247	LST	3504

Title: The Effect of Mutated Bacillus Thuringiensis On Tobacco Horn worms

Student Name(s): C. Hatfield-Mendez, M. Marshall

Abstract:

Tobacco Hornworms and other related species are an invasive pests. Bacillus thuringiensis is a natural pest killer used by farmers today, but the treatment takes approximately two weeks to eradicate the pests. By then, there could be severe crop damage. We hypothesized that if we mutated a B.T. strain using UV method to create a more aggressive strain, that it would reduce the time of eradicating the pests. Once we isolated strains from the soil, we grew them in liquid cultures. After we had mutated strains and were ready to dose the tobacco hornworms, we set up trials by separating them from each other and coating the dose of mutated B.T. on a traditional crop, tomatoes. After waiting overnight to see results the next day, we would monitor worms for death and reactions. The first dose of mutated strains of B.T. was dosed on the first trial of worms, and killed them in 2 days. The next mutation was made before the next trial, and had more results from the spectrophotometer. This mutation of BT reacts to the tobacco hornworms, a more aggressive strain of BT could have huge cost savings for farms. The tobacco hornworms were an interesting choice of species to work on, because there was already research on them. This helped us know their lifestyle and how to correctly take care of them. They would sleep for most of the day, but seemed to eat the food at night, and ate the food fast.

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

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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	LST	3505

Title: The Effects of Dietary Supplements on Cancer cells Vs. Normal Cells

Student Name(s): E. Keegan, D. Lucy, A. King

Abstract:

Dietary Supplements are implemented in daily use materials. One example is Conjugated Linoleic Acid (CLA), which is found in meat and dairy products derived from ruminants. CLA extinguishes the growth of some carcinogenesis cells and demonstrates potential in preventing growth in malicious cells. There are two other products that show potential in yielding the growth of malicious cells. Each item was thoroughly researched so the best results could be achieved, which was affecting the growth of malicious cells. The procedure which will be done is fairly simple with the right equipment and training. After all the equipment was purchased, the cells were purchased. Normal lung cells and cancerous lung cells were some of the cells that were purchased. Some mock labs had to be run so none of the actual cells could be wasted in an actual procedure. Unfortunately, data can not be drawn at the moment due to an error in shipping. However, the procedure could be explained. After the cancer cells are matured in the incubator, subcultivation will happen. Cells would be divided into 3 shares, for each different supplement product. The normal cells will be in one container, while the malicious cells in another. For the oleic acid and CLA, it will just be simply mixed in with both cancer cells, but for the Safflower oil, Beta Methyl Cyclodextrin will have to be used to separate the oil and mix it in the cell's food. Data will be measuring changes in the cells, for better or worse.

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	Fair Category	Project Number
251	LST	3506

Title: Biomarker model for cancer: Development of fast LC-MS/MS method for reduced and oxidized glutathione

Student Name(s): R. Nassar, P. Chitralia

Abstract:

In recent years, there have been significant efforts devoted to countering the challenge of detecting cancer in the early stages. Reduced glutathione (GSH) plays an important role in the antioxidant system and is required for the maintenance of the redox status of the cell, defense against free radicals and detoxification of toxic compounds. GSH may be changed to oxidized glutathione (GSSG) during the oxidative stress that it regularly undergoes when combating cancer cells. Therefore, the ratio of GSH to the total amount of glutathione can be an extremely useful biomarker for detecting cancer. However, there has yet to be an effective method of detecting and quantifying glutathione in cells, making it extremely difficult to use as a biomarker. In this study, we have created an effective method of detecting both forms of glutathione, utilizing high-performance liquid chromatography-tandem mass spectrometry (HPLC-MS/MS). The analysis time took less than 1 minute. We were able to quantify both GSH and GSSG in one method. The limit of quantitation is 1 ng/mL. We ran three trials, and each examined a range of concentrations, from 1 to 500 ng/ml of GSH and GSSG. Results were calculated using peak area ratios, and calibration curves were generated using a weighted (1/x2) linear least-squares regression. Using HPLC-MS/MS technology, we were able to determine both the amounts of GSH and GSSG in a single method, creating a fast, reliable, non-invasive, and cost-effective method of testing early stages of cancer.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) BI 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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
194	LST	3507

Title: Building a Space Neutral Hydroponics System for the Novice Gardener

Student Name(s): H. Burgess, A. Tsoukalas

Abstract:

A space neutral hydroponics system that is easy to use is something that could change the way people grow fresh produce. Using a hydroponic techniques called the Nutrient Film Technique as a base for the construction, our product will be compact enough to fit into a standard window frame. This gives people living in apartments or condos the opportunity to have fresh vegetables, especially when living in areas with limited access to such produce. This product will help eliminate food insecurity and make gardening easy for any type of home and home owner. The problem statement we are working off of is finding a way for people in small living accommodations to have a garden will help preserve space, and reduce their carbon footprint during this time of ecological failure. Knowing that people who live in apartments do not have a lot of extra room for an entire garden this compact hydroponics system is the ideal thing to have and use even when you are new to the gardening community. To make sure that the idea is effective we will measure the growth of the plants over time and the successfulness of the system.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
225	LST	3508

Title: Water dispenser for the homeless

Student Name(s): T. Donath, C. Lawrence, A. Megos

Abstract:

The main purpose is to help solve the water and plastic bottle crisis. I chose this one because it affects so many people in the world. About 700 million in over 43 countries around the world are affected by the water crisis, if it keeps going by 2025 there will be 1.8 billion people around the world will be affected. In our investigation like I just said this affects way to many people in the world. There is also more than 12.7 million tonnes of plastic entering the ocean every year. With our machine it will use reused and biodegradable water bottles. In my observations it's not only third world contries without running water 1.6 million americans don't have running or clean water. In my mind something like water should be easy to get but billions of people in this world don't have running clean water. In 2017, there wasn 35.4 million tons of of plastic generated in the US alone. 3.0 million tons of plastic is recycled, 8.4 precent of what was made in 2017.

In conclusion, the water and plastic crisis is a problem that needs to be fixed now. If we don't sovle this problem soon we will face the consicwens and will be very sorry that we didn't take action sooner than later.

Group members: Toby Donath, Colin Lawrence, Adien Megos

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

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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
257	LST	3510

Title: From Brown to Green: The Effect of Weather Conditions on Phytoremediation

Student Name(s): G. Galatioto, J. Lamoureux

Abstract:

Phytoremediation, the use of plants to remove contaminants in soils, is a cost efficient way to treat polluted land. Sunflowers, proven to be effective for phytoremediation, were put under harsh weather conditions to simulate weather regions. It was hypothesized sunflowers exposed to rainfall with higher or lower levels of pH would be less effective for phytoremediation. Two sunflower seeds were planted for each treatment, those being water, basic rain, acid rain, 0.075-M copper nitrate, 0.075-M copper nitrate+acid rain, and 0.075-M copper nitrate+basic rain. After the experiment, the hypothesis was proven incorrect because it was not alone the acid or basic rain that inhibited the sunflower's growth, it was the combination of the weather conditions and the pollutant. The sunflowers being watered with acid rain germinated both seeds and had an average stem length of 1.94cm. The same occured for the sunflowers treated with alkaline rain as both seeds germinated and had an average stem length of 2.26cm. However, with inadequate pH levels and being exposed to a pollutant, the sunflowers struggled. The acid rain+copper nitrate solution germinated 1 seed at an average stem length of 1.30cm and the alkaline rain+copper nitrate solution germinated 1 seed at an average stem length of 1.60cm. Results show that sunflowers can survive in environments with inadequate pH levels, however not when combined with the task of being used for phytoremediation. This means that sunflowers could be used for phytoremediation in environments with pH levels hovering around 6.0-7.5, but not extreme acidic or alkaline environments.

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
161	LST	3511

Title: The Effects of Virtual Reality on Adolescent Reaction Time and Cognitive Recall

Student Name(s): S. Guadalupe, A. Marks

Abstract:

The purpose of this study was to investigate the effect of virtual reality on adolescent cognitive function. It was hypothesized that exposure to virtual reality would hinder reaction time and cognitive recall in adolescents. The first phase established a beta and gamma wave baseline for each participant. To accomplish this, participants completed both simple and choice reaction test portions while wearing an electroencephalography headband (Muse 2) to measure beta and gamma brain waves. The participants were then placed in two groups: one that used virtual reality to play a game v. the group that played the game on a mobile device. Two weeks after establishing the baseline, participants played the game (Angry Birds) according to their group designation, and were retested using the EEG. The average beta and gamma decibel levels from each session were recorded and then analyzed for statistical relevance. Data trends indicate there may be an initial reduction in cognitive function and memory, but further study is needed.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
238	LST	3512

