CONNECTICUT SCIENCE & ENGINEERING FAIR

78th Annual Fair
March 2-14, 2026

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

2026

Word Count: 207

Fair Category: LS

Project Number: 3003

Title: Vision Transformer Model with Grad-CAM Highlighting Capability Predicting Dementia Severity with High Accuracy

Student Name(s): A. Whitney

Abstract:

Alzheimer's disease is a mental disorder which affects the physical structure of the brain significantly in a manner which is detectable with magnetic resonance imaging (MRI). Knowing this, we developed a vision transformer (ViT) model to classify stages of cognitive impairment: Non-demented, Very mildly demented, Mildly demented, and Moderately demented, using MRI scans. Using image feature-engineering techniques, we were ultimately able to achieve a test accuracy of 93%. Beyond classification, we implemented Gradient-weighted Class Activation Mapping (Grad-CAM) to identify brain regions contributing most strongly to model predictions. We have compiled our research into a Gradio app which allows the user to input an MRI image and receive a classification as well as an activation heatmap in return, allowing anyone to access and test the model. Our approach aims to bridge predictive performance with neurobiological interpretability, evaluating whether transformer-based attention mechanisms capture anatomically meaningful markers of neurodegeneration. Furthermore, we explore whether regional saliency patterns correlate with disease severity and cognitive decline metrics, providing insight into the relationship between structural degradation and clinical symptomatology. This framework demonstrates how explainable deep learning methods may contribute not only to accurate dementia staging but also to hypothesis generation regarding region-specific susceptibility and progression in Alzheimer's disease.

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

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

2026

Word Count	Fair Category	Project Number
167	LS	3004

Title: Effects of Environmental Conditions on DNA Degradation

Student Name(s): R. Craig

Abstract:

Thousands of bodies remain unidentified every year and with more knowledge on which primers help to identify DNA in the body, we have a better chance of being able to identify those unidentified bodies and give their families some closure. DNA degradation in bone is influenced by environmental conditions, which can affect the ability to recover genetic material for forensic and scientific analysis. This project investigates how temperature impacts the breakdown of DNA in bone over time. Bone samples were exposed to different temperature conditions, and small amounts of tissue DNA were analyzed using PCR primers that amplified short, medium and long fragments of the COI gene. DNA samples were also examined for visible signs of degradation using gel electrophoresis. and degradation measured using Gel Electrophoresis. These results suggest that bone degradation happens before the one week mark. Understanding how environmental conditions influence DNA preservation can help improve methods used in forensic identification and contribute to a better understanding of how long DNA remains detectable in tissue.

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

2026

Word Count: 256

Fair Category: LS

Project Number: 3006

Title: Multimodal Deep Learning for BI-RADS Prediction Using Breast Ultrasound and Patient Clinical Data

Student Name(s): D. Li

Abstract:

Breast Imaging Reporting and Data System (BI-RADS) is often used with ultrasounds to describe breast lesions. However, assigning BI-RADS categories can be challenging due to subtle differences between classes. This project aims to make BI-RADS prediction using two different data types more accurate and accessible through an interactive app.

An ExtraTrees model was trained on information like age and symptoms. SHapley Additive exPlanations (SHAP) revealed that margin, shape, and halo had the most impact on the final prediction. A cross-validated deep learning model was trained to classify breast ultrasound images. Logit-weighted late fusion was then used to combine predictions from the clinical and imaging models into a single BI-RADS output. Benign-malignant classification was similarly done as a secondary analysis. SHAP analysis identified margin, shape, and halo as the clinical features with the greatest contribution to BI-RADS prediction. Individually, the clinical and imaging models achieved BI-RADS prediction accuracies of approximately 0.51 and 0.52, respectively. When combined using late fusion, BI-RADS prediction accuracy improved to approximately 0.70, with an off-by-one accuracy of 0.92. Using late fusion, benign-malignant classification achieved an accuracy of approximately 0.92.

After model construction and training, an interactive Shiny-based web application was developed to allow users to input clinical features or ultrasound images and receive BI-RADS predictions from the three models. This makes BI-RADS classification faster and more accessible for both physicians and patients. This project demonstrates that the combination of two data types can significantly improve model accuracy.

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

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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

Word Count

265

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3007

Title: Novel Screening Device for Ovarian Cancer with SVM-RFE Algorithm on Relative Serum miRNAs with On-Chip Amplification

Student Name(s): S. Yu, S. Yu, S. Yu

Abstract:

Ovarian cancer (OC) is the deadliest gynecological cancer, largely due to only 36% of patients being diagnosed in the early stages and the lack of effective diagnosis. To address the lack of a rapid, accurate, and minimally-invasive screening test, a ML, SVM-RFE algorithm was first developed to screen a patient's own blood serum for isolated miRNA biomarkers for the detection of OC. miRNA microarray values of over 8000 patients across three datasets were used to construct a binary table of significant miRNA pairs' expression in every patient. SVM-RFE was trained to identify optimal pairs– miR-1275>miR-6800-5p, miR-6893-5p<miR-1290, which achieved 99.375% sensitivity and 95.946% specificity on validation. These target miRNAs were then amplified with "in-solution" nicking rolling circle amplification (NRCA) with EvaGreen-tagged 1nm, 100pm, 1pm, and 100fm samples. The resulting fluorescent spectra successfully demonstrated significant difference in 530nm emission intensity, relative to concentration. A 4-output, microfluidic was then created using PDMS, and an Arduino-PID heating system that included a tuned Kapton heater. The produced, 4-reservoir microfluidic ran NRCA twice, once of researcher-constructed miRNAs from a simulated ovarian patient, and another using researcher-constructed miRNAs from a simulated healthy patient. Portable, fluorescence detection of the 4-reservoirs was made via an iPhone camera, fitted with a 485nm bandpass filter on the flash, and a 515nm bandpass filter on the lens. iPhone-camera imaging demonstrated that miRNA amplification was successful in all four channels, and their images could be compared, to deliver a rapid, accurate, patient-specific OC diagnosis in a doctors' office setting.

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

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

Word Count

239

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3009

Title: Seeing Red: Examining Fixed Action Patterns and Vision in the Three Spined Stickleback Fish, Gasterosteus aculeatus

Student Name(s): C. Cabrera

Abstract:

Fixed action patterns are innate behaviors triggered by a sign stimulus and automatically executed through innate neural networks present in the species. A classic example is the Three Spined Stickleback fish, Gasterosteus aculeatus, where the males exhibit aggressive fixed behaviors towards the red underside of same-species males. First explored by Niko Tinbergen in the 1950s, this behavior is considered an evolutionary adaptation for nest defense. Although previous research delves into the light perception of the fish and their fixed action patterns, the effects of the former on the latter remain understudied. This study will investigate how different colored lights influence the responses in the male sticklebacks. Adult male sticklebacks will be subjected to red, blue, green, and white light conditions while presented with a model fish with a red underside. Latency to first attack as well as the number of attacks will be recorded for a duration of 30 seconds. Based on past research with respect to three spined sticklebacks, it is hypothesized that red lighting will reduce the contrast between the red underside of the model and the environment, consequently slowing or diminishing the effect of the fixed action pattern. Findings from this experiment will advance the understanding of the fish's vision and its underlying impact on their fixed action patterns. Further, this research will provide insight into how climate change-induced water discoloration could compromise the vision and protective fixed action patterns of three spined sticklebacks.

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

☐ Yes ☒ No

Word Count

209

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3010

Title: Blue Oyster Cult(ure): Using Pleurotus for Mycoremediation of Water Contaminants

Student Name(s): D. Mota

Abstract:

Microplastics have been found in all bodies of water across the world including freshly fallen snow in Antarctica and deep ocean trenches. Although studies on the effects on human bodies are limited, studies have shown that microplastics are linked to cancer, heart attacks, inflammation and infertility. Despite its rise to popularity in the 1950s, little research has been done on ways to mitigate its contamination of drinking water. This study investigates the use of Blue Oyster Mushrooms as an all natural and affordable filter. Blue Oyster Mushrooms (Pleurotus ostreatus) are known for their ability to break down complex organic pollutants. Whole and partial mushrooms were grown in water containing 1g of microplastics to determine if there is an optimal part of the mushroom that should be used for filtering. The hypothesis was Blue oyster mushrooms will use mycelium to clean up microplastics in water samples.

Observations showed the mushroom cap removed the greatest quantity of microplastics over one week trial. Although additional studies are still needed, these results suggest that Blue Oyster Mushroom caps are an ideal choice for the remediation of microplastics in drinking water. Blue Oyster mushrooms not only remove microplastics from water, but they transform them into harmless compounds which makes them suitable for water filtration.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) EM EN 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
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

252

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3013

Title: Vitamin D3 Supplementation Ameliorates Muscle Degeneration through Calcium Regulation in a Caenorhabditis elegans Model of Duchenne Muscular Dystrophy

Student Name(s): N. Francis

Abstract:

Duchenne Muscular Dystrophy (DMD) is a genetic disorder that causes progressive muscle wasting and weakness due to mutations in the dystrophin gene, which is essential for maintaining the integrity of muscle cells. DMD's also significantly burdens affected individuals and their families emotionally and financially. Vitamin D3 has a small positive effect on muscle strength determined via meta-analysis, and vitamin D insufficiency is frequently observed in DMD patients; however, studies in DMD mouse models have reported inconclusive effects on muscle pathology and function. This prospective investigation evaluates the effects and mechanisms of vitamin D3 supplementation in a DMD Caenorhabditis elegans (C. elegans) model. In previous experiments (Francis 2025), vitamin D3 improved locomotive behavior, longevity, and reduced reactive oxygen species levels. These positive results prompted this study, examining the mechanisms underlying these mitigating effects. Here, vitamin D significantly lowered calcium accumulation in muscle cells as measured by a calcium reporter fluorescence assay (all tested concentrations $p < 0.05$ vs. control), but did not alter the kinetics of Aldicarb-induced paralysis (log-rank $p > 0.45$ across groups). Collectively, these findings indicate that vitamin D3 may offer protective effects against muscle damage in DMD through muscular calcium regulation but not changes at the neuromuscular junction. These results provide mechanistic insight into an affordable strategy to improve muscle function in DMD patients. Given its established safety, accessibility, low cost, and ability to improve the cellular mechanisms of muscle dysfunction, prospective vitamin D3 supplementation in DMD patients warrants further investigation to clarify long-term benefits and dose concentration.

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

2026

Word Count	Fair Category	Project Number
272	LS	3014

Title: CD44-Targeted Nanoparticle Co-Delivery of Simvastatin and Colchicine for Localized Treatment of Atherosclerotic Plaque Inflammation in Cardiovascular Disease

Student Name(s): A. Bhatia

Abstract:

Atherosclerosis, characterized by macrophage-rich plaques that narrow arteries and restrict blood flow, is the primary contributor to cardiovascular disease, and the leading cause of death worldwide, resulting in life-threatening events such as heart attacks. Current treatments focus on preventing plaque buildup rather than targeting active lesions. Thus, a plaque-targeted, dual-layered nanotherapeutic system was engineered to facilitate plaque dissolution while reducing inflammation. An inner core consisting of Simvastatin, a drug with established plaque-reducing effects, was encapsulated within a PLGA-Chitosan-PVA polymer structure. Surrounding the inner core, a Colchicine-Chitosan layer was electrostatically conjugated, which delivers Colchicine, a rapid anti-inflammatory drug, to suppress macrophage-driven inflammation. To ensure selective plaque targeting, nanoparticles were coated with Hyaluronic Acid (HA), a ligand which binds to overexpressed CD44-receptors in plaque lesions. Nanoparticle formation was confirmed using Dynamic Light Scattering and Fourier Transform Infrared (ATR-FTIR) spectroscopy. Targeting specificity (HA-CD44) of the nanoparticles was verified through a plate-based assay experiment, using Recombinant CD44 Protein. Through fluorescence microscopy, modified fluorescently-labeled nanoparticles demonstrated strong retention in CD44-coated wells, supporting ligand-protein interactions. Nanoparticle performance was further assessed through a pH 5.5-induced drug-release study, demonstrating sustained release within 180 minutes under plaque-relevant conditions. Finally, the nanoparticle function was evaluated on simulated plaques by exposing them to cholesterol crystals, major contributors to plaque composition. Using a plate reader, 600nm-absorbance measurements showed significant disruption of cholesterol structures, indicating that the nanoparticles actively target key constituents of atherosclerotic plaques. These findings demonstrate the therapeutic potential of targeted nanoparticle plaque-therapy and underscore its promise in preventing cardiovascular disease.

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

2026

Word Count	Fair Category	Project Number
218	LS	3015

Title: Understanding The Effects of Music Usage On Caregivers of Alzheimer's Patients

Student Name(s): G. Muccia

Abstract:

Across the United States, over 11 million people care for those affected by dementia, and the purpose of my project was to determine whether music calms down the patients, and whether the caregivers feel better mentally after playing music for them. I made an anonymous survey using Google forms, which asked questions related to the use of music by the caregivers and its effects on the patients and caregivers. The participants in this study were found by reaching out through email to local nursing homes, posting on the national Alzheimer's association platform, and support groups that reside on social media (using Reddit and Facebook). Before sending the survey, it was expected that caregivers receive benefits from using music as a tool because the patients are calmed down and less agitated. After receiving results and analyzing data, it was found that playing music to their patients was beneficial (ranging from somewhat to very beneficial) for the caregivers. The frequency of caregivers who use music in their practice, as well as the frequency of caregivers who feel better mentally was also very high, strongly supporting my hypothesis that using music helps caregivers mentally. In the future, I hope to look into ways to make personalized playlists for particular patients, in order to see if the benefits would be even higher.

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

2026

Word Count: 233

Fair Category: LS

Project Number: 3016

Title: A Data-Driven Evaluation of Behavioral and Dermatologic Factors in Adolescent Skincare Practices in the Context of Social Media Exposure

Student Name(s): A. Vaidheeswaran

Abstract:

Social media has become a major source of skincare information for adolescents, yet limited quantitative research has examined how this influence shapes skincare behaviors and potential skin outcomes. The purpose of this study was to investigate whether social media influences adolescent skincare practices and whether this influence is associated with routine complexity and reported skin concerns. It was hypothesized that adolescents influenced by social media would be more likely to adopt more intensive skincare routines and report a greater number of skin-related issues.

An anonymous survey was administered to adolescent participants to assess social media engagement, skincare routines, product usage, and skin concerns. Responses were analyzed using descriptive statistics, chi-square tests, and Spearman rank correlation to evaluate relationships between social media influence, routine intensity, and reported outcomes.

Results indicated that 74% of participants used social media for skincare advice and 61% reported trying trends seen online. A significant association was found between social media influence and higher routine complexity ($p=0.013$). Trend participation was also significantly associated with reporting multiple skin concerns ($p=0.027$). Additionally, a positive correlation was observed between the number of products used and the number of reported skin concerns ($p<0.001$).

Overall, these findings suggest that social media may shape adolescent skincare behaviors in ways associated with more complex routines and increased reporting of skin concerns, highlighting the importance of informed guidance in navigating online skincare trends.

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

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

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

2026

Word Count: 247

Fair Category: LS

Project Number: 3017

Title: Illuminating the Role of Lipid Metabolism Pathways in T-cell Exhaustion

Student Name(s): M. Kennedy

Abstract:

Cancer is a pervasive condition with approximately 39% of people receiving a cancer diagnosis at some point in their lives. To address the prevalence and significant toll of cancer, immunotherapies are a burgeoning cancer treatment methodology. As more research has been conducted in the field of immunotherapy, T-cell exhaustion has become a prominent challenge: it intensifies immunotherapy failure and loss of tumor control. One area of research within the field of T-cell exhaustion focuses on metabolic pathways; however, there are still many questions surrounding the role of lipid metabolism pathways within the T-cell exhaustion cycle. In this study, we worked to elucidate specific pathways related to lipid accumulation. Lipid accumulation can be harmful to the cell as it forms lipid peroxides, often leading to T-cell oxidative stress and T-cell exhaustion. We used CRISPR technology and E. coli to make a retrovirus that was used to infect T-cells to inhibit two vital lipid metabolism pathways. We performed analyses using flow cytometry with fluorescent dyes to track exhaustion markers within the T-cells. This was useful in determining the role of each pathway in both acute and chronic conditions. One of the primary preliminary findings suggested that the CD36 pathway may not play as key a role in lipid accumulation as previously thought. This study aimed to further the understanding of T-cell lipid metabolism and its potential role in the exhaustion phenotype, providing better grounds for immunotherapy research and improved cancer treatments.