Title: The Fireflies of the Sea

Student Name(s): L. Noblet, J. Reed

Abstract:

The purpose of this project is to test the effect of temperatures on the growth of bioluminescent dinoflagellates. Dinoflagellates are pyrocystis algae that grow in the warm waters of the south and will release an effortless glow when disturbed or moved. When these algae glow, they produce a light using a luciferin-luciferase reaction. The luciferase found in dinoflagellates is related to the green chemical chlorophyll found in plants. The dinoflagellate ecosystems are rare, and mostly only form in clear water lagoons with small openings to the open sea. In order for them to grow, they need nutrients from the sea water, a steady and stable environment, and the perfect temperature of reproduction. These bioluminescent algae are in fact quite good for the ocean and are actually losing parts of their population due to global warming and pollution. The algae themselves are in most cases the lowest on the marine food chain and will provide a stable food source for other marine life such as fish and even shrimp. The goal for this project is to determine what temperature the algae is willing to grow the best with and monitor their reproduction in order to help them reproduce and see how they need to be regulated the ocean. In time, we should have the ability to reproduce the algae and even extend their lifetime. We will then find new ways to keep the ocean clean for the future.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
83	LST	3513

Title: The Mental and Physical Effects of Processed and Organic Food

Student Name(s): A. Leblanc, M. Brown

Abstract:

The whole purpose of this research project is to stop organizations from giving us chemical filled foods that are slowly killing us and making us

more violent, while wasting more energy than organic foods. The procedure of this will be based on or mental and physical health throughout Jan-March by writing down how we felt and our thoughts during this project. We are hoping this will show the cause this has on our society and hopefully get this change showing this data.

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

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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
168	LST	3514

Title: The Effects of Mycorrhizae and Salinity Stress on Kale Growth

Student Name(s): R. Cruse, K. Bryan

Abstract:

Arable land is expected to decrease by 50% in the next 40 years due to salinization. This is a huge problem for the world's food supply because food cannot be grown without arable land. Mycorrhizae could help make it so plants can be grown in salinized soil. The purpose of this experiment was to see if mycorrhizae could ameliorate the effects of salinity stress. Sixteen kale plants were grown. Four were watered with freshwater and had no mycorrhizae added to them. Four were watered with freshwater and had mycorrhizae added to them. Four were watered with saltwater and had no mycorrhizae added to them. Four were watered with saltwater and had mycorrhizae added to them. Data on the stem and root length and the amount and diameter of leaves were collected. When ANOVA was run, the results failed to reject the null hypothesis. Therefore, it cannot statistically be proven based on this study that mycorrhizae and saltwater affect kale or that mycorrhizae ameliorate the effects of salinity stress.

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

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4. Is this project a continuation? ☒ Yes ☐ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
246	LST	3515

Title: The Effect of Construction on the Water Quality in the Mianus River

Student Name(s): C. Calcano, B. Rogers

Abstract:

The Mianus River is used by over seven rowing teams who practice daily for three seasons every year. In the fall of 2019, a large construction project started on the river with the RowAmerica Greenwich Boathouse being built. It is hypothesized that the construction and debris from this project will affect the quality of the water and have detrimental effects to marine life. In addition, the train bridge site may also exhibit lower water quality due to observed pollution in the area. Three testing sites were chosen to measure water quality parameters. The first site is adjacent to the construction at RowAmerica Greenwich, the second site is under the train bridge, and the third site is a control site at Goose Island, a pristine location that should be unaffected by the construction. Water was collected before and during construction and the following parameters were measured: dissolved oxygen, conductivity, nitrates, pH, and coliform bacteria. Data thus far demonstrates differences in water quality parameters among the three sites. For example, water quality was lower at the construction site when compared to the control due to repeated positive coliform results. Further research will be completed in the spring so that we can educate the town and hopefully play a role in limiting pollution. Additional actions include limiting boat pollution in the Mianus River to help return the water to a healthy state, and regulating and enforcing construction rules when construction occurs in the vicinity of a body of water.