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

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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

2026

Word Count	Fair Category	Project Number
232	LS	3018

Title: Enhancing Superoxide Dismutase (SOD) Stability Through Synthesis With Mesoporous Silica Nanoparticles (MSNs) Tested in C. elegans to Determine Its Potential Role in Breast Cancer Treatments

Student Name(s): E. Yan

Abstract:

Breast cancer is the most commonly diagnosed cancer in women, accounting for one in ten new diagnoses(Menon,2024). Elevated reactive oxygen species(ROS) levels are linked to tumor growth(Shah,2015). Superoxide Dismutase(SOD) is an established antioxidant with poor pharmacokinetics. Mesoporous Silica Nanoparticles(MSNs), which are highly customizable and nontoxic, can be fed to wild-type C. elegans without altering lifespan and even increase the lifespan by ~six days when combined with SOD(Yang,2022). These results support investigation of unexplored SOD-MSN treatments in breast cancer models. This study utilized two C. elegans cancer models: YF15, with brap-2 mutation homologous to the human BCRA1 gene(Koon,2010); and MT2124 with a multivulva(MUV) phenotype(Medina,2021) caused by a mutation to the Ras-ERK signaling pathway, associated with 20-30% all cancers (Gimple,2019). In this study, SOD@MSNs was synthesized and fed to MT2124 and YF15 then evaluated for oxidative stress and the multivulva phenotype (MT2124 only). When evaluating ROS levels there was a decrease from 2.4 fluorescence units/µg protein to 0.47 units/µg in the YF15 strain and 3.67 units/µg to 1.01 units/µg in the MT2124 strain. The multivulva phenotype decreased from 40% to 26%, but did not achieve statistical significance ($p>0.05$). Overall, these findings indicate that SOD@MSN treatment holds promise but requires additional studies to optimize the treatment method or dosage.

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

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

CSEF Official Abstract and Certification

2026

Word Count: 244

Fair Category: LS

Project Number: 3020

Title: Exploration of the Neuroprotective Potential of Moringa Oleifera

Student Name(s): R. Li

Abstract:

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by β-amyloid (Aβ) plaque accumulation, cholinergic dysfunction, and cognitive decline. This study evaluated the neuroprotective potential of Moringa oleifera leaf extract through phytochemical profiling, computational docking, ADMET analysis, and in vivo validation in a Drosophila AD model. Leaves were extracted using 70% ethanol and analyzed by HPLC–DAD at 280 nm. Quercetin was identified as the dominant compound (55%) using an external calibration curve, while additional phenolics including gallic acid, catechin, and chlorogenic acid were reported as relative abundances based on retention behavior and UV spectra. Molecular docking using SwissDock (AutoDock Vina scoring) demonstrated favorable binding affinities of these compounds to β-secretase (BACE1) and acetylcholinesterase (AChE), suggesting potential inhibition of amyloid processing and cholinergic degradation. SwissADME analysis indicated acceptable drug-likeness, predicted gastrointestinal absorption, and low toxicity risk. Functional effects were then assessed using a Drosophila melanogaster negative geotaxis (climbing) assay.

Extract-treated flies showed dose-dependent improvement in locomotor performance, with 0.5 mg/mL producing the greatest effect (70.5% climbing versus 20.4% control). ATR-FTIR analysis of fly heads in the Amide I region (1600–1700 cm^{-1}) revealed reduced β-sheet content in treated groups, indicating decreased amyloid-like protein aggregation. These results demonstrate that Moringa oleifera contains bioactive phenolic compounds capable of modulating key AD molecular targets, reducing aggregation-associated β-sheet structure, and improving functional outcomes, supporting further investigation of this plant as a potential source of neuroprotective therapeutics.

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

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

CSEF Official Abstract and Certification

2026

Word Count: 192

Fair Category: LS

Project Number: 3021

Title: How does the expression or dysfunction of KCC2 protein relate to epilepsy and a potential treatment

Student Name(s): H. Wen

Abstract:

Epilepsy is the most common neurological disease, affecting 1 in every 100 people. Epileptic seizures are spontaneous brain electrical activities. This experiment was conducted to investigate the clinical potential of zt-1a, a potent non-ATP-competitive inhibitor of STE20/SPS1-related proline-alanine-rich kinase (SPAK), as a targeted intervention for epilepsy through modulation of cation–chloride cotransporters (CCCs).

A pentylenetetrazole (PTZ)-induced mouse seizure model was used to evaluate the behavioral effects of zt-1a on seizure latency and severity using the Racine scale. Immunofluorescence imaging was used to confirm KCC2 activity during seizures. Hippocampal tissue were analyzed through Western blot to determine KCC2, NKCC1, SPAK, and actin activity.

Immunofluorescence imaging confirmed that SPAK phosphorylation decreased KCC2 activity during seizures. Animal model results show that zt-1a decreased seizure latency and reduced seizure severity compared to PTZ controls. Western blot analysis of hippocampal membranes showed KCC2 activity restored after zt-1a was used, but analysis of hippocampal cytoplasm did not show that.

These results support the potential of zt-1a as a therapy for epileptic seizures. However, further investigation is required to clarify the discrepancy in the Western Blot data.

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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- ☐ 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

Word Count

145

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3022

Title: Gut content analysis of Invasive European Green Crabs (Carcinus Maenas)

Student Name(s): L. Kosma

Abstract:

The European Green Crab (Carcinus maenas) is an invasive species that harms coastal ecosystems by feeding on native shellfish and damaging eelgrass habitats. This project examines what European Green Crabs eat by analyzing the DNA found in their stomach contents. Green crabs were collected from coastal water. DNA from their stomach contents were extracted and amplified using the Cytochrome c Oxidase Subunit (CO1). The amplified DNA was then compared to known genetic sequences to identify their most common prey. The results are expected to show that European green crabs consume a wide variety of organisms, suggesting they have a broad impact on local food webs. Understanding the diet of this invasive species can help researchers better predict its ecological impact and support efforts to protect native species and coastal ecosystems. Sequencing results are pending due to a weather-related delay at the commercial sequencing facility.

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

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

☐ human subjects ☐ potentially hazardous biological agents

☒ vertebrate animals ☐ controlled substances

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
234	LS	3024

Title: How to Make Extra-curriculum Activities Work:

Listening to Student Perspectives on Motivation and Outcomes

Student Name(s): C. Weng

Abstract:

While extensive research has documented the quantitative outcomes of extracurricular activities (ECAs), there remains a gap in understanding how students themselves perceive the value of ECAs, especially qualitatively. This study tries to address this gap by exploring how student participants evaluate the impact of ECAs in their lives through extensive interviews and surveys on students who have participated in popular ECA programs in China. Data from interviews (n=32) and surveys (n= 50) with students from conversation-focused and test-prep programs reveal that the perceived significance is shaped by who made the decision to join. The study finds that autonomy correlates with purpose, with parent-driven participation tends to align with instrumental goals such as improving test scores, while self-driven participation more often associates with recreational and social benefits. Furthermore, older students are more likely to internalize their parents' goals, and more interestingly, a gendered pattern emerges in which self motivated female students blend personal interest with academic strategy more than their male peers. These findings challenge homogeneous perception about the value of ECAs, showing that student agency, age, and gender together shape how students construct purpose and significance. This research and its findings provide important insight to educators and ECA providers in designing future education programs, and to policymakers in considering policies that promote equitable access, and equally important, to parents in helping students achieving higher level of enjoyment and engagement.

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

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

   ☒ human subjects ☐ potentially hazardous biological agents
   ☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

   ☐ Yes ☒ No

Word Count
210

CSEF Official Abstract and Certification

2026

Fair Category
LS

Project Number
3025

Title: Nano-Enabled Defense: Using Sulfur Nanoparticles to Limit Cadmium in Soybeans

Student Name(s): L. Wang

Abstract:

Cadmium (Cd) contamination in agricultural land threatens crop productivity, food safety, and human health. This project tested whether sulfur nanoparticles (S NPs) can reduce Cd availability in soil and limit Cd accumulation in soybean plants. Soybeans were grown in Cd contaminated soil under six treatments: a healthy control, Cd only, and Cd combined with pure sulfur nanoparticles (NS), stearic-coated sulfur nanoparticles (CS), bulk sulfur, or sulfate. Plant growth was assessed through shoot and pod biomass, and Cd and sulfur concentrations in plant tissues were measured. Soil Cd bioavailability and oxidative stress were analyzed using available Cd, malondialdehyde (MDA), and antioxidant enzyme activity. Compared to Cd only, NS and CS significantly improved plant growth, increasing shoot biomass by up to 62% and pod biomass by up to 39%, while reducing Cd accumulation in pods by 20–23%. In soil, S NP treatments lowered available Cd by up to 32%. Cd exposure caused severe oxidative stress, more than doubling MDA levels in roots, while S NP treatments reduced MDA and boosted antioxidant enzyme activity. Overall, sulfur nanoparticles reduced Cd mobility in soil, limited Cd accumulation in soybean plant tissues, and improved plant stress tolerance, supporting their potential as a strategy to reduce heavy-metal risks in agriculture and enhance crop performance.

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

2026

Word Count	Fair Category	Project Number
244	LS	3026

Title: Trends in Early-Onset Cancer and Associations With Obesity, Alcohol Use, Nicotine, and Marijuana Use in the United States

Student Name(s): A. Samat

Abstract:

Early-onset cancer, defined as a malignancy diagnosed before age 50, has been rising across multiple cancer types in the United States, but the exposures correlated with these trends are unknown. This study investigated associations between four exposures, obesity, alcohol use, cannabis use, and nicotine use, and early-onset cancer incidence using de-identified electronic records from the TriNetX US Collaborative Network. Separate retrospective cohort analyses were run for each exposure using propensity score-matched cohorts. The obesity analysis included adults aged 20 to 40 with an 8-year follow-up time, evaluating six cancer types. The substance analyses included adults aged 21 to 25 with two years of follow-up, which evaluated overall malignancies, blood, CNS, endocrine, mesothelium, sarcomas, GI, and oral cancers. The statistical analyses included risk ratios, Kaplan-Meier survival analysis, and independent t-tests. Significant associations were found across all exposures. Obesity was strongly associated with uterine cancer ($HR = 4.61$, $p < 0.001$) and kidney cancer ($HR = 1.56$, $p < 0.001$), with an inverse association found for breast cancer in this cohort. Nicotine produced the strongest overall cancer signal ($RR = 1.73$, $p < 0.001$), with significant associations for blood, CNS, GI, and oral cancers. Cannabis showed the most widespread associations, including overall malignancy, blood, mesothelium and sarcomas, and GI and oral cancers. Alcohol was significantly associated with GI and oral cancers only ($RR = 1.98$, $p = 0.031$). These findings suggest that these exposures are meaningfully associated with early-onset cancer risk in young adults.

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

2026

Word Count	Fair Category	Project Number
245	LS	3027

Title: Investigating the Role of APC4 and Shtd in Spermatogenesis of Drosophila Melanogaster

Student Name(s): S. Chennavajhula

Abstract:

Spermatogenesis, the process of sperm cell development, is one of the most tightly coordinated processes in biology. Cell division, differentiation, and structural organization must happen in precise sequence. When everything functions properly, developing spermatids remain tightly bundled as they mature. I hypothesized that APC4 and Shtd are required for proper spermatid bundling during spermatogenesis, and knocking them down will cause a sperm scattering phenotype that begins at a specific stage detectable using temporal control (Gal80ts). My project focuses on pinpointing exactly when this structural breakdown begins, using temporal control of gene knockdown. By identifying when the phenotype first appears, we can better understand how APC/C regulation contributes to cell cycle progression. Understanding how genes such as APC4 and Shtd contribute to the formation of proper sperm bundles and sperm maturation, will help explain why errors in this process lead to sperm defects and infertility. These findings can also provide insight into similar cellular mechanisms in other organisms, possibly even humans. To investigate I set up control and experimental Drosophila crosses using Gal4/UAS, RNAi, and Gal80ts; temperature-shifted adult males (over time as temperature increased), dissected testes at intervals, fixed and stained samples, imaged via confocal microscopy, and quantified sperm morphology. The result showed that knockdown of APC4 and Shtd using RNAi produced a clear sperm scattering phenotype, supporting the hypothesis that these genes are required for normal spermatid bundling. The Gal80ts timing experiment was inconclusive due to experimental failure and is being repeated.

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

2026

Word Count: 253

Fair Category: LS

Project Number: 3030

Title: The Effects of Glucose on Traumatic Brain Injury Recovery in Drosophila Relevant to Chronic Traumatic Encephalopathy

Student Name(s): W. Knispel

Abstract:

Chronic Traumatic Encephalopathy (CTE) is a neurodegenerative disease linked to repeated Traumatic Brain Injuries (TBIs). It occurs most commonly in athletes of contact sports like football, wrestling, and rugby. CTE is diagnosed post-mortem through elevated tau protein accumulation in the brain. Currently, CTE cannot be diagnosed antemortem, and no treatments exist, making early prevention after a TBI vital. Glucose is a key reactant in producing ATP, and studies have proven that minimal amounts can improve cognitive function, but excessive amounts can disrupt cellular function. This study used Drosophila Melanogaster to model the impact of varying levels of glucose on TBI-recovery. Flies were divided into a control group receiving no glucose and three experimental groups receiving 2%, 8%, or 15% glucose solutions in H_2O. The recovery time (how quickly flies resumed movement) was measured post-injury. Results showed that all glucose groups recovered faster than the control, with the 2% group recovering the quickest and most consistently, indicating an optimal dose. Higher glucose doses (8% and 15%) also improved recovery but with greater variability, suggesting a potential deleterious effect. These findings imply moderate glucose intake after a TBI aids recovery by addressing the brain's energy crisis, supporting the Glucose Facilitation Effect. Excessive glucose offers minimal benefit and may cause harm due to metabolic stress. Overall, this research highlights glucose's potential as an immediate treatment following head trauma and underscores the importance of dosage. Proper glucose management could reduce short-term brain damage and lower the risk of developing CTE later in life.

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

2026

Word Count: 232

Fair Category: LS

Project Number: 3032

Title: The Shared CpG DNA Methylation Patterns in the Cerebellum of Bipolar Disorder and Alzheimer's Disease Patients

Student Name(s): A. Hanson

Abstract:

Recent evidence suggests an epigenetic association between Bipolar Disorder (BD) and Alzheimer's disease (AD), given shared underlying mechanisms. Cytosine-Guanine-Phosphate (CpG) DNA methylation sites regulate gene expression that influences mood and neurodegeneration. This project aims to quantify the unknown epigenetic overlap between AD and BD in the cerebellum to identify the potential targets for intervention. CpG datasets, GSE38873 (BD dataset) and GSE134379 (AD dataset), were obtained from the public database NCBI Gene Expression Omnibus (GEO). For integrity, datasets were subsetted to have the identical 25,912 CpG sites in RStudio. Epigenetic instability was measured by calculating the standard deviation at each CpG. The 1000 most variable sites across controls, BD, and AD individuals were analyzed to identify common patterns. Analysis revealed 39 overlapping CpGs among AD and BD. A Hypergeometric test yielded a p-value of 0.49, indicating that the epigenetic overlap between AD and BD is insignificant. However, a T-test was conducted and determined that 7 CpGs among 39 in AD and BD had significantly different methylation values from controls ($p < 0.05$). While the 7 CpG methylation values were distinct from each other, they shared identical methylation directions (hypermethylation and hypomethylation). While epigenetic overlap is minimal, the identical directional methylation indicates that chronic mood epigenetic dysregulation may contribute to neurodegeneration. Future work aims to identify the genes associated with these 7 CpG sites to determine if methylation contributes to neurodegeneration.

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

2026

Word Count: 250

Fair Category: LS

Project Number: 3033

Title: The Hidden Danger of Overusing Antibiotics

Student Name(s): B. Zhou

Abstract:

Antibiotics are widely used to treat bacterial infections, but overuse may affect the balance of beneficial bacteria in the human body. This project aimed to investigate how different concentrations of the antibiotic Kanamycin affect the growth of E. coli, a harmful bacteria, and Lactobacillus, a beneficial probiotic important for gut health. When Lactobacillus levels decrease, it can cause digestive problems such as bloating, stomach pain, and other discomfort. Therefore, it is important to determine an antibiotic concentration that effectively kills harmful bacteria while minimizing damage to beneficial bacteria. In this project, E. coli was plated on agar plates in four groups: Control, Low Density, Medium Density, and High Density of Kanamycin discs. After incubation at 37°C for 1-2 days, inhibition zones were measured and compared. The same procedure was repeated using Lactobacillus to evaluate the negative impact of increasing antibiotic concentrations. Results showed that the Higher Density group produced larger inhibition zones in E. coli, showing stronger antibacterial effects. However, increasing concentration also led to larger inhibition zones in Lactobacillus, demonstrating greater harm to beneficial bacteria. In contrast, the Lower Density group is less harmful to Lactobacillus, but weaker against E. coli. The Medium Density group balanced effect significantly inhibits E. coli while causing moderate damage to Lactobacillus. Therefore, Medium Density appears to be the most suitable level for the human body because it balances effectiveness and safety. In conclusion, increasing antibiotic concentration increases bacterial inhibition but also increases negative effects on beneficial bacteria, emphasizing the risks of antibiotic overuse.

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

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

- ☐ human subjects
- ☒ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☒ Yes ☐ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 259

Fair Category: LS

Project Number: 3034

Title: Effects of Betanin as a Potential Therapeutic Agent in Parkinson's Disease using Drosophila melanogaster as a Model Organism

Student Name(s): T. Samant

Abstract:

Parkinson's disease (PD) is a neurodegenerative disorder primarily affecting elderly adults, characterized by motor and non-motor functions such as tremors, rigidity, and cognitive decline as well as fragmented sleep. PD is caused by a combination of genetic mutations in Leucine-rich repeat kinase 2 (LRRK2), synuclein alpha (SNCA), and environmental factors. Dopamine deficiency and deposits of Lewy bodies (aggregates of alpha-synuclein proteins) contribute to neurodegeneration. Current treatments, such as levodopa, attempt to lessen the severity of symptoms. However, long-term use can lead to tolerance and toxicity. Beetroots (Beta vulgaris) contain high amounts of nitrates that are converted to nitric oxide (NO) which are known to increase dopamine regulation in the brain. Beetroots also contain betanin which has shown neuroprotective and anti-inflammatory properties against PD. This study aimed to research the use of betanin as a potential therapeutic agent in PD using Drosophila melanogaster as a model organism. All the four fly genotypes (healthy, LRRK-2, alpha-synuclein, cross-bred) were given various treatments (betanin, levodopa, combined, or none) to determine their motor activity. While cross bred flies showed sleep disturbance patterns and high motor activity at night which is a relevant non-motor symptom of PD, those treated with betanin or levodopa showed motor activity comparable to healthy flies. Treatment effects with betanin remained stable across all days indicating that no adaptation or tolerance occurred, suggesting that dose adjustment was not needed. Betanin was as effective as levodopa (the current standard) in normalizing sleep suggesting its effectiveness as a potential natural alternative to treat PD.

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

2026

Word Count: 253

Fair Category: LS

Project Number: 3035

Title: DISCOVERING DIRECT PROBING REAGENTS FOR MODIFYING DNA STRUCTURE WITH MASS SPECTROMETRY

Student Name(s): O. Chi

Abstract:

Viruses rely on their DNA or RNA genome structure to function. By understanding these genetic materials' structures, we become able to develop drugs which selectively target the virus based on that structure, which has not yet been achieved. My research is focused on finding chemicals which bond selectively towards unstructured DNA, providing valuable structural information through mass spectrometry analysis–information impossible to obtain from alternative methods. A mass spectrometer serves as a high-resolution "scale" that analyzes the molecules in a solution and is sensitive to mass additions from chemicals modifying DNA. I first tested known RNA-bonding chemicals to obtain preliminary results. When I analyzed these solutions, I collected and examined data to see if the chemical was modifying the RNA. From there, I tested these RNA probes on DNA to determine if they could also bond to DNA. Of the three known RNA reagents, I found that two didn't work effectively on DNA, but one worked very well. I also tested a new chemical known to modify DNA, which also bound and revealed structural information. Throughout this process I optimized reaction conditions of these chemical probes and analyzed them on the mass spectrometer. The findings of three chemicals that selectively target unstructured DNA should be applied further to find the structure of a real viral DNA and develop a drug that targets a specific conformation. There are many possibilities to expand with mass spectrometry, a technique with many opportunities. Overall, this research provides many new pathways to take for viral treatments.

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

2026

Word Count: 191

Fair Category: LS

Project Number: 3036

Title: Budgerigars' Behavioral Responses to Different Genres of Music

Student Name(s): C. Fox

Abstract:

Parrots are one of the most popular pets globally, distinguished for their unique abilities and exotic features. Nevertheless, they face many welfare issues inside captive homes, zoos, and in the pet industry as a whole. A lack of daily enrichment can lead to boredom, feather picking, self-mutilation, and other behavioral issues. This study explored the use of music as a form of auditory enrichment on parrots, experimenting on three groups of budgerigars, which totaled seven subjects. Three genres of music were utilized, which were pop music, metal music, and classical music, aiming to determine which type of music is most effective for enrichment. Various behaviors were documented when collecting data during a baseline, where no music was played, as well as in response to the three genres. While there was some variation in behavioral responses among the groups, it was confirmed that music had changed behavior in all three groups when compared to the baseline. There was a trend in which pop music and metal music had produced similar vocalization results in all groups. Sexual differences in vocalization behaviors were also apparent in the data. Experimentation in the future can explore behavioral responses in budgerigars to other types of music that were not used in this study, as well as utilize other species of parrots to discover species-specific trends.

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

Word Count
184

CSEF Official Abstract and Certification

2026

Fair Category
LS

Project Number
3037

Title: Antioxidants From Food Sources Inhibit Bacterial Growth

Student Name(s): C. Rogers

Abstract:
Antioxidants are compounds that neutralize free radicals, harmful unstable molecules with potential to damage cellular structures. This experiment evaluates whether antioxidants derived from fruits can inhibit bacterial growth. To test this, antioxidants were isolated from strawberries, blueberries, grapes, limes, and apples. Antioxidant activity of the fruit isolates was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay of test samples. Bacterial growth inhibition by antioxidants was then evaluated using a Kirby-Bauer test in which test disks, prepared with fruit isolates, were tested on the growth of Escherichia coli (E. coli). Blueberry demonstrated the greatest antioxidant activity. Strawberry and lime had one third of the antioxidant activity, while apple and grape had one tenth of the antioxidant activity of blueberry. The Kirby-Bauer test demonstrated inhibition of bacterial growth. Specifically, blueberry, lime, apple, and grape had clear zones of inhibition with blueberry having the widest zone. Additionally, strawberry, blueberry, and grape all had zones of intermediate bacterial inhibition. In summary, antioxidants isolated from fruits do inhibit the growth of E. coli bacteria with the greatest activity demonstrated by isolates with the highest level of antioxidants.

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

Word Count

273

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3039

Title: The Effect of Coenzyme Q10 and Epigallocatechin Gallate on Alpha-Synuclein Aggregation in Caenorhabditis elegans to Treat Parkinson's Disease

Student Name(s): L. Dombrow

Abstract:

Parkinson's Disease(PD) is the second most common neurodegenerative disease, characterized by aggregation of alpha-synuclein protein and formation of Lewy bodies, leading to dopaminergic neuron death and motor symptoms(Hughes 2022; He 2022). Currently, levodopa is the standard PD treatment(Pirker,2023); however, levodopa treats symptoms and does not address PD's root cause(Gandhi, Saadabadi 2023). Alternative treatments targeting alpha-synuclein aggregation and oxidative stress are in development(Song 2024; Ishii 2004). There is little research on combined antioxidant therapy with aggregation inhibitors to combat oxidative stress and alpha-synuclein aggregation. The NL5901 Caenorhabditis elegans strain overexpressing alpha-synuclein fused to YFP was treated with 2.5µM aggregation inhibitor epigallocatechin gallate(EGCG), 150µM antioxidant coenzymeQ10(CoQ10), EGCG+CoQ10, or none. This study evaluated whether combined treatment would be more effective at inhibiting PD progression than single drugs. Nematodes were assessed at young and adult stages. Fluorescence microscopy showed increased aggregation in adult control compared to combined treatment worms. A locomotion assay revealed decreased movement in young worms treated with CoQ10(24.1±12.8 body bends; P=.025) and EGCG(27.2±8.6 body bends; P=.036) compared to control(36.3 ± 12.3 body bends), indicating possible developmental toxicity. In contrast, adult worms treated with CoQ10 (39.7±16 body bends; P=.045) and CoQ10+EGCG(38.4±13.8 body bends; P=.014) showed increased movement over control(23.6±17.9). Movement significantly declined with age in control(P=.020). Together, these results reveal a possible link between treatment and alleviation of PD progression; however, combined treatment did not outperform single treatment. Future ROS and lifespan assays could reveal more about combined treatment versus singular treatment on overall worm health.

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

Word Count

89

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3042

Title: Determining optimal growth conditions for kombucha-based biofilms

Student Name(s): G. Scott

Abstract:

The purpose of this project was to optimize conditions for the growth of kombucha-based biofilms. With the value of probiotics as a health supplement, it is important to improve efficacy and quality of them. Biofilm growth was optimized with different growth media formulae. Biofilms were dried as a method of long-term storage. Efficacy of biofilms were tested by inoculating the samples in nutrient broth and growing them under different temperature and agitation conditions. Growth was quantified using UV-VIS spectrophotometry at 600 nm to determine optical density.

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

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

☐ human subjects ☒ potentially hazardous biological agents

☐ vertebrate animals ☐ controlled substances

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 246

Fair Category: LS

Project Number: 3043

Title: Impact of Photosynthetic Pathway Type on Trait Tradeoffs and Nitrogen Use in Bromeliads

Student Name(s): Q. Qian

Abstract:

Plants balance key traits in response to the availability of resources essential to photosynthesis, such as water, light, CO2, and Nitrogen. Most research on this "plant economic spectrum" is based on species using the C3 photosynthetic pathway, and it remains unclear how species using other photosynthetic pathways, such as Crassulacean acid metabolism (CAM), respond to stress and resource limitation. This study aims to investigate how the type of photosynthetic pathway influences nutrient cycling and functional trait trade-offs in Bromeliaceae, a highly diverse plant family. Using greenhouse and herbarium samples from the New York Botanical Garden, we measured physiological traits, such as Specific Leaf Area (SLA), and prepared ground tissue samples to measure chemical properties, including nitrogen concentration, in over 40 Bromeliad species. We found that SLA continuously declined as carbon isotope ratios decreased, indicating that species with greater CAM expression tend to develop thicker, longer-lived leaves typical of resource-conservative strategies. However, there was no strong association between growth habits and SLA. In addition, preliminary chemical analysis revealed that tissue samples of C3 species exhibited higher N concentration, while CAM species showed higher C:N ratios in their leaf litter, suggesting greater N use efficiency and longer nutrient retention. This result supports the strategy of favouring tissue longevity over rapid growth in CAM species. Understanding the resource-conservative strategies associated with CAM photosynthetic pathways can guide innovations in the field of agriculture to improve photosynthetic efficiency and ensure crop growth in nutrient-poor environments.

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

Word Count	CSEF Official Abstract and Certification 2026	Fair Category	Project Number
182		LS	3044

Title: Using Deterministic Modeling Techniques to Determine the Impact of the Removal of the Measles Vaccine Mandate in Florida

Student Name(s): A. Leih

Abstract:
The purpose of this project was to determine the long-term health impacts of removing the vaccine mandate for rubeola, commonly known as measles, in Florida. To accomplish this, spread of disease was simulated using a deterministic susceptible-infected-removed (SIR) model coded in Python. The Floridian population was split into two groups: a "pro-vaccination" group who was willing to get vaccinated, and an "anti-vaccination" group who did not get the vaccine. The SIR model had population parameters, vaccination, and measles-specific inputs and produced estimates of the expected infections, deaths, and economic costs associated with varying levels of vaccine hesitancy. The results indicate that if current levels of vaccine refusal remain constant, over the next 25 years measles will cause 393,066 additional measles cases, 874 deaths, and $11.37 billion in economic costs in Florida. Additionally, most of the impact went to the pro-vaccination population due to the large number of people in the group. These findings highlight the substantial long-term health and economic risks that come with declining willingness for a population to take the measles vaccine.

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

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

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 250

Fair Category: LS

Project Number: 3045

Title: The Effectiveness of Physical Therapy Camp Interventions on Motor Function in Children with Cerebral Palsy

Student Name(s): A. Mohr

Abstract:

Cerebral palsy (CP) is one of the most common motor functional disorders in children in the United States. Children who have CP struggle with impairments in functional mobility, fine motor control, balance, and coordination. The disorder presents differently in each person, which is why targeted treatment plans are vital for improving motor control. Physical therapy camps are common ways to help treat the symptoms of CP, but the most effective camp intervention has not yet been established. The objective of this meta-analysis was to evaluate the effectiveness of physical therapy camp interventions that use motor and functional assessments to determine improvements in motor function in participants with cerebral palsy under 18 years old. A systematic search of peer-reviewed literature was conducted, and eligible studies were analyzed for effect size of intervention. The results of the meta-analysis showed that sports intervention camps, functional electrical stimulation mobility camps and functional training camps had the greatest effect size for lower extremity camps. HABIT-ILE and CIMT camps had the largest effect size for upper extremity camps. HABIT-ILE also had the greatest effect size in upper and lower extremity combined camp interventions. The findings highlight the most effective physical therapy camps for children with cerebral palsy. These camps yield the greatest motor function improvements from the beginning of the intervention to the end. By identifying the most successful camps, individual targeted therapy plans can be better made for each child with CP, helping to aid each child's quality of life.

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

Word Count

224

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3046

Title: The effects of nitrogen pollution on the competition of growth for

Invasive versus native plant species.

Student Name(s): E. Taleb

Abstract:

Excess nitrogen is one of the reasons that invasive species are able to outcompete native species. Nitrogen is a common component in fertiliser due to its qualities in promoting photosynthesis. The excess nitrogen that wasn't absorbed by the plant is carried into forests by runoff. Nitrogen runoff negatively impacts plants by overstimulating growth, causing them to develop weak roots and stems while disrupting soil nutrient balance. This excess nitrogen favors fast-adapting invasive plants, allowing them to outcompete native species that are adapted to low-nutrient conditions. As invasive plants grow more aggressively, they crowd out native plants for space, sunlight, and water, reducing biodiversity and weakening the stability of the ecosystem overall. Compartments will be made containing: control invasive alone in soil, control native alone in soil, control invasive and native together in soil. These pairings will be replicated with a low, medium, and high dose of nitrogen. They will share the same environmental factors, such as sunlight and temperature. As nitrogen levels increased, the invasive species (Creeping Jenny) better outcomepeted the native species (Black-eyed Susan). While both species grew under the added nitrogen, the Creeping Jenny responded aggressively and suppressed Susan's growth, overall outperforming the native species. The invasive species outcompeted the native at the highest nitrogen level, indicating that nitrogen pollution amplifies its competitive advantage and reduces native plant success.

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

2026

Word Count: 255

Fair Category: LS

Project Number: 3047

Title: Investigating the Association Between LEPR Expression in Breast Cancer (BC) Tumors with BC Patient Survival, Stratified by Menopausal Status and Age

Student Name(s): J. Vatner

Abstract:

Breast cancer (BC) is a highly prevalent and deadly disease. The risk of contracting and dying from BC has been shown to be increased with obesity and obesity has been strongly associated with the hunger-regulating protein leptin and its receptor; however the association between the expression of the leptin receptor gene (LEPR) in BC tumors and BC has been insufficiently studied. This project aimed to investigate the correlation between different levels of LEPR expression in BC tumors and BC prognosis, and how that correlation changes when stratified by menopausal status and age. The experimenter, with oversight from mentor Dr. Rachel Perry at Yale University, collected BC survival data (a measure of BC prognosis/progression) and generated Kaplan-Meier (KM) survival-over-time curves using publicly available, de-identified data from the Human Protein Atlas and UCSC Xena databases, comparing high and low LEPR expression. There was a tendency toward increased mortality for patients whose tumors had very high LEPR expression. Stratifying the data by menopausal status and age did not show strongly significant trends when comparing different LEPR expression levels. Being able to predict BC prognosis is very important, so any research on potential biomarkers (like LEPR) is important because it shows if LEPR expression is something physicians should test for with BC patients. Future experimental studies should focus on collecting weight, BC survival prognosis, and LEPR expression data so that future correlational studies can examine whether the associations between LEPR expression and BC prognosis are explained by obesity rates or by another factor.

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

2026

Word Count	Fair Category	Project Number
197	LS	3049

Title: Association Between Short-Term Sleep Deprivation and Cognitive Performance: Inhibitory Control, Problem Solving, Working Memory, and Divergent Thinking

Student Name(s): T. Platt

Abstract:

Sleep is essential for optimal cognitive function but there is limited research on the extent to which sleep duration affects various executive function domains simultaneously, including suppression of bias, problem solving, working memory, and divergent thinking. This study examined whether sleep duration predicts performance across those four domains. A sample of 169 United States adults took a 15-minute survey composed of a series of cognitive tests, demographic, sleep, socioeconomic, and well-being questions. Cognitive performance was evaluated through the incongruent Stroop Test, Tower of Hanoi, Digit Span Memory Test, and Alternative Uses Test. A significant negative association was found between sleep duration and divergent thinking, such that participants who slept less showed more divergent thinking fluency ($\beta = -.65$, $p < .05$). A positive correlation emerged between divergent thinking and inhibitory control, which challenges the well-established "disinhibition hypothesis." Non-significant positive relationships between sleep and problem solving, working memory, and inhibitory control may align with the largely diverse findings in the research field. This locates a general finding for sleep duration's effect on various cognitive factors by researching four variants of cognitive processes, especially divergent thinking, and adds to research discussions about the relationship between executive functions.