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

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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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
216	LST	3516

Title: Gluten is Bad it Makes me Sad

Student Name(s): L. Heft, S. Velez

Abstract:

Gluten sensitivity is an issue that affects roughly six to seven percent (about 20 million) of the American population. The purpose of this research project was to isolate, then mutate using UV light to create a more aggressive gluten degrading strain of bacteria. If we succeeded in creating a more aggressive strain it could be used so people could consume gluten without suffering the negative effects of gluten sensitivity. We hypothesized that if we UV treat the bacteria isolated from the silva and grow on a gluten-based media we could continue to mutate it so it becomes a more aggressive gluten degrading strain. For our project, we swabbed silva on a gluten-based media to grow the initial bacteria trial. After the bacteria grew on the gluten-based media, we inoculated the bacteria into liquid cultures. We then UV treated the bacteria to initiate the mutation process. After UV treating the liquid cultures we streaked them on gluten-based media. After repeating this process multiple times we replaced the liquid cultures with gluten-based liquid TSA. We continued the process with the gluten liquid cultures a few more times. Our results show the definite zones of inhibition around the gluten degrading bacteria that have been mutated using the UV method on the plates containing gluten.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) BE CH 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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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	LST	3517

Title: Wavelet-Based Machine Learning Algorithms to Enhance Cardiovascular Disease Diagnosis

Student Name(s): V. Pegkou Christofi, R. Kottou

Abstract:

In recent years, the heart has become a popular topic of discussion as the amount of cardiovascular deaths continues to grow at an alarming rate worldwide. Early detection of such diseases plays a crucial role in resolving this concerning health crisis. However, natural human error combined with a lack of doctor availability often hinder accurate detection, especially in developing countries. In this study, we will show that machine learning and artificial intelligence can provide the best tool available to detect heart diseases. We employed Wavelet-based machine learning algorithms such as Long Short-Term Memory Network, Convolutional Neural Network, and Support Vector Machine in order to devise a mathematical model which classifies human heart beats as either normal or abnormal. Utilizing MATLAB and Google Colab, we processed our data and wrote codes. Our models were tested using the data provided by the PhysioNet/Computing in Cardiology Challenge 2016, the largest public heart sound database consisting of 3,126 heart recordings from healthy subjects and patients with a variety of heart conditions. Such computational models would then allow patients from any region of the world to record a heart sound using their mobile device, enter it into our model, and receive an immediate diagnosis. We found that the Wavelet Transform approximation yielded a similar accuracy to the Wavelet Transform tensor, indicating that the approximation is a good representation of the entire dataset. In fact, our highest accuracy of 94% was achieved through the Convolutional Neural Network using the first level Wavelet Transform approximation.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) MA 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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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	Fair Category	Project Number
242	LST	3518

Title: The Impact of the Global Thermostat

Student Name(s): F. Suede, K. Nolan, J. Green

Abstract:

As a part of the coming generation growing into a world that will be dealing with climate change, we wanted to see the impact that it will have on the animal kingdom. To do so, we choose to do an experiment that would monitor how isopods would reproduce depending on the 'climate' they lived in. Isopods were our creature of choice as they would show results that could layover to other animals, since they play a role in decomposing dead plant matter. Thus our hypothesis was, if climate change increases isopod population growth then isopods will consume more leaf litter and put animals that use dead leaves as shelter at risk. So we gathered a small amount of isopods and created groups. The first group was placed in a colder temperature range, the second in a temperature range that emulated the one they usually live in, this was our control group that wasn't affected by the independent variable of atypical temperature so we would have data to judge with. The third group was placed in a warmer temperature range, to emulate the increasing global temperatures we are expected to experience in coming years. Over a twelve week period, we conducted censuses on each group weekly to gather the data. Our hypothesis was proven, in terms of climate change leading to an increase in isopod population growth. Future applications of this experiment would show an ecosystem impact if conducted on a larger scale.

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):

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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	Fair Category	Project Number
231	LST	3520

Title: Alternating Red Wiggler Worms Gut Microbes to Degrade Lignin in Plants for Biofuels

Student Name(s): J. Adams, O. Perry

Abstract:

Lignin is an organic substance found in plants, essentially being the structure for a plant as it gives stability, strengthening the cell walls. It is the woody material found in plants that is very difficult to degrade for further use. This research involved looking for a way to degrade lignin using Red Wiggler worm models. Red Wiggler worms themselves had a complex digestive system, and have the ability to degrade dead and decaying plant material around them. Using Red Wiggler worms as the research model, soil samples were collected for 5 months and serial dilutions were performed to isolate the bacteria. The worms were fed increasing measurements of lignin to get their gut microbes to adjust to the lignin and produce bacteria capable of degrading lignin. Based on the results, the hypothesis was supported as the worm's gut microbes were altered to digest and degrade lignin particles. A total of 11 isolates were collected and tested positive for degrading properties and were able to grow and survive in a lignin environment. The positive isolates turned yellow and began to halo as they broke down the rings in the organic compound Azure Blue found in the media. Those that were not positive remained white and absorbed the Azure Blue dye. A total of 8 trials were performed and found 11 positive isolates that can be used for future biotechnology endeavors in biofuels.