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

2026

Word Count	Fair Category	Project Number
258	LS	3051

Title: Next-Generation E-Skin for Real-Time Monitoring to Prevent Livestock Disease Outbreak

Student Name(s): H. Kim

Abstract:

Livestock diseases pose a critical threat to global food security, the economy, and animal health. During the 2022 avian influenza outbreak the U.S. culled 58 billion million birds, underscoring the devastating consequences of delayed detection. Although early intervention is essential, current diagnostic methods remain inadequate. This study presents an innovative yet affordable electronic skin (E-skin) sensor for real-time monitoring of lactate, glucose, and body temperature in livestock. These parameters are key physiological indicators that change in response to stress and disease in livestock. Designed as a stretchable and easily applicable platform, the sensor enables detection without blood sampling or costly equipment. A graphite rod registers increased current with rising lactate levels, a copper oxide element detects decreased current as glucose increases, and a PEDOT:PSS film shows reduced resistance with increasing temperature. The lactic acid sensor shows a linear growth in current from 0.25M to 2M with a 200% growth in current relative at 2M relative to 0.25M, the glucose sensor shows a decrease in current from 0.0625M to 0.5M, and the temperature sensor exhibits a decrease in resistance from 38°C to 46°C. These elements are integrated into a single flexible device for continuous, field-ready monitoring. By collecting biometric data in real time, the E-skin sensor provides a practical tool for early diagnosis and individualized livestock management. Integration with artificial intelligence could predict disease progression and reduce mass culling, safeguarding animal welfare and food security. This work demonstrates a step toward sustainable livestock management through a low-cost, real-time health tracking.

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

Word Count

248

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3052

Title: SAFETY ASSESSMENT OF RADIOISOTOPE LOADED MESOPOROUS SILICA NANOPARTICLES AND ITS TRANSLATIONAL IMPLICATION

Student Name(s): C. Brown

Abstract:

This project aimed to evaluate the safety of mesoporous silica nanoparticles (MSNs) by determining their effects on cell viability in vitro and to assess how these findings may influence future clinical translation. The problem addressed was whether MSNs cause cytotoxicity in either CT26 colon cancer cells or RAW264.7 macrophages, two cell types relevant to nanoparticle delivery and clearance. It was hypothesized that MSNs would show minimal toxicity in cancer cells but may negatively affect macrophages due to their role in nanoparticle uptake, though toxicity was still expected to be minimal. To investigate, CT26 and RAW264.7 cells were cultured in RPMI medium, seeded into 96□well plates, and grown to approximately 60% confluence. MSNs and Ho(acac)3 were added at varying concentrations, and cell viability was measured using the CellTiter□Glo luminescent assay, which quantifies ATP as an indicator of metabolic activity. Nanoparticle size and surface charge were also evaluated to contextualize biological interactions. The results showed that CT26 cancer cells maintained viability across most MSN and Ho(acac)3 concentrations, indicating low cytotoxicity in this line. Contrastingly, RAW264.7 macrophages exhibited dose□dependent toxicity when exposed to MSNs, demonstrating reduced metabolic activity even at lower concentrations. These findings suggest that while MSNs appear well□tolerated by cancer cells, their toxicity toward macrophages may present a barrier to safe clinical translation. They highlight the importance of evaluating immune□cell responses when developing nanoparticle□based therapies and suggest that further optimization of MSN surface chemistry or dosing may be necessary to reduce toxicity and improve safety.

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
- [x] potentially hazardous biological agents
- [ ] vertebrate animals
- [ ] controlled substances

2. Student independently performed all procedures as outlined in this abstract. [x] Yes [ ] No
3. This project was conducted at a Registered Research Institution. [x] Yes [ ] No
4. Is this project a continuation? [ ] Yes [x] No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

[ ] Yes [x] No

CSEF Official Abstract and Certification

2026

Word Count: 236

Fair Category: LS

Project Number: 3053

Title: Association of Gut and Oral Microbiome Composition with Antidepressant Usage in Multiple Sclerosis Patients

Student Name(s): T. Sahu

Abstract:

Depression is highly prevalent in individuals with multiple sclerosis (MS), a chronic autoimmune disease affecting around 2.8 million people worldwide. This research aims to answer whether variation in gut and oral microbiome composition is associated with antidepressant usage and other lifestyle factors in a cohort of 50 patients diagnosed with MS. Using saliva and stool microbiome data from these patients, I performed a Principal Coordinate Analysis (PCoA) to visualize variation in microbiome composition with respect to clinical data across multiple taxonomic levels. Then, I used Permutational Multivariate Analysis of Variance (PERMANOVA) to test which clinical variables explained variation in microbial community composition. Alpha diversity metrics for both the oral and gut microbiomes were calculated for each participant. Associations between clinical variables and microbiome alpha diversity metrics were evaluated using Wilcoxon rank-sum tests for categorical variables and Spearman correlation analyses for continuous variables. PERMANOVA revealed that the gut microbiome composition had a significant association with antidepressant usage, EDSS (Expanded Disability Status Scale) score, and Neuro-QoL sleep score at different taxonomic levels. Oral microbiome associations were found with the MS relapse status of patients within 2 years. Through the Wilcoxon and Spearman's tests, a significant correlation was found between patients' antidepressant usage and gut microbiome richness and between weight and BMI with oral microbiome Shannon diversity. These findings suggest the gut and oral microbiome compositions vary meaningfully with different clinical and neurological factors in MS patients.

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

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

- ☐ human subjects
- ☐ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

262

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3054

Title: Design of a Zein Nanoparticle for Capturing and Removing Neural Microplastics

Student Name(s): I. Bharti

Abstract:

Rising global concentrations of micro/nanoplastics (MNPs) raise increasing concerns for human health. These particles can enter the body through ingestion and inhalation and accumulate in multiple organs, including the brain. Among the most commonly identified plastics in the human brain, polystyrene (PS) has shown particularly high toxicity in cellular and animal models. Despite growing evidence of accumulation and neurotoxicity, no effective strategy currently exists to remove plastic contaminants from neural tissue. This project designs and evaluates a brain permeable nanoparticle system capable of removing polystyrene microspheres post accumulation. This system consists of a newly-developed zein nanoparticle core stabilized with lecithin and coated with trimethyl chitosan chloride (TMC), whose synthesis was confirmed via ATR-FTIR spectroscopy, dynamic-light-scattering (DLS), and scanning electron microscopy (SEM) analyses. The TMC-coating enhances transport across the blood-brain barrier (BBB) via electrostatic interactions. Following incubation in artificial cerebrospinal fluid, the TMC coating dissipated, exposing the zein-lecithin core for plastic binding. Attachment to polystyrene microspheres was confirmed through increased particle size measured by DLS, and visualized using SEM. BBB permeability was demonstrated using a PAMPA well-plate barrier model, where ATR-FTIR analyses confirmed their passage into the model's receiver well. The system was further evaluated in vivo, in Drosophila melanogaster. Thoracic injection of PS-MPs, followed by SEM-imaging, confirmed their presence in neural tissue. Behavioral assays demonstrated reduced lifespan and activity, due to neural PS-MPs presence. Similarly, subsequent thoracic injection with TMC coated zein-lecithin nanoparticles removed the PS-MPs from brain tissue (SEM), and restored normal Drosophila activity and lifespans.

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

Word Count

244

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3055

Title: XAI-SHAP Analysis of Potential Atopic Dermatitis Flares Using Corneometric Biomarkers and Hyper-Local Environmental Data

Student Name(s): S. Kasinadhuni

Abstract:

Atopic dermatitis (eczema) is a chronic inflammatory skin condition characterized by impaired skin barrier function and episodic symptom flares. Although environmental factors such as humidity, temperature, and particulate air pollution are recognized triggers, their individualized and temporally delayed effects are difficult to quantify using subjective symptom tracking alone. This project investigated whether hyper-local environmental conditions could be used to model flare dynamics through objective biometric monitoring and explainable artificial intelligence. A 39–40 day longitudinal N=1 time-series dataset was constructed, pairing daily corneometric stratum corneum hydration measurements and a structured itch severity score with environmental variables including average temperature, dew point, relative humidity, precipitation, and PM2.5 concentrations. To account for delayed physiological responses, 24-hour lagged variables were engineered for PM2.5 and dew point. To support stable model training under small-N constraints, a noise-based augmentation method was implemented by applying a 2% Gaussian stochastic multiplier to selected environmental features, simulating realistic sensor variance without altering the overall relationships in the dataset.

A two-stage predictive framework was developed in which environmental variables were used to estimate skin hydration, and hydration was then used as a biological mediator to estimate itch severity. Model outputs were further analyzed using SHAP-based explainability to quantify feature influence on hydration predictions. Overall, this work demonstrates the feasibility of combining objective skin biometrics with interpretable modeling to generate personalized insights into environmentally driven flare risk, while highlighting important limitations of single-subject observational data.

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

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

- [x] human subjects
- [ ] potentially hazardous biological agents
- [ ] vertebrate animals
- [ ] controlled substances

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

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

4. Is this project a continuation? [ ] Yes [x] No

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

[ ] Yes [x] No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
259	LS	3056

Title: The effect of various sugar compounds on long-term memory and synaptic plasticity

Student Name(s): M. Citrin

Abstract:

The dramatic rise in refined sugar consumption has prompted concern regarding its effects on hippocampal-dependent memory and synaptic plasticity. While sucrose has been shown to impair spatial learning and reduce expression of brain-derived neurotrophic factor (BDNF), little research has examined the cognitive effects of distinct sugar monosaccharides. This study investigates the impact of sucrose, glucose, and galactose on long-term spatial memory, learning efficiency, and cognitive flexibility in young adult male mice using the Barnes Maze model.

Sixteen male mice (8–10 weeks old) are randomly assigned to four treatment groups (n=4 per group): sucrose (15% solution), glucose (15%), galactose (15%), and water control. Following one week of dietary acclimation, mice undergo habituation and a five-day acquisition phase in the Barnes Maze, with two trials per day. Spatial learning is quantified via escape latency, error frequency, and qualitative search strategy classification (random, serial, direct). Long-term memory retention is assessed through probe trials conducted 24 hours after acquisition. Cognitive flexibility is evaluated using a five-day reversal learning phase, during which the escape location is rotated 180°, followed by a reversal probe trial.

It is hypothesized that chronic sucrose exposure will impair spatial learning, resulting in prolonged escape latencies, increased errors, and reduced flexibility during reversal trials. In contrast, glucose and galactose exposure may produce neutral or enhanced performance relative to controls, potentially reflecting different metabolic and neuroplastic effects. This study aims to clarify how specific dietary sugars differentially influence hippocampal-dependent memory processes, contributing to a more nuanced understanding of diet-mediated cognitive modulation.

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

Word Count
135

CSEF Official Abstract and Certification
2026

Fair Category
LS

Project Number
3057

Title: Influence of microplastic size and density on the structure of microbial communities: Implications for soil health

Student Name(s): N. Bostick

Abstract:
Plastic has affected soil communities by introducing toxic chemicals into the soil and changing the soil structure. This is important because toxic chemicals reduce organic matter that then causes compaction. Compaction is bad because it squeezes out pore spaces between the soil particles. Soil microbes are important to protect plants by suppressing pathogens, build soil structure, and decompose organic matter. Healthy and diverse soil is necessary for soil to be more resilient in extreme weather, ultimately making the soil stronger and more stable. The aim of this study was to test the effect of microplastic size and density on soil microbe community composition. Data was collected daily for 7 days, DNA was extracted, and microbial composition was sequenced using Next-generation sequencing. NGS "Next-generation sequencing data will be used to characterize overall species composition.

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

2026

Word Count	Fair Category	Project Number
279	LS	3059

Title: Discovery and Validation of Biopolymer Coatings for Nanoparticle-Loaded Silk Fibroin Sutures to Accelerate Tissue Regeneration with a Novel Multimodal Machine Learning Model

Student Name(s): R. Ramji

Abstract:

Polymer-facilitated therapeutic delivery is a promising medical solution, yet scaling the discovery and validation of novel in situ tissue regeneration approaches across epithelial, cardiovascular, and neural tissues remains challenging. PLGA-like linear aliphatic polyesters often exhibit unstable release dynamics and insufficient durability, while many alternatives lack biocompatibility, increasing the risk of surgical site infections (SSIs) and sepsis, a leading cause of death worldwide. Herein, an end-to-end system was designed for robust biopolymer discovery in regenerative medicine and therapeutic applications. A multimodal machine learning model was developed using PyTorch and trained on 988,223 polymer strings and molecular graph representations, jointly aligned in a latent space via contrastive learning. To ensure target-site selectivity, a separate multi-task property prediction model was trained alongside motif-based clustering. The model proposed 100 candidates with 92.6–97.5% anchor similarity, filtered to two polymers: Poly(L-lactide-co-trimethylene carbonate) (LA-TMC; predicted success with controlled release), not previously considered for rapid tissue regeneration, and Poly(L-lactide-co-ε-caprolactone) (PLLA-PCL; predicted instability). These polymers were evaluated with synthesized DSS-protamine nanoparticles (NPs) for rhEGF delivery to an in vitro keratinocyte cell culture with a simulated wound. NP-loaded silk fibroin sutures coated with 10 mg/mL of LA-TMC, PLGA, and PLLA-PCL were separately introduced to keratinocytes for 48h. EGF ELISA demonstrated a 330% increase in expression with LA-TMC-coated sutures, corroborated by Ki-67-mediated immunofluorescence microscopy highlighting more targeted proliferation at the wound bed to mitigate SSIs, compared with burst release behaviors of other polymers. Successful NP retention was supported by ATR-FTIR spectroscopy exhibiting stronger hydrophobic interactions between the NP and LA-TMC.

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

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

2026

Word Count: 263

Fair Category: LS

Project Number: 3061

Title: Eco-Friendly Floating Bio-Island for Simultaneous Removal of Heavy Metals from Polluted Water Using Aquatic Macrophytes

Student Name(s): M. Tae

Abstract:

This study investigates an eco-friendly floating bio-island system using aquatic macrophytes for the simultaneous removal of cadmium and nutrients from polluted water. A small-scale hydroponic platform was constructed and planted with Eichhornia crassipes (water hyacinth), Hydrocotyle verticillata (water coin), and Hygrophila difformis (water wisteria). Synthetic wastewater containing nitrate and 10 mM Cd^{2+} was used to evaluate metal-detection sensitivity, temporal removal kinetics, and tissue-specific accumulation. A colorimetric strip assay first established a detection limit of approximately 1 μM Cd^{2+}, indicating that the commercial kit is suitable for monitoring moderate to high contamination but not trace levels. Visual color changes after seven days confirmed that all three species could lower cadmium concentration, with water coin producing the greatest decolorization. Quantitative measurements over 8–20 days showed steadily increasing removal efficiencies, reaching roughly 82–90% for water coin, 78–82% for water hyacinth, and 72–78% for water wisteria by day 20. Stacked-tissue analyses revealed that more than three-quarters of accumulated cadmium was retained in roots, with stems and leaves containing only minor fractions. Mechanistic interpretation based on literature suggests that water coin's superior performance arises from dense, regenerating root systems, strong phytochelatin synthesis, active vacuolar sequestration, and restricted xylem loading that minimizes shoot translocation. Overall, the results demonstrate that a simple floating bio-island can effectively sequester cadmium while confining most of the metal to root biomass, highlighting Hydrocotyle verticillata as a promising candidate for scalable, nature-based remediation of agricultural and urban water bodies. These findings also inform future integration with nutrient removal and native wetland species.

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

2026

Word Count: 266

Fair Category: LS

Project Number: 3063

Title: Can Your Diet Protect Against Microplastics? Discovering the Impact of Probiotic E. coli Strains on Microplastic-Induced Toxicity in C. elegans

Student Name(s): S. Schwartz

Abstract:

Microplastics threaten human health by accumulating in the gut, disrupting microbial balance, and impairing metabolism, though it is unclear whether altering gut microbiota can reduce their toxicity, but it is unclear whether modifying gut microbial composition can mitigate this toxicity (Dehaut et al., 2016) (Schwabl et al., 2019) (Jin et al., 2019). This study investigated whether a bacterial diet influences behavioral responses to microplastic-induced stress in C. elegans, a model with conserved stress and metabolic pathways (Cabreiro et al., 2013). Synchronized L1 N2 worms were fed E. coli OP50 (control), E. coli Nissle 1917 (probiotic), or heat-killed E. coli K-12 (dysbiotic), followed by exposure to 100 µg/mL fluorescent 1 µm aged polystyrene microplastics for ~3 days. Toxicity was assessed via lifespan, locomotion, and protein-normalized oxidative stress. Lifespan analysis showed diet-dependent differences under microplastic exposure: Nissle 1917–fed worms survived longest (~13 days) (HR=0.59), OP50 controls lived ~10 days (HR=1), and K-12–fed worms had the shortest lifespan (HR=2.81)(~6 days). Locomotion reflected similar trends, with probiotic-fed worms moving fastest under control conditions (78.8 vs. 63.5 body bends/min for OP50, $p=0.0362$) and maintaining higher movement after exposure, whereas dysbiotic-fed worms had the lowest baseline and post-exposure performance. Microplastic exposure increased oxidative stress across all diets, with the highest ROS in K-12-fed worms (18.4 AU/ug), intermediate in Nissle (9.6 AU/ug), and lowest in OP50 controls (3.7 AU/ug). Gut microbial composition influences resilience to microplastic damage, with probiotics reducing oxidative and functional effects and representing a target for mitigation.

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

2026

Word Count	Fair Category	Project Number
256	LS	3064

Title: Identification of Candidate Biomarkers for Diabetic Complications via High Glucose-Induced Endothelial Injury Mechanisms

Student Name(s): X. Wu

Abstract:

Diabetes has long become one of the most common chronic diseases worldwide. Conventional insulin therapy can only maintain patients' normal daily functioning but cannot achieve a complete cure. In the later stages of diabetes, vascular complications often develop, leading to multi-site deterioration in patients and even threatening life. Diabetic nephropathy (DN) and diabetic retinopathy (DR) are common microvascular complications of diabetes, and oxidative stress plays a key role in the pathogenesis of both complications. This study aims to integrate transcriptomic data from DN and DR, perform differential expression analysis and weighted gene co-expression network analysis (WGCNA) based on alterations in gene expression, to identify key gene modules that play a central role in these diseases. Furthermore, it combines analysis with single-cell data from diet-induced oxidative stress to identify endothelial cell marker genes and employs LASSO regression for diagnostic value prediction. In this experiment, 505 and 969 differentially expressed genes were identified in DN and DR, respectively, from which five core gene modules were identified as shared regulatory modules. Single-cell analysis identified eight cell types. Focusing primarily on endothelial cells, a joint analysis screened out 35 endothelial dysfunction genes related to oxidative stress. LASSO regression further selected four core genes (NOTCH1, CELF2, EMP3, VGLL4), whose excellent diagnostic and predictive value were validated using ROC curves. This study reveals the shared molecular mechanisms of oxidative stress-mediated endothelial dysfunction in DN and DR, identifies four potential diagnostic biomarkers, and provides new insights for the early diagnosis and targeted therapy of diabetic microvascular complications.

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

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

2026

Word Count: 148

Fair Category: LS

Project Number: 3067

Title: Flexible Organic Transistor-Based Devices for Neural Recording in the Gut

Student Name(s): E. Sun

Abstract:

The enteric nervous system (ENS), controlling several gastrointestinal functions, is difficult to study in live organisms due to low neuron density and the highly-mobile nature of the guts. Conventional bioelectronic implants are often rigid or invasive, limiting signal detection while increasing the risk of tissue damage and unnatural animal distress. Here, we present a biocompatible, flexible implant thin enough for surgical placement between the myenteric and submucosal layers. Its conformity and pliancy minimizes disruption to the surrounding tissue, enabling speedy post-surgical recovery and regular behavior. We further optimized and streamlined the fabrication workflow to improve device consistency and recording performance. The device enables real-time recordings of ENS activity in response to chemical stimuli and mechanical stressors, including single-neuron signals in free-moving animals. These results display a minimally invasive strategy for monitoring neural activity and give way to experiments investigating the gut–brain axis.

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

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

2026

Word Count	Fair Category	Project Number
202	LS	3069

Title: Optimizing Bromelain and Papain Protease Formulations to Preserve Catalytic Activity Under Simulated Human Gastrointestinal Stress

Student Name(s): R. Bishi

Abstract:

Gastrointestinal digestive enzyme insufficiency can lead to health complications such as maldigestion, bloating, gas, diarrhea, and steatorrhea. As a result, people rely on external sources of proteolytic enzymes, which aid in the breakdown of certain proteins into smaller peptides or amino acids by hydrolyzing peptide bonds. Papain and Bromelain, derived from Carica papaya and Ananas comosus, respectively, are two predominant plant-based proteases commonly found naturally and in dietary supplements. This project investigates the comparative proteolytic activity of Bromelain and Papain under simulated gastrointestinal stress conditions. Samples were exposed to acidic pH, physiological temperature (37°C), and ionic stress to model aspects of the digestive environment. Proteolytic degradation is quantified using a gelatin substrate assay, measuring the volume of digested liquid to assess how effectively a honey-based sugar matrix preserves enzyme functionality under varying pH, temperature, and ionic conditions. From the experiment, it was concluded that using natural fructose and glucose creates a cosolvent, resulting in excess residual water volume, corresponding to an increased amount of protein digested under the simulated conditions. These findings support the potential of low-cost, natural stabilization strategies to improve the reliability of plant-derived digestive enzyme supplements and promote accessible approaches to digestive health support.

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

2026

Word Count: 242

Fair Category: LS

Project Number: 3071

Title: MemotionCare: Decoding the Epigenetic Nexus Between Alzheimer's and Depression via Transformer-Driven Network Medicine

Student Name(s): Y. Wang

Abstract:

Alzheimer's disease (AD), affecting over 55 million globally, is marked by cognitive decline, amyloid-β plaques, and tau tangles. Major depressive disorder (MDD), impacting 280 million worldwide, involves persistent depression and anhedonia. Strikingly, 30–50% of AD patients develop MDD, while late-life MDD increases AD risk by 1.5–2 fold, suggesting a bidirectional relationship between the two. Despite evidence of shared mechanisms, the links between AD and MDD—spanning genetic, molecular, and clinical dimensions—remain poorly defined, largely due to conflicting genetic evidence and the inconsistent efficacy of antidepressants in treating comorbid populations. Here, we identified a gene regulatory network (GRN) linking AD and MDD, established a transformer model to identify convergent pathways underlying their comorbidity, and evaluated the established network, prioritized genes, and drug candidates in C. elegans transgenic models. Contrary to prior studies that focused on genetic or pharmacological mechanisms independently, this study explores the comorbidity between AD and MDD through multiple dimensions. Our findings reveal that this comorbidity is driven by shared biological pathways, particularly chromatin organization and epigenetic regulation, centered on the GRN we identified. These findings challenge the traditional view of AD and MDD comorbidity as a shared pathophysiological process instead of a complex network. By linking computational predictions with experimental validation, this study provides a mechanistic framework for future dual-target therapies. This advances the precision of treatment strategies for comorbid AD and MDD, addressing a critical gap in neurodegenerative and psychiatric knowledge and care.

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

2026

Word Count	Fair Category	Project Number
104	LS	3073

Title: Which Surface in the Lab has the Most Microbes that Could Cause Bread to Spoil?

Student Name(s): J. Quezada

Abstract:

This experiment tested how different surfaces affect microbial growth. The purpose is to show that microbes grow on different surfaces, and this is one of the reasons why we should not eat in laboratories and classrooms to avoid getting sick. Bread was placed on a table, a door and a sink surface and then observed over several days. The bread on the table and door grew visible microbes, while the bread on the sink showed little growth of microbes. This shows that some surfaces, like the sink can reduce microbial growth, highlighting how the type of surface and hygiene on it affects microbial 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
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

Word Count

153

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3074

Title: Determining the Effects of Oleic Acid

on α-Amylase Enzyme Activity

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

Abstract:

The purpose of this study was to investigate the effects of oleic acid on α-Amylase enzymes. It was hypothesized that the application of three biopesticides, insecticidal soap, horticultural oil, and neem oil, would inhibit the α-amylase enzymes due to oleic acid. By inhibiting α-amylase enzymes, bees would struggle to turn nectar into honey as the enzymes is invaluable to the process, breaking down amylose turning it into glucose. The hypothesis was tested by running a DNS assay. For the DNS assay, six test tubes were filled with phosphate buffer, enzyme solution, sugar (either starch substrate or glucose) solution, and oleic acid solution. The test tubes were then boiled in distilled water and placed in the plate reader. This hypothesis was proven incorrect as the α-Amylase enzymes seemed to be enhanced by the oleic acid while acting on the soluble starch substrate. For the glucose substrate, the data was inconclusive.

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

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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

2026

Word Count	Fair Category	Project Number
252	LS	3076

Title: Mapping the Dynamic Brain: Analysis of Static & Dynamic Functional Connectivity Within & Across Reading & Default Mode Networks in Children Varying in Family Risk for Dyslexia

Student Name(s): M. Rajagopal

Abstract:

Developmental Dyslexia, an unexpected learning disability, has been linked to altered resting-state functional connectivity (RSFC) among reading-related brain areas. However, most prior work has examined static features, overlooking temporal fluctuations that may relate to reading performance. This study focuses on the Reading Network (RN) and Default Mode Network (DMN) in a group of children, to investigate how static and dynamic RSFC between and across networks are associated with family risk for dyslexia and reading performance. Resting-state fMRI and behavioral data from an existing dataset of 40 school-aged children with varying reading skills, vocabulary scores, socioeconomic background, and parental reading history was analyzed using region-of-interest (ROI) based static and dynamic RSFC measures within and between RN and DMN (derived via Sliding Window Analysis). The correlations with reading performance and family risks were examined while controlling for age, sex, and handedness. The results showed that maternal family risk was associated with both increased and reduced connectivity between the RN and DMN, while paternal risk reduced average connectivity within RN. Reading performance was primarily related to connectivity with the angular gyrus. Unexpectedly, family risk was not always associated with increased connectivity variance, but depended on specific nodes and networks. Moreover, better reading was associated with greater RSFC variance. These findings first support that poor reading is associated with abnormal functional connections. It also suggests that the prior hypotheses about brain variance in reading and dyslexia are oversimplified. As an initial effort, this study encourages further investigations on this topic.

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

Word Count

270

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3077

Title: The activation of SKN-1 via the RNAi knockdown of wdr-23 to reduce oxidative stress from microplastics in Caenorhabditis elegans.

Student Name(s): W. Kwong

Abstract:

Microplastic pollution is a significant issue due to increases in plastic production. Currently, there is no solution to combat microplastic damage in the body (Thompson 2024). In humans, microplastics are associated with increased oxidative stress levels, resulting in inflammation, disease, and cancer (Liu 2023). This research aims to knockdown the upstream repressor (WDR-23) of the antioxidant system (SKN-1) via RNA interference (RNAi) to increase C. elegans resistance to microplastic induced oxidative stress. Wild type worms were exposed to 0.2 mg/ml polystyrene microplastics aged in H_2O_2 and HT115(DE3) meant to induce RNAi and knockdown wdr-23. To study the effects, lifespan and reactive oxygen species(ROS) levels were measured. Lifespan assays utilized 100µM FUdR to inhibit reproduction, and nematode survival was evaluated daily until death. ROS was measured using chloromethyl-H2DCFDA dye and a LS55 fluorescent spectrometer, and was normalized via PierceBCA protein assay. Both microplastics alone and HT115 alone were discovered to lead to significant decreases in lifespan (hazard ratio(HR) 4;$P<0.001$). Notably,WDR-23 knockdown with microplastics partially reduced the harmful effects(HR1.7;$P=0.02$), though it did not fully restore lifespan(HR0.34 relative to MP; $P<0.001$). It was found that, by itself, RNAi significantly decreased ROS, lowering levels to 8.848 A.U./µg. However, this decrease was not observed when RNAi was done in the presence of microplastics. There were also no significant differences among control (33.349 A.U./µg), MP (34.647 A.U./µg), and MP + HT115 (43.219 A.U./µg) treatment groups. These results raise questions about the mechanisms behind lifespan and ROS levels, suggesting that there may not be a biological correlation.

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

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

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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

2026

Word Count: 229

Fair Category: LS

Project Number: 3078

Title: Investigating the Role of Rad52 in BRCA2-Mediated DNA Repair in Ovarian Cancer

Student Name(s): R. Rao

Abstract:

The BRCA2 gene plays a critical role in the repair of double-strand breaks in DNA through Homologous Recombination (HR). A loss of its function leads to genomic instability associated with the development of ovarian cancer. While a type of drug called PARP1 inhibitors can target BRCA2-deficient cells, creating synthetic lethality, some cells remain resistant to this treatment. Studies show that the RAD52 gene, which acts as an inefficient backup for DNA repair in BRCA2-deficient cells, may enable cancer cells to bypass PARP1 inhibition. In this experiment, we hypothesized that when RAD52 is knocked down or inhibited, BRCA2-deficient PEO1 cancer cells will exhibit more sensitivity to PARP1 inhibitors than non-BRCA2-deficient PEO1-NR (NR) cancer cells. PEO1 and NR cell lines were subjected to RAD52 inhibition via siRNA knockdown or drug treatment, followed by exposure to a PARP1 inhibitor. Cell viability was subsequently assessed. Contrary to our hypothesis, upon RAD52 inhibition, NR cells displayed greater sensitivity to PARP1 inhibitors than PEO1 cells. These findings suggest that RAD52 does not function solely as a backup in BRCA2-deficient cells but instead works together with BRCA2 to repair DNA damage. Further investigation with other ovarian cancer cells lines and in-vivo studies is needed to identify the precise role of RAD52 in BRCA2-mediated DNA repair and evaluate its potential as a therapeutic target in ovarian cancer.

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):

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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

2026

Word Count: 249

Fair Category: LS

Project Number: 3080

Title: Comparative Efficacy of Intravenous vs. Intraosseous Tranexamic Acid in Simulated Hemorrhage and Warfarin-Altered Clotting

Student Name(s): D. Karpf

Abstract:

Severe hemorrhage is a leading cause of preventable death, and tranexamic acid (TXA) is widely used in emergency medical services (EMS) to inhibit fibrinolysis. However, uncertainty remains regarding the optimal route of administration (intravenous [IV] vs. intraosseous [IO]) and the effectiveness of TXA in anticoagulated patients. This study investigated: (1) whether IV or IO TXA produces faster effective antifibrinolytic action when EMS access times are incorporated, and (2) whether warfarin exposure alters clot formation and TXA effectiveness in an ex vivo plasma assay.A simulated circulation model using a peristaltic pump and chicken thigh tissue was developed to replicate peripheral vascular resistance. Clot formation and fibrinolysis were chemically induced. TXA with sodium fluorescein tracer was administered via IV or IO access. Pharmacokinetics were assessed by spectrophotometry at 490 nm wavelength, and pharmacodynamics by turbidity measurements. ImageJ quantified dye-positive area and mean intensity. A separate ex vivo plasma assay compared clot formation with and without warfarin using spectrophotometry (405 nm), turbidity, and mean gray value analysis. IO administration demonstrated greater antifibrinolytic effect than IV, with higher mean turbidity (51.18 vs. 35.4 NTU). Although IV tracer was detected earlier, incorporating EMS access times (2.5 min IV vs. 0.16 min IO) resulted in faster overall effective action for IO (9.16 vs. 11.5 min). Warfarin significantly reduced clot stability (turbidity 96.7 vs. 160 NTU), and TXA showed minimal preservation of fibrin structure in anticoagulated samples. These findings support early IO TXA administration in prehospital hemorrhage and reduced TXA effectiveness in patients receiving warfarin.

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

2026

Word Count	Fair Category	Project Number
251	LS	3081

Title: Identifying EEG Markers of Neonatal Hypoxia Through Electroencephalography

Student Name(s): A. Menon

Abstract:

Fetal hypoxia arises when oxygen delivery to the brain and other organs is reduced, which can cause damage and lesions. This is linked to fetal mortality and to negative postnatal outcomes such as cerebral palsy. In the electroencephalogram (EEG) of neonates, hypoxia appears as a reduction in signal amplitude and high-frequency activity, which suggests that the power spectrum of EEG signals becomes flatter in response to hypoxia. The purpose of this project was to evaluate the predictive value of reductions in the PSD (Power Spectral Density) exponent as an index of hypoxemia and hypoxia in neonates. It was hypothesized that if a neonate experienced hypoxemia or hypoxia, then their EEG would show a reduction in high-frequency power and a flatter power spectrum, reflected in a smaller PSD exponent. The independent variable in this study was the oxygenation status of the neonate, defined as a binary variable determined as blood oxygen saturation (SpO_2) levels within the normal range and below ($SpO_2 < 90\%$). The dependent variable was the EEG power spectral density (PSD) exponent. Segments with and without hypoxia/hypoxemia were compared, and the student used the specparam Python package to estimate the PSD exponent of the recordings with and without hypoxia/hypoxemia. While a general trend was found in line with the hypothesis, statistical significance was not established, and as such, no relationship was found. However, refinement of this novel EEG technology, as well as exploration of alternative EEG features, could present opportunities to establish early markers of neonatal hypoxia.

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

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

2026

Word Count: 269

Fair Category: LS

Project Number: 3083

Title: Development of an Adaptive Glucose-Responsive Oral Insulin Capsule: A Glucose Oxidase Nanoparticle System for Intestinal Delivery in Type 1 Diabetes

Student Name(s): E. Mao

Abstract:

Type 1 diabetes destroys insulin-producing cells, causing blood glucose to rise while depriving cells of energy. Current treatments, insulin injections and pumps, demand frequent monitoring and can be inconvenient and frightening, underscoring the need for effective and comfortable therapy. This research presents an oral capsule that delivers insulin to the jejunum through glucose-responsive nanoparticles. The capsule shell, Evonik's Eudracap Enteric, protects insulin in the stomach by remaining intact for minimum 2hr at the gastric pH 1, compared with ~20min dissolution for a standard capsule. Eudracap dissolves only at pH ~6.8, corresponding to the proximal jejunum, and releases its contents over ~35min into the early-mid jejunum, where insulin absorption is optimal. Inside, GOx (glucose oxidase)-ALG (sodium alginate)-CNPs (chitosan nanoparticles) averaging 101.4nm provide "smart" release. GOx, the component driving insulin release by catalyzing glucose into gluconic acid and H_2O_2, remained active after immobilization: nanoparticles with 10mg GOx produced ~36mM H_2O_2, and those with 5mg generated ~16mM in 500mg/dL glucose over 2hr, confirming glucose-dependent responsiveness. Moreover, chitosan coating enhanced mucoadhesion dramatically in ex-vivo porcine-jejunum tests, extending residence times versus uncoated formulations. Further, over a 5hr study, the nanoparticles exhibited need-proportional insulin release with 9.3% in 0mg/dL glucose, 23.8% in 100mg/dL, and 94% in 500mg/dL (hyperglycemic level). Notably, release in 500mg/dL mirrored clinically-used rapid-acting insulin: 25% by ~30min, 50% by ~1hr, 75% by ~2hr, and near-100% by 4-5hr. Collectively, these results establish the GOx-ALG-CNP capsule as a practical, painless, and adaptive oral insulin system, delivering physiological control while easing the burden of Type 1 diabetes.