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

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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	Fair Category	Project Number
252	LST	3521

Title: Studying the Evolution of People Pleasing in the Canis lupus irremotus in Comparison to the Canis lupus familiaris

Student Name(s): L. Jeniski, S. Bell

Abstract:

While most studies specifically focus on either wolves or dogs, this investigation compares the differences between both species with regards to their eagerness to please humans. In order to measure this, the researchers paid attention to how many times the wolves/dogs correctly guessed the right toy, and how long they stood at the fence paying attention. There were two toys, one with a positive connotation and one with a negative connotation. The squeaky cow had a positive connotation so when the wolf/dog touched it with their nose they received a treat. When they touched the tennis ball, the toy with a negative connotation, they received nothing. There were two-minute trials with a two-minute break. Our results showed that the wolves were consistently engaged in the experiment. They guessed correctly 1,678 times over 77 trials, which averages out to be 10.9 times per trials. The dogs only guessed correctly 45 times over 52 trials, and 42.3 percent of the time the dogs did not interact with the experiment at all. The wolf results proved they were very food motivated, while the dog results revealed they are motivated by a relationship. The dogs had a much shorter attention span than wolves. This confirms the belief that training dogs in short spurts fosters their learning, which is important for training dogs for task forces. This also raises the question, since humans have evolved to have things such as food much more readily available, is their attention span also shortening, like dogs?

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) BE 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	Fair Category	Project Number
251	LST	3523

Title: The Effect of Temperature on Lung Capacity

Student Name(s): J. Patel, J. Ashcom

Abstract:

This study was dedicated to analyzing and recording any potential relationships or patterns present between lung capacity and the change in varying temperatures. The lungs are an important and crucial part for survival and maintaining their health is needed to function. The study relates/can be applied to many activities and overall, lung health and capacity plays a very vital role in many biomedical fields today especially with topics of smoking, COPD, asthma, and more recently vaping becoming more relevant. Factors like pressure and temperature can impact how a lung will react to change depending on lung development and health. The study began with the three tests being performed at a gradient of varying temperatures, ranging from 10-37 degrees Celsius. he tests each provided a specific set of data unique to that test. Through the research, different factors were covered and the final hypothesis was formed, stating: When applying a change in temperature (ie. the applied heat) the balloon capacity (representing lungs) will increase at a higher temperature; due to the oxygen expanding within the lung. The tests provided results that helped elaborate on the effects of temperature on lung capacity/function. The data that was gathered showed that when the balloon was exposed to cool temperatures the volume would decrease and when heated, the balloon would expand. The secondary data that showed a correlation between temperature and volume showed when the temperature was decreased the pressure decreased and when heat was added, the pressure increases similar to the volume trials.

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	Fair Category	Project Number
248	LST	3524

Title: The influence of reading comprehension and manuscription ability correlative to public speaking performance.

Student Name(s): M. Shabazz, K. Nadama

Abstract:

Reading, writing, and oratorical performance are crucial, necessary skills as all are being demanded in education and business. However, relative to reading and writing, public speaking is seen as a more daunting and nerve-racking task. To measure public speaking performance, the participant's resting heart rate was measured, they were then asked to present about a picture in front of an audience, finally, their heart rate was measured and the difference was recorded. Individual test subjects gave their Scholastic Reading Inventory (SRI) score because it was used for an accurate comparison, to an extent, between participants. Since grammar is an essential part of manuscription ability, participants were tested on their ability to correctly spell commonly misspelled words. Test subject #12 has an SRI of 1590, received a 90% on the writing test, and had a 36.8 BPM increase from resting to presenting heart rate. Test subject #7 has an SRI score of 1550, got 80% on the writing test, and an increase of 24.2 BPM from their resting heart rate. Test Subject #13 has an SRI score of 1175, received 50% on the writing test and their heart rate increased by 19.1 BPM. An increased BPM represents the participants being passionate, confident and talking loudly which are skills that are associated with great public speaking. With this experiment, children with aphasia, communication disorder, and language impairment will be able to improve their speech by focusing on reading since it shows that it more prominently corresponds with oratorical performance.