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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- ☐ 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

2026

Word Count: 208

Fair Category: LS

Project Number: 3084

Title: Dose-Dependent Effects of Chitosan Nanoparticles on Human Fibroblast Proliferation and Skin Wound Closure: Smart pH-Responsive Chitosan Nanoparticle Wound Dressing

Student Name(s): E. Kwon

Abstract:

Chronic wound care requires dressings that not only support tissue repair but also detect infection and provide adaptive antimicrobial protection. This project developed a smart pH-responsive wound dressing that combines chitosan nanoparticles (CNs) with an anthocyanin–chitosan hydrogel to promote fibroblast healing while responding to wound pH changes. Chitosan nanoparticles were prepared by ionic gelation and characterized as nanoscale, positively charged particles suitable for biological applications. To evaluate biological performance, human skin fibroblasts were treated with CNs (0–100 µg/mL), and cell proliferation was measured using the PrestoBlue assay. Fibroblast migration and wound closure were assessed using a scratch wound healing assay. In parallel, hydrogel swelling behavior and antibacterial activity against E. coli were tested under wound-relevant pH conditions. CN treatment significantly enhanced fibroblast proliferation and accelerated scratch wound closure, with 50 µg/mL identified as the optimal concentration for fibroblast growth and migration. The anthocyanin–chitosan hydrogel exhibited clear pH-dependent color changes and increased swelling under alkaline (infection-like) conditions, which corresponded to stronger antibacterial effects. These findings support a multifunctional dressing platform that can simultaneously promote skin repair, visually indicate wound status, and enhance antimicrobial action in response to infection-like environments, highlighting its potential as a next-generation smart wound dressing.

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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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

Word Count

240

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3087

Title: Analysis of Approval-Based Committee Voting Methods using Real-World Ballot Data

Student Name(s): I. Bozzuto

Abstract:

In contrast to a typical “Plurality” Ballot which involves voting for only one candidate, an Approval Ballot involves voting for any number of candidates. While the application of Approval Ballots to single-winner elections is trivial, where the candidate that is approved on the greatest number of ballots wins, there exist many ways to apply approval voting to multi-winner elections, called Approval-Based Committee (ABC) Rules. These ABC Rules have been compared via both mathematical analysis as well as application to non-political contexts, like selecting validators on a digital blockchain. However, there is currently a gap in existing literature on how these perform in real-world political elections. This study closes this gap by looking at Block Plurality Voting (BPV) elections in the US, which work similar to Approval Voting but with an upper limit on the total number of candidates approved. Data is taken from over 160 municipal races in Dane County, Wisconsin and various counties in Colorado and California. A variety of existing methods for mathematically comparing ABC Rules are used for comparison using the Python library abcvoting. This research comes at a time when organizations advocating for Approval Voting are considering the use of the method for real-world political elections, and will help to increase confidence in how these ABC Rules perform in practice. Some further avenues of research after this study is conducted could be more competitive elections or scored multi-winner rules.

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

2026

Word Count: 232

Fair Category: LS

Project Number: 3088

Title: Ginger-Derived Exosomes Inhibit Microbial Contamination in Aqueous Environment

Student Name(s): L. Fan

Abstract:

Pathogenic microorganisms in water represent a major source of water pollution. However, traditional chemical disinfectants often produce toxic by-products and cause environmental damage. Plant-derived exosomes have been proven to be highly promising green antibacterial agents, and their natural nanovesicular structure can effectively protect active ingredients. Yet, the potential of ginger-derived exosomes (GDEs) in inhibiting the proliferation of aquatic pathogenic bacteria remains unclear.

This study aimed to: (1) isolate GDEs via ultrahigh-speed differential centrifugation; (2) systematically evaluate their dose-, time-, and temperature-dependent inhibitory effects on Escherichia coli(E. coli); and (3) investigate their ability to counteract the growth-promoting effect of glycerol, a common additive in personal care products. Antibacterial efficacy was quantitatively assessed using the microbroth dilution method and CCK-8 assay.

The results indicated that the inhibitory effect of GDEs on E. coli exhibited a clear dose-, time-, and temperature-dependent manner. The optimal antibacterial efficacy was achieved at a concentration of 100 μg/mL, an incubation time of 24 h, and a temperature of 37°C. Furthermore, GDEs successfully reversed the significant growth-promoting effect of 5% glycerol on E. coli, reducing bacterial proliferation to a level comparable to or lower than that of the control group.

These findings demonstrate that GDEs are efficient, biocompatible, and sustainable antibacterial agents, with significant application potential in water pollution control and the preservation of glycerol-containing skincare products.

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

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

- ☐ human subjects
- ☒ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

262

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3091

Title: Targeting Pulmonary Fibrosis: A Lung-targeted, Macrophage-Specific Lipid Nanoparticle for TGF-β siRNA Delivery

Student Name(s): L. Lin

Abstract:

Pulmonary fibrosis (PF) is a fatal lung disease characterized by excessive fibroblast activation and collagen deposition, affecting millions worldwide with a median survival of 3-5 years post-diagnosis (CDC). The prevalence is expected to rise substantially due to global population aging. Currently, no effective cure exists, as commercial antifibrotic drugs demonstrate limited efficacy and severe adverse effects, creating an urgent need for safer and more effective treatments.In PF pathogenesis, macrophages serve as central regulators through M1-M2 phenotype polarization and release of profibrotic cytokines, including TGF-β1, IL-4, PDGF, and IL-13 (Jiang et al.). Among these, transforming growth factor-β1 (TGF-β1) signaling has been validated as the primary driver of fibrotic processes by inducing profibrotic gene transcription via the Smad pathway (Meng et al.), making it a promising therapeutic target for attenuating the maladaptive injury-repair cycle in PF. To specifically suppress TGF-β1 derived from macrophages, we designed a multifunctional lipopeptide nanoparticle (LNP) platform for targeted siRNA delivery. The formulation was rationally optimized by incorporating lipopeptide as the ionizable lipid component to achieve high lung-specific delivery (Xiao et al.), while phosphatidylserine (PS) was included to mimic apoptotic cell surfaces, facilitating macrophage-specific uptake via PS-binding receptors such as TIM4 (Min et al.). Through systematic characterization and gene silencing efficiency evaluation in RAW264.7 macrophages, POPS-containing LNPs demonstrated optimal performance with approximately 98.5% cellular uptake and 86.7% reduction in TGF-β gene expression while maintaining excellent cell viability. This research presents a promising targeted strategy for PF treatment and provides valuable insights for next-generation LNP development.

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):

- ☐ 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

2026

Word Count: 239

Fair Category: LS

Project Number: 3093

Title: The Effect of Different Concentrations of Ampicillin vs. Tea Tree Oil on Bacterial Growth

Student Name(s): B. Amen

Abstract:

Antibiotic resistance is an increasing healthcare concern that can mainly be attributed to the overprescription and misuse of antibiotics. In fact, approximately 48,000 deaths occur in the United States each year due to bacterial-resistant infections (Nguyen et al., 2023). In response to this problem, researchers have shifted their attention towards the importance of alternative treatments (Quave, 2016). Plants have been a valuable source for traditional medical practices (Nguyen et al., 2023). One antimicrobial compound that has been effective at killing persister cells is tea tree oil. As a result, my goal is to find whether plant-based antimicrobials are as effective as antibiotics. To do this, I will use petri dishes to examine how different concentrations of ampicillin and TTO impact the growth patterns of E. coli k-12. The five different concentrations for both treatments will include 10 M, 1 M, 0.1 M, 0.01 M, and 0.001 M. The zones of inhibition will be examined after 24 and 48 hours and the radii of each zone will be measured using image J. I expect that the tea tree oil will be effective at inhibiting bacterial growth at concentrations of 10 M and 1 M, whereas ampicillin will be effective at concentrations of 10 M, 1 M, 0.1 M, and 0.01 M. If the results of my study align with my predictions, it would begin a pathway to finding information on an alternative treatment for antibiotic-resistant infections.

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

2026

Word Count: 257

Fair Category: LS

Project Number: 3094

Title: Determining how prevalence of single nucleotide polymorphisms alters HLA molecule's expression, and dictates Juvenile Idiopathic Arthritis' best treatments in

Student Name(s): T. Addeo

Abstract:

Juvenile Idiopathic Arthritis (JIA), the most common autoimmune disease in children, causes joint inflammation and can lead to growth and bone development issues. Determining the optimal therapy for JIA across different populations is a long and costly process. The available therapies include the weakest, NSAIDS; moderately stronger, DMARDS (methotrexate); and the strongest, TNF inhibitors. The frequencies of single nucleotide polymorphisms (SNPs), prevalent in JIA patients, have been studied by the Genome-Wide Association Study only in the British population (GBR). Herein, single nucleotide polymorphisms, located in the non-coding HLA region, with biologic effects on HLA expression, were used to determine optimal therapies in populations outside of GBR. R-studio Coding was used to generate allele frequencies at these SNPs in MXL, PUR, CLM, PEL, and ASW populations. The nonmatching SNPs of the populations, when compared to GBR, were identified: 7 in MXL & PUR, 8 in ASW, 3 in CLM, and 1 in PEL. The Gene Tissue Expression Portal was used to query these SNPs across the tissues: whole blood, spleen, & cells EBV-transformed lymphocytes (EBV-LCLs), and within the genes: HLA-DQA1, HLA-DRB1, & HLA-DRB5, to determine gene expression associated with each SNP. All of the nonmatching SNPs influence high expression of HLA-DRB1 & HLA-DQA1 in EBV-LCLs, which is associated with resistance to methotrexate. Thus, the more of these nonmatching SNPs, the more support for resistance to methotrexate, and the need for a more aggressive therapy. Therefore, the predicted therapy for CLM and PEL is DMARDs and for MXL, PUR, ASW; TNF inhibitors.

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
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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

2026

Word Count: 258

Fair Category: LS

Project Number: 3097

Title: Role of FGF2 in Uterine Wound Healing: Gene Expression Analysis in Mouse Tissue and Human Endometrial Stromal Cells

Student Name(s): D. Bahtiyar

Abstract:

Cesarean sections account for one-third of U.S. deliveries. Subsequent pregnancies carry increased risk of complications including placenta accreta spectrum and uterine rupture, yet no therapies exist to specifically improve uterine healing. Fibroblast Growth Factor 2 (FGF2) promotes wound healing in skin by stimulating cell proliferation and angiogenesis, but its role in uterine repair remains poorly understood. This project investigated how FGF2 influences gene expression during uterine wound healing. Using a previously established mouse uterine injury model, RNA sequencing identified candidate genes altered by FGF2. Fourteen differentially expressed genes were validated using qPCR, targeting extracellular matrix remodeling, integrin signaling, and inflammatory pathways. Tissue samples were provided and analyzed; cDNA was synthesized and expression quantified using SYBR-based detection with GAPDH as reference. To further define cellular responses, uterine injury was modeled in vitro using a human endometrial stromal cell line (HESC). Confluent monolayers were scratch-wounded and treated with FGF2 at 100 ng/mL in serum-free media. In mouse tissue, qPCR confirmed changes in LOX, Serpine1, and ITGB1. Notably, LOX was highly upregulated in whole tissue but only modestly in stromal cells, indicating other uterine cell types are major contributors requiring further investigation. In the HESC model, Serpine1 was upregulated 2-fold and ITGB1 1.6-fold by FGF2 during wound closure. Serpine1 is associated with tissue remodeling, while ITGB1 mediates cell-matrix adhesion critical for migration. These findings suggest FGF2 facilitates matrix remodeling and cell migration during repair, providing a foundation for exploring FGF2 as a therapeutic strategy to improve uterine healing and reduce abnormal placentation risk.

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
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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

2026

Word Count: 211

Fair Category: LS

Project Number: 3099

Title: Viability of Mussels as a Water-Management Tool in America:Elliptio complanata and C16H22ClN3O Fungicide

Student Name(s): C. Auerswald

Abstract:

Mussels have been successfully used in European countries as a biological indicator of contamination in community water systems. No research has been done on American mussels, but biological tools could be useful in solving the issues posed by aging hydro-infrastructure. This study uses Elliptio complanata, a freshwater mussel common across the eastern United States, and studies its behavioral changes in response to the commercial fungicide Tebuconazole (C16H22ClN3O), which is widely used individually and industrially. 20 E. complanata mussels are randomly divided across 4, 20-gallon tanks, with five individuals in each tank. All tank conditions are identicaly and remain constant throughout the experiment. Mussels are allowed a 9 day acclimation period before data collection begins to eliminate behavioral changes from shipping stress. Control data is then collected from all tanks for 5 days. On the 15th day, a diffent concentration of Tebuconazole is added to each tank, and experimental data is collected for seven days. Data will be collected using underwater ultrasonic sensors to determine if mussels are open or closed. For each tank, experimental data on average time each mussel spends open will be compared to the same tank's control data using a T-test. Average time spent open will be compared across all tanks using an ANOVA test.

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

Word Count

190

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3100

Title: Investigationing the Antibacterial Properties of Pigments Isolated from Environmental Samples

Student Name(s): K. Diaz Ruiz

Abstract:

Antibiotic resistance is a global health crisis that reduces the effectiveness of many current antibiotic treatments. Many antibiotics originally come from soil microbes that naturally produce antimicrobial properties to compete with other organisms.Bacteria produce various pigments to protect themselves from UV radiation, environmental toxins, and help bacteria procure resources. Commercially, bacterial pigments are used across the cosmetic, pharmaceutical, and food industries. This study investigated whether pigments made by environmental bacteria could inhibit the growth of clinically relevant bacterial strains. Five pigment-producing microbes were isolated from environmental samples and cultured under laboratory conditions. Pigments were extracted and tested for antimicrobial activity using standardized zone of inhibition assays. The extracts were applied to agar plates inoculated with multiple non-pathogenic relatives of clinically relevant species to model potential targets. Zones of inhibition were measured to quantify antibacterial effects. Results indicated that the tested pigments did not produce measurable inhibition against the tested strains of bacteria. These findings suggest that, under the conditions tested, not all microbial pigments may contain compounds with antimicrobial potential. Further research should evaluate a broader diversity of pigments and extraction methods to better assess their antimicrobial potential.

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

2026

Word Count: 275

Fair Category: LS

Project Number: 3101

Title: Design of a Fluorescence-Based, Point-of-Care Diagnostic for Chronic Kidney

Student Name(s): R. Choudhary

Abstract:

Chronic kidney disease (CKD) affects millions worldwide, yet many cases go undiagnosed because screening typically requires inaccessible blood or urine tests. If unchecked, CKD can lead to increased risk of heart attack, stroke, hypertension, and even early death, due to the kidney's inability to filter waste products from the blood. In response, this study presents a novel, rapid, non-invasive fluorescence-based diagnostic for CKD through smartphone detection of salivary creatinine. Visible sensor color change is commensurate with the static quenching of red/magenta $Eu(TTA)_3Phen$ fluorescence in the presence of creatinine, caused by the formation of a (endocyclic) N-Eu bond between $Eu(TTA)_3Phen$ and creatinine (supported by ATR-FTIR analysis). It was found that 3.5 minutes is needed to allow for the quenching to stabilize, to produce concentration-dependent reduction in fluorescence intensity across a series of creatinine concentrations. To highlight sensor selectivity for creatinine, common salivary interferents were similarly evaluated, with no measurable fluorescence response. To create a user-friendly, simple testing kit, 100µl of 10mM-$Eu(TTA)_3Phen$ is pipetted onto a 90mm-circle filter paper, located within each of a 2-well assay strip, where ~200ul saliva is then added. Fluorescence quenching is subsequently measured in a (kit-included) light-tight imaging box, containing a 395nm excitation-LED. A new application then captures a smartphone image of the light intensity drop between the 2 wells, and correlates the %-decrease to an immediate CKD-stage diagnosis, with a 5E-6 M creatinine minimum detection. This fluorescence detection system represents a low-cost, scalable approach to non-invasive, point-of-care kidney health monitoring while expanding access to early detection.

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

Word Count

224

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3103

Title: Unilateral Leg Press Cross-Education Training Effects on Strength, Endurance, and Movement Velocity in Male High School Students

Student Name(s): J. Liang

Abstract:

Cross-education refers to strength and performance gains in an untrained limb following unilateral training. While this phenomenon has been observed in adults, it is less studied in high school populations. This study investigated whether unilateral leg press training in trained male high school students produces cross-education effects in the untrained leg and which outcome—strength, muscular endurance, or movement velocity—is most affected. It was hypothesized that if one leg is trained on the leg press machine, the untrained leg would also demonstrate increases in strength, endurance, and movement velocity compared to baseline, with strength showing the greatest increase due to neural adaptations. The independent variable was the randomly assigned trained leg. The dependent variables were strength gains (estimated 1RM), muscular endurance (number of repetitions at 70% 1RM), and angular velocity in the untrained leg. Participants completed baseline testing for strength, endurance, and velocity, followed by eight weeks of unilateral training performed twice per week (3 sets of 8–12 repetitions at 70% 1RM with progressive overload). Mid- and post-testing repeated baseline assessments to measure changes over time. Results showed muscular endurance increased the most from pre- to post-testing (approximately 22%), strength increased moderately (about 9%), and movement velocity showed minimal change. These findings suggest neural adaptations contribute to cross-education, with endurance demonstrating the greatest effect in this population.

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

2026

Word Count: 267

Fair Category: LS

Project Number: 3104

Title: Colorimetric Sensory Detection of High Levels of Uric Acid and Endothelin-1 for Early Pulmonary Hypertension

Student Name(s): A. Foell

Abstract:

Pulmonary hypertension (PH) is a progressive and often life-threatening cardiovascular disorder in which there is abnormally high blood pressure in the arteries of the lungs. PH frequently goes undiagnosed until it reaches an advanced stage, in which there may already be significant and irreversible damage to the heart and lungs. Research indicates that high levels of uric acid (UA) and endothelin-1 (ET-1) are the most prevalent and specific indicators of pulmonary hypertension. This research project designed and developed an effective, rapid liquid test for PH, where a patient's serum is added to tetramethylbenzidine (TMB), which is oxidized by H2O2, and then mixed with Bromothymol Blue dye (BTB). From these reactions, hypertension is indicated by visible color change from yellow to green, based on elevated concentrations of 90µg/ml-UA and 1µg/ml-ET-1. To characterize UA/ET-1 sensor response, the fluorescence of 1.7µM TMB with 0µM, 100µM, and 1000µM H2O2 was measured, to find the ideal concentration of TMB with H2O2 for maximum color change. Then, the spectral responses of TMB-H2O2 with normal and hypertensive levels of UA and ET-1, separately and then combined, were measured. TMB-H2O2 alone could not produce a visible color change between normal and hypertensive concentrations, but rather an emission at 395nm. To complement the TMB-H2O2 reaction, BTB was added, so that elevated-UA of hypertension would increase the dye's 610-630nm absorbance, and cause the desired color change from yellow to green within 5 minutes with the addition of a hypertensive concentration, or conversely stay yellow for normal UA-concentrations up to ~85µg/ml.

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

2026

Word Count: 189

Fair Category: LS

Project Number: 3106

Title: A Multiscale Wavelet Transform Approach to Spatial Gene Expression in Breast Cancer

Student Name(s): G. Mayorga

Abstract:

Spatial transcriptomics allows measurement of gene expression while preserving physical location within tissue, but most methods only analyze data at one spatial scale at a time. This study investigates whether gene expression in breast cancer is organized differently at broad tissue-level versus fine local scales. Using publicly available Visium HD data from human breast cancer tissue, the analysis covered 82,248 spots across 17,202 genes at 16µm resolution. A spatial graph was constructed connecting nearby spots and the graph Laplacian was computed to extract eigenvectors, which were split into low, mid, and high frequency bands based on eigenvalue. Gene expression was projected onto each band and reconstructed separately, then clustered to identify groups of spots with similar patterns at each scale. Low frequency revealed broad tissue regions like tumor core, immune zones, and stroma. Mid frequency showed intermediate zones where tumor and immune cells meet. High frequency uncovered fine cellular microniches including a HER2+ tumor zone that was completely invisible at broader scales. Gene Ontology enrichment confirmed that each frequency band captured distinct biological pathways, validating that spatial gene expression in breast cancer is hierarchically organized across multiple scales.

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

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

- ☐ human subjects
- ☐ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
243	LS	3107

Title: Decoding Adhesion Proteins: Computational Insights for Smarter Brain-on-a-Chip Interfaces

Student Name(s): S. Kothandam

Abstract:

The brain-on-a-chip that uses living neurons and brain cells is gaining popularity for assisting disabled people. It contains microelectrodes that can record and store electrical signals from the brain. Laminin is a protein that is highly important for tissue structure and function. It occurs in the thin layer called the basement membrane, which supports cells and separates tissues, such as skin or blood vessels. The dystroglycan receptor is a protein complex that links cells to their surroundings and maintains tissue strength and stability. I hypothesize that laminin binds to a specific region of the dystroglycan receptor, thereby strengthening the interaction between the brain chip and nerve cells. Laminin protein modeling is the process of determining the 3D structure of laminin and understanding how it works and why it is as it is. We will use the amino acid sequence of laminin as the starting point. Then we will use AlphaFold to predict how the protein folds into its final shape. These programs use information from other known proteins to make accurate predictions. Once the shape is ready, we will study how laminin works and connect it with the brain chip information. The result shows that the two receptors form strong interactions and exhibit structural flexibility. The current research will help in designing a brain chip interface. The current study will pave the way for developing a novel brain chip interface system that can significantly reduce inflammation caused by this device.

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

Word Count

251

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3108

Title: Assessing the Effects of Equine Grazing Muzzles on Upper Incisor Length and Dental Qualities in Ponies

Student Name(s): M. Sommerville

Abstract:

Grazing muzzle usage in ponies is a common management strategy to reduce forage intake on pasture and decrease risk of obesity and laminitis. Though grazing muzzles are effective and preserve regular equine behaviors, they may compromise other aspects of welfare, including the equine dentition. Though 17% of horse owners reported muzzle-induced damage to their equine's dentition in a survey, this subject area has never been researched. Thus, this study aimed to determine the effects of three equine grazing muzzles on incisors and the dentition in ponies. Pony 1, Pony 2, and Pony 3 were equipped with grazing muzzles of soft, medium, and hard base material, respectively. Muzzled ponies grazed on pasture for approximately 6 hours daily for 19 weeks. Upper incisors were measured regularly throughout the study. Muzzles were tested with force to determine relative material rigidity. Results indicated that Pony 1 experienced an average increase in incisor length, while Pony 2 and Pony 3 experienced an average decrease in incisor length. The increasing hardness of muzzle base material was directly proportional to increasing incisor wear. Overall, grazing muzzle usage decreased incisor length by an average of 0.0965 millimeters per week. The study found that grazing muzzles have the potential to impact the dentition in ponies and recommends using a grazing muzzle with a flexible, soft base material to minimize incisor wear. Understanding the dental effects of equine grazing muzzles will help horse carers make informed, case-specific decisions to manage their horses' health issues and promote greater animal welfare.

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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- ☐ 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

2026

Word Count 153

Fair Category LS

Project Number 3109

Title: Physiology Modification; Equine Cooling Patterns

Student Name(s): C. Grimm

Abstract:

The objective of my experiment was to determine whether hotwalking is effective in the process of cooling down horses. My hypothesis stated that if I hotwalk a horse for 15 minutes after a 20-minute exercise period, then the horse's body temperature will return to normal. To test this, I observed three horses during multiple 20-minute exercise periods. As I observed them, I took their temperatures right before their work, directly after, and at 5-minute intervals during the 15 minutes of hotwalking. The temperature data collected at each time point showed that hotwalking is effective and useful in the cooling-down process. The experiment also showed that around 15 minutes or more is the ideal amount of time for hotwalking. Knowing this can prevent poor cool-down practices and help keep horses in better condition. Overall, this experiment supports a better understanding of cool-down methods and encourages safer horse management.

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):

☐ 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

2026

Word Count: 251

Fair Category: LS

Project Number: 3111

Title: Innovative Restoration of Coastal Marine Ecosystems: Phage-Based Disease Control and pH Modulation in Connecticut Waters

Student Name(s): T. Kim

Abstract:

Accelerating ocean acidification and rising sea temperatures are rapidly destabilizing marine ecosystems, placing shellfish aquaculture at risk through widespread disease outbreaks and mass mortality. Increased carbon dioxide absorption has lowered seawater pH, while warmer conditions have intensified pathogenic bacterial infections, leaving economically and ecologically vital shellfish populations increasingly vulnerable. This study presents an integrated mitigation approach for Connecticut aquaculture by combining bacteriophage therapy with salt electrochemical batteries to reduce pathogen-induced mortality and counteract acidification. Vibrio carchariae was inoculated and exposed to isolated bacteriophages to identify effective viral strains, with agar bacteriophage blocks serving as durable carriers enabling sustained release. In parallel, a saltwater battery system was deployed to modulate pH levels. Bacterial populations, turbidity, and clam survival rates were monitored across experimental conditions, while artificial intelligence was employed to optimize bacteriophage selection and pH control based on Vibrio optical density, marine bacterial density, and turbidity. Agar proved to be the most effective delivery medium, reducing Vibrio optical density by 66.67% with minimal disruption to water clarity. The electrochemical system increased seawater pH by 30.16%. In survival trials, tanks treated with a single bacteriophage block demonstrated the highest clam viability and clearest water conditions. Machine learning analysis further revealed a 55.4% reduction in V. carchariae populations without adversely affecting beneficial bacteria. The proposed dual response AquaGuard system demonstrates a scalable strategy to suppress marine pathogens, enhance shellfish survival, and mitigate acidification. Further field-scale testing and real-time system optimization are needed to evaluate long-term viability under natural ocean conditions.

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

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

- ☐ human subjects
- ☐ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
239	LS	3112

Title: Investigation of reptile UV bulb on vitamin D2 synthesis in pulverized mushrooms: An analysis over specific durations using Thin Layer Chromatography (TLC)

Student Name(s): W. Iqbal

Abstract:

About one billion people around the world have a vitamin D2 deficiency, and Vitamin D2 is used to treat vitamin D deficiency. Various studies have also shown a positive influence of vitamin D on autoimmune disorders. Mushrooms are one of the few food sources that can make its own vitamin D2 precursor ergosterol which converts to vitamin D2 when exposed to UV light. This research aims to investigate how will the intensity of vitamin D2 in oyster mushrooms using Thin Layer Chromatography be affected by the duration of pulverized oyster mushrooms exposed to the reptile UV Bulb? The longer duration time will result in an increase of the intensity of Vitamin D2 when examining pulverized mushrooms using Thin Layer Chromatography. For the experiment store bought oyster mushrooms are sliced and dried in an oven at 170 Fahrenheit for one and half hour and then pulverized. The powder mushrooms are exposed to reptile UV bulbs for a specific duration. After exposure, 0.1g of mushroom powder was extracted and TLC was performed for concentration of ViminD2. Samples were spotted using a 254 UV light. Results indicated a positive correlation between UV exposure time and the Rf values. The Rf values increased from the control of 0.162 and after 60 minutes to 0.246 with a steady state. This concludes reptile UV bulbs are an effective tool for increasing Vitamin D2 content in mushrooms for an accessible method for addressing Vitamin D2 deficiency.

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

Word Count: 215

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3114

Title: Potential Medications to Treat Concussion in D. melanogaster as a Model Organism

Student Name(s): K. Kennedy

Abstract:

In cases of concussion, following initial trauma, the neurometabolic cascade of concussion occurs. Many aspects of this neurometabolic cascade can serve as targets for pharmacological concussion treatments. Dantrolene, a ryanodine-sensitive calcium store blocker may be able to reduce the effects of calcium-induced calcium release that occurs following concussion. Fingolimod, promotes microglia M2 polarisation, which should be neuroprotective, as M2 tends to be anti-inflammatory (instead of pro-inflammatory like its M1 counterpart). Quinolinic acid, a product of tryptophan-metabolism in the brain is harmful in concussion, but deactivating the kynurenine-3-monooxygenase (KMO) enzyme that promotes quinolinic acid production may aid in concussion recovery; this would be done by KMO-Inhibitor II. The products of another part of the same (kynurenine) pathway is kynurenic acid, which tends to be neuroprotective in concussion (by modulating glutamate levels), so L-kynurenine was used to promote the production of kynurenic acid. Tests were preformed in D. melanogaster with the different drugs mixed in their food. The flies were subjected to trauma using a high intensity trauma device. The medications (with the exception of KMO-Inhibitor II) were placed in an emulsion to increase (oral) bioavailability. Preliminary tests using fingolimod and dantrolene, have yielded somewhat promising results, though further experimentation is required to mark statistically significant results

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

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

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- ☐ 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

2026

Word Count	Fair Category	Project Number
154	LS	3117

Title: How do different soils affect the growth rate of plants.

Student Name(s): J. Colon-Machado

Abstract:

In this experiment we investigated the effect of different soils on plant growth. The planters, (plant containers were filled with equal amounts of soil, include Garden Soil, Compost Soil (from Mr. Neale), All-purpose Soil, Joseph's Home Soil (from Bridgeport), and Valerie's Home Soil (from Bridgeport). Then 40 Radish seeds were placed in each planter and treated with water and the same type and amount of lighting. Each container was checked regularly to measure plant using tactile / motion or feeling with hands and then height measurements with a ruler. This was done over a six-week period of time. The six-week experiment involves consistent watering for all planters under a sun lamp. Weekly data collection will track the growth and performance of the plants in their respective conditions. The growth light helped to facilitate photosynthesis. The compost soil from Mr. Neale exhibited the highest growth and height among all soil types.

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

2026

Word Count: 246

Fair Category: LS

Project Number: 3119

Title: Hyper-Activated Asthmatic B Cells Contribute to Exaggerated Immune Response

Student Name(s): A. Bhave

Abstract:

Asthma is a very common chronic respiratory disease that imparts severe health risks and is difficult to control, characterized by airway inflammation mediated by hyperresponsive immune cells and tissue remodeling. Asthma has generally been thought to have deficient type I interferon (IFN) responses, with low levels of IFN-alpha being linked to insufficient response to viral infections and poor inflammatory control, leading to asthma exacerbations. However, new evidence is accumulating that demonstrates elevated IFN may exacerbate asthma and lead to more severe outcomes. This study aims to explore the effect of varying levels of interferon in asthmatic PBMCs, and aims to understand other reasons for asthma responses to address gaps in treatment efficacy. B cell specific gene expression was also analyzed to see individual effects. Multiple publicly available datasets from GEO were combined and analysis with R was conducted on expression patterns before and after stimulation with rhinovirus. Data was processed by filtering, normalizing, and integrating metadata. Gene expression signatures across multiple comparisons were annotated by ontology analysis to discover molecular pathways important in B cell/PBMC dynamics in asthma. Results showed that high IFN samples had more proinflammatory pathways upregulated, suggesting that IFN overproduction has a significant effect on asthma exacerbations. Type-2 skewed response was also seen in asthmatic cells, characterized by parasite pathways upregulated in both PBMC and B cells. The presence of parasite related pathways during viral stimulation suggests dysregulated antiviral response, potentially reflecting improper immune training consistent with the hygiene hypothesis.

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

2026

Word Count	Fair Category	Project Number
258	LS	3121

Title: Computationally Engineering a Thermostable Enzyme for the Degradation of PET Through Manipulation of Disulfide Bonds

Student Name(s): J. Lieberman

Abstract:

Plastic pollution represents a significant problem, accounting for approximately 12% of total global solid waste. This issue is not slowing down, with plastic production and waste more than doubling since 2000. Plastics do not biodegrade for centuries, breaking down into toxic microplastics that harm ecosystems. There are many forms of plastic recycling; however, many are unsustainable and create additional waste. Biocatalytic recycling using the enzyme PETase currently offers the most sustainable option; however, less than 1% of global plastic waste processing uses this process. Currently, PETase enzymes exhibit limited thermostability, which limits the general applicability of this approach and reduces their usability. One mechanism by which nature enhances thermoenzyme stability is through the incorporation of disulfide bonds, a defining feature of thermophilic bacteria that thrive at elevated temperatures. This raises the question: how does disulfide bond density affect the thermostability and catalytic activity of PETase-type enzymes? In this study, the FAST-PETase structure was mutated in PyMOL to introduce disulfide bonds. Molecular dynamics simulations were then used to measure backbone root-mean-square deviation, radius of gyration, backbone root-mean-square fluctuation, and native contacts across a range of temperatures. The engineered variants demonstrated enhanced thermal robustness compared to existing PETase benchmarks, indicating that rational disulfide bond engineering can stabilize PET-degrading enzymes. Improving thermostability will enable PET depolymerization over a wider temperature range, reducing depolymerization time and increasing efficiency. These computational results demonstrate a novel enzyme-design approach that addresses a key bottleneck in biocatalytic plastic recycling and advances enzymatic PET degradation toward global industrial viability.