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):

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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	Fair Category	Project Number
210	LST	3525

Title: The Effects of Biochar on Plant Growth in a Large Scale Setting

Student Name(s): M. DeWolf, O. Blanchard

Abstract:

Fertilizer is an issue for modern agriculture due to the amount of excessive runoff of the nutrients into local bodies of water caused by large scale farms. Biochar is a type of charcoal, that is often used as a soil amendment due to its ability to absorb phosphate and nitrates. Due to this fact, biochar is a possible alternative to fertilizers. We grew Raphanus sativus in trays of 30 plants each. Each tray had a specific amount of biochar added, in amounts of 10%, 15%, and 20% by weight. A control was also grown as a baseline. During the growth period the germination rate was recorded, along with nitrate and phosphate content using nitrate test strips and phosphate by molybdate assays. Our results showed that the addition of biochar to the soil increased the sprout rate of Raphanus sativus. The nitrate test strips and phosphate by molybdate assays showed that nitrates and phosphates in soil with biochar lasted longer when compared to that of the control group. Results show that biochar is more effective compared to unamended soil. If biochar is combined with small amounts of fertilizers it could prove to be more effective than just large amounts of fertilizers on their own, and eliminate the need for crop rotation.

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	Fair Category	Project Number
214	LST	3526

Title: Creation of a Natural Water Filtration System for Heavy Metals Using Agaricus Bisporus Fungi

Student Name(s): C. Mulshine, B. Ferguson

Abstract:

The purpose of this project was to investigate the White Button mushroom's ability to absorb common heavy metals by designing a water filtration system utilizing fungal hyphae. It was hypothesized that the addition of White Button mushrooms to natural soil filtration systems would be more effective in absorbing copper, lead, and arsenic ions. The first phase of the process involved growing a large amount of White Button mushrooms and hyphae, using moist peat moss and a wood chip substrate inoculated with White Button spores. While the mushrooms were growing, a fitted acrylic box was designed to function as the framework for our filtration system. Within the box, a raised layer of window screening was wedged 3 inches from the base of the box, permitting the filtration of water while preventing the soil from permeating the small holes. For the experimental portion, water was first ionized through a process of crushing the metals into small bits and heating them in solution. Prior to filtration, concentration of metal levels were determined using a heavy-metal, water testing kit. The ionized water was then filtered through the hyphae rich soil. The product was guided to a hole that dripped into the collecting duct where the final metal concentration was tested to determine the effectiveness of our system.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) BI 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	Fair Category	Project Number
246	LST	3527

Title: Using DNA Barcoding to Detect Mislabeling in the Sushi Industry

Student Name(s): C. Chmiel, L. DeConcini

Abstract:

It is estimated that 30% of the seafood entering the United States is mislabeled, creating a potentially dangerous issue with respect to allergies, species endangerment, and toxins. The research question deals with comparing the potential mislabeling of sushi in restaurants, fish markets, and supermarkets. While studies have been conducted, many are outdated and none have specifically focused on the difference in fish quality due to the source of the sushi. We obtained sushi samples from restaurants, supermarkets, and fish markets. Then, using DNA barcoding, we deciphered whether or not they are labeled correctly. DNA barcoding involved extracting DNA from our samples, amplifying the DNA using PCR, and sending the amplified DNA out for sequencing. The results were then read on the DNA subway database. Sources of sushi that we sampled include: Fogama - a local restaurant known for its sushi; Nikkei of Peru - local Japanese restaurant; Whole Foods- high quality American supermarket chain; June and Ho - local fish market; and Stop and Shop - American supermarket chain. While our other sample results are pending, one crab sample from June and Ho was sequenced as Alaskan pollock, thereby indicating mislabeling. It is expected that when all samples are sequenced, the supermarkets will have the highest percentage of mislabeling due to past studies describing mislabeling. This study will inform consumers of the danger of sushi mislabeling. We hope that this study will shed light on the issue of fish mislabeling and possibly put an end to the potentially dangerous issue.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
240	LST	3528

Title: Teeth Stain Removal with Electric vs. Manual Toothbrushes

Student Name(s): N. Torres, A. Zelaya

Abstract:

In this experiment, a theory was tested on whether electric toothbrushes remove more staining than manual toothbrushes. To begin, there were two (4x8 inch) marble tiles and painted them with two layers of white paint. Next, the tiles were left to dry for over 24 hours. The next day a bowl was used and filled with grape soda (2 cups, 2 oz). Both tiles were laid and faced down to absorb the soda inside the bowl. Both tiles were taken out to dry for another hour. Tiles were taken out and applied one inch of Ultrabrite Advanced Whitening Toothpaste and scrubbed both tiles in a circular motion with the same amount of pressure for one minute and thirty seconds. Those results showed that the electric toothbrush had more of an effect than the manual one. That wasn't all that, more products like tomato paste, coffee and soy sauce. For each liquid, 2 cups and 2oz were used except for the paste. Two teaspoons of tomato paste were spread across the surface and left to dry for the same amount of time. kept the same brushing technique and the same amount of time. The last product we tested it out on was black coffee. The same process was done to the coffee as the soda. Our data showed that electric toothbrushes and manual toothbrushes removed the same amount of staining but the electric toothbrush was more efficient to prevent enamel damage.

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

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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☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
226	LST	3529

Title: Testing the Effect of Apis mellifera Gut Microbiome on Honey Production and Immunity to the Varroa Parasite.

Student Name(s): K. Ruddock, Z. Lear

Abstract:

This project is on testing the Apis mellifera bacteria from different beehives finding the change of gut microbe diversity of Apis mellifera from honey bees, and see how the diversity of the microbes changes how much honey they produce and how it repels the Varroa destructor parasite. Studies are useful to see if the higher gut microbe diversity helps fight off the parasites which will be used for the beekeeping industry. The quantity and diversity of the microbes living in Apis mellifera are expected to be higher during Summer and go down during the rest of the year while being its lowest in January. Honey and pollen which is supplied to us by honeybees are important to humans and life, bees give essential pollinations needed for the production of crops. Studies are useful to see if the higher gut microbe diversity helps fight off the parasite, which is used for the beekeeping industry to find ways to make the gut microbiome more diverse which will be solving this Varroa destructor parasite problem. This is very important because it is a parasite that attaches to a bee and sucks out all of the fat out of it which can severely weaken the bees and cause deformities in newly hatched bees. The side effects of this dangerous parasite are catastrophic to be hives which is a serious issue.

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

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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	LST	3530

Title: Developing Competitive Inhibitors of the Alcohol Dehydrogenase Enzyme

Student Name(s): J. Bachman, D. Li

Abstract:

During alcohol metabolism, the alcohol dehydrogenase enzyme (ADH) catalyzes methanol, ethanol, and ethylene glycol produce toxic byproducts that can cause permanent damage to the body. Current competitive inhibitors, namely fomepizole (C4H6N2) work by binding to the acting enzyme, preventing the production of toxic metabolic byproducts. However, fomepizole is costly and requires intravenous delivery. This project aims to develop an improved competitive inhibitor over fomepizole in efficiency, cost, and convenience. Tested inhibitors were derived from starting alcohol molecules, which were modified using the VEGA ZZ molecular modeling toolkit computer program. These molecules were modified by altering their initial molecular atom composition, bond angles, torsions, and structure. After the modification process, the binding efficiency of the inhibitors was measured through the dissociation constant (Kd). The constant, measured through computational simulations via VEGA ZZ, indicates the tendency of an enzyme-ligand complex to dissociate. Thus, an inhibitor with a lower Kd is desired. After multiple molecule modification strategies were completed on the starting molecules, the final designed inhibitor yielded a significantly lower Kd than fomepizole, indicating significant improvement in efficiency. Through the development of an improved competitive inhibitor of ADH, treatment can be efficiently administered to a patient with methanol, ethanol, or ethylene glycol, poisoning. On a yearly basis, there are thousands of cases of alcohol poisoning, not including the medical complications related to alcohol overdose, such as fetal alcohol syndrome. Due to the magnitude and intensity of these poisonings and accidents, a more efficient and powerful antidote poses serious medical implications and applications.

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

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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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☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
244	LST	3531

Title: The Effect of Extracurricular Activities on Student Well Being: A Correlational Study

Student Name(s): B. Jureller, A. Sandhu

Abstract:

My name is Bella Jureller. I am a senior in the Ridgefield High School Science Research Program. My mentor is the school psychologist, Dr. Richard Gallini. My research partner and I wanted to do research that would directly benefit the people in our lives. So we decided to address the most obvious problem in our lives. Student stress and the lack of well being. We decided specifically that the problem to study is the impact of extracurricular activities. Extracurricular activities can include anything from clubs, sports, instruments or having a job. We obtained the results of our school's Challenge Success Survey from the Board of Education and then found the national trends of the Challenge Success Survey. We individually analyzed each survey and then looked at them together to draw conclusions on the impact of extracurricular activities has on student well being. We found that students that engaged in extracurricular activities did on average have higher GPAs and take more rigorous course loads, they reported the highest levels of student anxiety. As well they lacked leisure time in their days. Leisure time is time for students to relax and to do whatever they want, it helps them develop as a person. It was also found that overscheduled students do not get nearly enough sleep which can cause irritability and the brain cannot function to its full potential. In conclusion, students cannot be overscheduled, their time must be balanced healthily between extracurriculars, homework, and downtime.

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):

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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	Fair Category	Project Number
134	LST	3532

Title: The effect of motor oil and surfactant on phytoplankton cell density

Student Name(s): T. Smith, N. Ortiz

Abstract:

The purpose of this experiment was to determine how motor oil and surfactants affect cell density of phytoplankton. Eight beakers of phytoplankton were grown. Two were treated with nothing (control), two were given 10-ml of motor oil, two were given 10 ml of surfactant, and the final two were given 10ml of motor oil and 10-ml of surfactant. Phytoplankton samples were rested for a week before being tested for cell density. The final result showed that the motor oil led to a higher cell density. This outcome did not support the predicted hypothesis. A literature review demonstrated that oil spills can affect phytoplankton, favoring the growth of some while inhibiting the growth of others. The results are important because it gives insight on how damaging oil spills can be to aquatic life.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) MI 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	Fair Category	Project Number
249	LST	3533

Title: Using Nile Red Dye to test for the Presence of Microplastics in Bottled Water

Student Name(s): R. Trevino, E. O'Connor, J. Welsh

Abstract:

Approximately 42.6 billion plastic water bottles are purchased in the United States each year. One issue with bottled water is the potential presence of microplastic residue due to the manufacturing process. This study tested bottled water to identify the presence of microplastics in different brands. It was hypothesized that Nile Red dye, which clings to plastics and fluoresces under a blue light, could be used to locate the microplastics, and that they will be found in almost every brand of water tested. Nile Red was placed in each bottled water for 30 minutes. The water was filtered through a glass filter, and glowing regions were viewed, counted, and photographed under a blue light and orange filter. The negative control, distilled water, with Nile Red showed no glow. The positive control in which we added microplastics to water, glowed. Poland Spring and Nestle Pure Life showed major areas of fluorescence (10 and 18 glowing regions, respectively). No or low fluorescence was observed in Essentia (0), Dasani (0), Aquafina (1), and Life Water (3). Nestle Pure Life, filtered using a Brita filter, showed a reduction of microplastics (9 regions), and those that remained were smaller in size. Microplastic debris can lead to health issues and can disrupt the environment. Since microplastics were found in many of the bottled water brands tested, this demonstrates that they may pose a threat to human health, such as an enhanced inflammatory response. This study is significant because there is limited research available on this topic.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EV ME 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	Fair Category	Project Number
248	LST	3534

Title: The Effects of Sugar on Drosophila Melanogaster with Fragile X

Student Name(s): O. Corrente, K. Clark

Abstract:

Fragile X Syndrome is a genetic mutation that affects the X chromosome in people. People with this genetic disorder have physical and mental defects. The symptoms of Fragile X Syndrome mimic autistic behavior. It is unclear the exact cause of autism so it is difficult to study. However, what is known is what causes Fragile X Syndrome. The model used for this research is Drosophila melanogaster. Drosophila melanogaster is a powerful genetic model organism for studying Fragile X Syndrome.This research project is trying to determine if different levels of dextrose affect the flies level of hyperactivity, death rates and birth rates. The methods used were fly tapping to transfer the flies, climbing assay to record hyperactivity, and an egg assay to record the birth rates. The fly strains used were 3605 (wild type), 6930 (FMR1), and 7732 (DF). Our results showed that the 3605(wild) continuously increased in birth rates and stayed around the same for deaths and hyperactivity. The 6930(FMR1) had sharp increases in births and deaths, but stayed around the same for hyperactivity. The 7732 (DF) had a sharp increase in births at the end, the deaths stayed about the same, and their hyperactivity sharply decreased. In the beginning, 6930(FMR1) was affected the most, but towards the end 7732(DF) became the most affected strain. In conclusion, sugar does affect the level of hyperactivity, birth rates, and death rates. Although, greater changes in birth and death rates were expected, the data supports the hypothesis.

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

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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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☒ Yes ☐ No