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

2026

Word Count: 171

Fair Category: LS

Project Number: 3122

Title: Never Miss A Dose

Student Name(s): B. Dikow

Abstract:

This project aims to combat common events of forgetfulness pertaining to medication usage. In the United States, 258 million adults self-administer prescription medication. About 75% of these Americans experience difficulty remembering to take their medication at the times the prescription requires. This automatic pill box that has been designed and built is a solution to this obstacle. This automatic pill box consists of an Arduino microcomputer, a servo motor, and a simple gumball machine built with cardboard. Pill capsules made of vegetable cellulose have been used in place of pills. The presented prototype dispenses pills at the time that the user inputs and contains an LCD screen that lets the user know when to take their medication. These two forms of reminder will be a useful tool for patients and will solve widespread forgotten medication. In conclusion, an automatic pill box that reminds a patient to take their prescribed medication is a solution to the 193 million American adults who have trouble recalling when to take their medication each day.

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

2026

Word Count	Fair Category	Project Number
258	LS	3125

Title: Creation of PACA Nanoparticles with a Chitosan/γ-PGA bilayer for Oral Delivery of Sildenafil PDE-5 Inhibitor for Treatment of Non-Alcoholic Fatty Liver Disease

Student Name(s): N. Pendkar

Abstract:

NAFLD is an extremely prevalent chronic disease in the world, affecting >59% of the population. This study presents sildenafil encapsulated in a PACA nanoparticle with a Chitosan/γ-PGA bilayer (CPB) (PACA-NPs) to mitigate nonalcoholic fatty liver disease (NALFD) damage through sildenafil's therapeutic capacities. The system allows for oral delivery and uptake into liver sinusoidal endothelial cells (LSEC) through interactions between the different parts. An ex vivo, everted gut sac apparatus was used as a model for oral delivery. Through ATR-FTIR analysis, samples collected hourly support oral delivery through the absorption of PACA-NPs through the intestinal wall membrane. SEM analysis highlighted adherence of the PACA-NPs to the intestinal wall, supporting CPB as an effective oral delivery mechanism. Histopathology SEM analysis shows that the CPB has no adverse effects on intestinal health. Ex vivo precision cut liver slices (PCLS) exhibiting NAFLD via oleic acid pre-treatment were used as a model for PACA-NPs dissolution, sildenafil delivery, and its therapeutic effectiveness. Separate PCLS were given 30µM, 20µM, 10µM, 5µM, or 1µM concentration of PACA-NPs. SEM analyses support PACA-NP therapeutic effectiveness, as the number of lipid particles decreased from over 500 at 1µM, 40 at 5µM, 16 at 10µM, 14 at 20µM, to 3 at 30µM. Finally, histopathology SEM analysis shows that the PACA-NPs do not have adverse effects on liver health. This research highlights use of PACA NPs with a CPB as a delivery mechanism for sildenafil, to provide a practical, effective, and versatile solution to the extremely prevalent chronic disease, NAFLD.

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

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
225	LS	3127

Title: Investigating the Impact of BRCA1/2 Co-Expression Gene Silencing on Chemotherapy Efficacy in Ovarian Cancer

Student Name(s): C. Stannard

Abstract:

BRCA1 and BRCA2 are central mediators of homologous recombination (HR), a DNA repair pathway that resolves double-strand breaks and preserves genomic stability. Genes co-expressed with BRCA1/2, including ATAD5, ASPM, and POLQ, modulate HR efficiency and influence cellular responses to DNA-damaging agents. It was hypothesized that siRNA-mediated knockdown of BRCA1/2 co-expressed genes would sensitize ovarian cancer cells to PARP inhibition by impairing HR capacity. PEO1 (BRCA2-mutant), PEO4 (BRCA2-wild type), and PEO1-NR (BRCA2-wild type) cells were plated in 96-well format and transfected with siRNAs targeting ATAD5, ASPM, or POLQ, alongside non-targeting control siRNA. Cells were subsequently treated with increasing concentrations of olaparib (0–50 μM) for 72 hours across three independent trials. Cell viability was quantified using a MTS proliferation assay, and Western blot analysis confirmed efficient gene knockdown. Knockdown of ASPM, POLQ, and ATAD5 significantly increased olaparib-induced cytotoxicity in BRCA2-wild type PEO4 and PEO1-NR cells, whereas no enhanced sensitivity was observed in BRCA2-mutant PEO1 cells. These findings partially support the hypothesis and suggest that disruption of BRCA1/2 co-expressed genes compromises DNA repair capacity in HR-proficient contexts, thereby augmenting PARP inhibitor efficacy. Targeting ASPM, ATAD5, and POLQ is a good way to treat advanced stage BRCA-related ovarian cancers, with the goal of improving treatment outcomes and extending patient survival.

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):

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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

2026

Word Count: 253

Fair Category: LS

Project Number: 3130

Title: Identifying Psychiatric Disorder Risk Genes: Computational Multi-Omic Analysis of Gene Expression and Chromatin Accessibility Comparing Developing vs. Adult Prefrontal Cortex

Student Name(s): A. Sharma

Abstract:

Approximately half of all psychiatric disorders begin before age 14, yet the molecular mechanisms underlying this early vulnerability remain incompletely understood. While previous studies have characterized broad gene expression changes in the prefrontal cortex (PFC), none have directly tested whether the genes most dramatically remodeled during brain maturation are the same genes underlying psychiatric vulnerability. This study hypothesized that because these disorders emerge during critical developmental windows, genes most actively remodeled between fetal (GA24) and adult (40Y) PFC would be enriched for genetic risk associated with autism spectrum disorder (ASD), schizophrenia (SCZ), major depressive disorder (MDD), and attention-deficit/hyperactivity disorder (ADHD).

Publicly available single-nucleus RNA sequencing and chromatin accessibility data from human PFC were analyzed using Python scripts, Scanpy and ArchR. Excitatory neurons were isolated and compared across developmental stages. Differential expression analysis identified developmentally dynamic genes, and were linked with functions through Gene Ontology analysis using EnrichR. Genes showing coordinated changes in both expression and chromatin accessibility were selected as multi-omic candidates and tested against psychiatric GWAS datasets using MAGMA gene-set enrichment analysis. Fetal PFC genes showed the strongest enrichment for ADHD ($-\log10P = 1.56$), while adult genes showed the greatest enrichment for SCZ ($-\log10P = 0.81$), with MDD and ASD showing weaker signals revealing that distinct disorders map onto separate developmental windows of PFC maturation. Future applications of this work could use identified candidate genes as developmental therapeutic targets, where CRISPR-based gene editing or early molecular monitoring could intervene before psychiatric symptoms, transforming psychiatry into predictive, precision medicine.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): BC 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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- ☐ 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

2026

Word Count: 248

Fair Category: LS

Project Number: 3131

Title: Investigating Neural Regeneration and Memory Retention in Dugesia Planaria Under Different Light Conditions as a Model for Stroke Recovery

Student Name(s): H. Monschein

Abstract:

Despite strokes being a leading cause of death and long-term disability such as memory impairments, which remain one of the most persistent challenges of recovery, current rehabilitation methods rarely restore full cognitive function. Therefore, understanding how environmental factors influence, enhance, or inhibit neuroplasticity is critical for improving stroke outcomes. This study investigated how light exposure during neural regeneration affects memory retention using Dugesia tigrina planarians as a model organism. Planarians were classically conditioned to associate a neutral red light stimulus with an aversive green light stimulus, decapitated, and then allowed to regenerate under constant light, constant darkness, or a 12 hour light/dark cycle before being tested to see if conditioned responses were still present as a way to examine memory retention. Prior to conditioning, planarians showed little to no response to the isolated red light stimulus, but after repeated pairings with green light, they demonstrated clear aversive behavioral responses, indicating successful classical conditioning. After regeneration, planarians maintained under constant light exhibited a substantial reduction in memory retention compared to both their non-decapitated control and experimental groups under constant darkness or a light/dark cycle. Overall, these findings indicate that continuous sensory exposure during regeneration significantly impairs neural recovery and memory retention. Additionally, reduced sensory environments may better support neural recovery, while excessive stimulation may disrupt neuroplastic processes. These findings provide insight into how environmental conditions could influence cognitive recovery following brain injury and guide future research on how controlled sensory conditions can optimize rehabilitation environments.

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

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

- ☐ human subjects
- ☐ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

210

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3136

Title: Generating Mutant CSRP2 Constructs to Explore Copper-Binding Site Function

Student Name(s): A. Sticca

Abstract:

Copper (Cu) is a vital trace metal that supports many biological processes, including gene regulation and muscle development. The Padilla-Benavides lab recently identified CSRP2, a cysteine-rich transcriptional regulator, as a novel copper-binding protein. CSRP2 knockout (KO) in cultured mouse primary muscle cells, namely primary myoblasts, leads to excessive cell proliferation and impaired differentiation, suggesting a role for this protein in cell division.

We hypothesized that specific copper-binding residues within CSRP2 are essential for its role in muscle development and regulating cell proliferation. To test this, we used site-directed mutagenesis to disrupt predicted copper-binding sites in the CSRP2 gene to be tested in primary myoblasts. To this end, the gene was cloned in a mammalian expression vector, and specific residues were mutated by PCR. Our goal is to use these constructs in downstream functional assays in primary myoblasts to assess phenotypic differences. To this end, these CSRP2 mutant constructs will be introduced into primary myoblasts via retroviral transductions to examine changes in proliferation, differentiation, and gene expression. Through the process of disrupting each of the individual copper-binding domains, this study will provide a basis for identifying key residues within the CSRP2-mediated transcriptional process and how copper-binding affects skeletal muscle development in vitro.

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
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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

Word Count
246

CSEF Official Abstract and Certification

2026

Fair Category
LS

Project Number
3137

Title: In Vitro Assessment of Lactase Production Activity, Efficiency, and Survivability of L. acidophilus in Non-Dairy Carriers

Student Name(s): M. Weng

Abstract:

L. acidophilus produces lactase, an enzyme that breaks down lactose into glucose and galactose, helping alleviate symptoms of lactose intolerance. The protective effects of non-dairy carriers on L. acidophilus remain unclear, creating a need to assess the lactase production activity, efficiency, and survivability of L. acidophilus in non-dairy carriers. The study hypothesized that if L. acidophilus is delivered through a non-dairy carrier and exposed to stomach-like conditions, then it will reduce the amount of lactose present because the non-dairy carrier protects the probiotic, allowing it to survive and produce lactase. The independent variable is the type of non-dairy carrier used (rice milk, almond milk, or oat milk), and the dependent variables were the number of surviving bacteria and the amount of lactose broken down. The negative control was the respective carrier without L. acidophilus. The carriers were inoculated with L. acidophilus, plated, acid-exposed, and supplied with lactose. Glucose production measured every 30 minutes for two hours served as an indicator of lactose metabolism. Instantaneous lactose metabolism rates differ significantly at 30 minutes for each carrier compared to its control. All three carriers only differed at 30 minutes in instantaneous rate of glucose production. The study found all carriers support lactose metabolism, but they differ in when and how it happens. Survivability rates could not be determined due to plate contamination. Further research is needed to directly assess survivability and the ability of other probiotic strains in non-dairy carriers.

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

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

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
256	LS	3138

Title: How Cooking Affects Antioxidant Levels in Cauliflower

Student Name(s): O. Cheon

Abstract:

This study examined the impact of different cooking methods on antioxidant retention in cauliflower, with a focus on vitamin C as a measurable indicator of antioxidant capacity. Antioxidants play a critical role in reducing oxidative stress which is associated with chronic diseases. Therefore, identifying preparation methods that preserve antioxidants can help prevent related health problems in simple and affordable ways. It was hypothesized that boiling and microwaving would result in greater antioxidant loss, while griddling and frying retaining higher levels, with raw cauliflower exhibiting the greatest concentration.

Uniform samples from the same cauliflower head were treated to boiling, griddling, frying, and raw. The endpoint of cooking was defined as an internal temperature of 210°F(99°C), when prob was inserted into the stem of the sample. Cooked samples were homogenized and stabilized with oxalic acid to prevent further oxidation.

Vitamin C concentration was quantified using a 2,6-Dichloroindophenol sodium salt(DCPIP) redox titration method calibrated with known L-ascorbic acid standards, and calibration curve made. Then, the volume of DCPIP required to reach the endpoint of each sample was recorded using a microburette. The calibration curve enabled conversion of titrant volumes into ascorbic acid equivalents, allowing standardized comparison of antioxidant retention among cooking methods.

Fried samples showed the highest vitamin C retention, followed by boiled, raw, and griddled samples. The finding suggests that cooking method indeed influences antioxidant preservation. However, since the differences in DCPIP volume were minor, conditions varied slightly, and a single trial was performed for each, the results should be interpreted cautiously.

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

Word Count

250

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3139

Title: Discovering Novel Targets for the FMN Riboswitch to Test the Utility of Computational RNA-folding Methods to Address Multidrug Antibiotic Resistance

Student Name(s): J. Hari

Abstract:

Rapid discovery of antibiotic molecules is essential to reducing the antimicrobial resistance crisis(Frieri,2017). Computational methods may be an important resource to increase the antimicrobial pipeline. While novel therapeutics have been successfully developed through computational pipelines, RNA-based efforts are understudied(Ren,2023). Computational determination of RNA tertiary structures lags behind that of protein structures, and its use in identifying ligands has been limited(Bernard,2025). This study evaluated the accuracy of one novel and two established RNA-folding algorithms, next using the best performer to computationally and experimentally determine antimicrobial chemicals that inhibit the FMN riboswitch in E. coli to assess whether computational pipelines of ncRNA-targeting are accurate, and to demonstrate the utility of targeting ncRNAs. A pool of small molecules similar to Ribocil and FMN, known ligands of the FMN riboswitch, have been narrowed down through a three-tiered cheminformatic analysis to potential hits. Positive computational hits (n=1) will be tested in two bioassays in an E. Coli K-12 model system: a dose-response assay where growth curves and MICs will be compared across different administered concentrations of compounds, and a resazurin growth curve assay. It was first discovered that a novel transformer approach is an ineffective RNA-folding algorithm. It was next found that trRosettaRNA is the best existing RNA-folding model, despite being significantly inaccurate, yet good for comparative usage. Three novel candidate compounds have been identified for antimicrobial research. Future studies should focus on testing the discovered possible ligands in bioassays.

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

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

- ☐ human subjects
- ☐ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

158

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3141

Title: Passive Tick-Borne Disease Surveillance Activity with Haemaphysalis Longicornis in Bridgeport CT

Student Name(s): S. Hill

Abstract:

Tick-borne diseases impact hundreds of thousands of people every single year and cause many life-altering complications. The surveillance of tick-borne diseases through field and laboratory work ensures a deeper understanding of possible pathogens in invasive tick species. Detection of the possible pathogens present in invasive species allows an understanding of public health safety against tick-borne diseases. Fieldwork will include the collection of the invasive longhorn tick, Haemaphysalis Longicornis, to monitor the spread and assess potential ecological and public health impact. In the laboratory, work focused on tick species identification and the detection of pathogens using molecular biology techniques, including DNA and RNA extractions, polymerase chain reaction (PCR), and gel electrophoresis. These methods will ensure the accurate identification of tick-borne agents and contribute to the understanding of their distribution. Together, these efforts support ongoing surveillance programs aimed at improving tick-borne disease prevention and control strategies to help ensure the safety of the public.

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

Word Count

183

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3142

Title: How Different Compression clothing Items Help a person with Hypermobile Elhers Danlos syndrome.

Student Name(s): B. Solimine

Abstract:

The reason for the experiment I have done is to improve my everyday life. The problem was my constant dizziness and faintness, and soreness and pain with HEDS. I have trouble standing and moving for long periods of time without rest and/or sitting.

I did different daily exercises in different compression clothing items to have them acting as another outside layer of skin. I ran to the best of my ability, did ab exercises and stood for long periods of time. All of these would make me very winded without these clothing items, and I had to take breaks in between experiments and their rounds in order to not injure myself.

I found the compression pants to be the most helpful when it comes to soreness and discomfort throughout my body and joints. The socks were ranked second and the long sleeve shirt last.

All of the items were helpful, but the pants helped the most in both ways and overall the average best. The pants did the most for me and they were not interfering with my everyday clothing and appearance.

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

2026

Word Count	Fair Category	Project Number
192	LS	3143

Title: Fostering GFP Bioluminescence in Moss Protema Using Plasmid Transformation

Student Name(s): T. Walsh

Abstract:

The purpose of this project was to attempt a new protocol for eukaryotic genetic transformation using moss protonemata. Standard protocols for eukaryotic transformation typically include puncturing the cell wall with tools and chemicals such as gene guns and Polyethylene glycol. Heat shock is typically performed on prokaryotic cells, due to the fact that their cell barriers are much more simplistic. However, heat shocking the cell with a solution containing the plasmid may porate it for a short period of time where the plasmid is able to enter the cell. Eight agar plates of moss protonemata grown in four slightly different ways were split into four quadrants each, with each quadrant receiving 100ul of a mixture containing PGLO plasmid and arabinose. Results showed that none of the protonemata uptook the plasmid due to the fact that none fluoresced under blacklight. This is likely due to the fact that, once again, the cell barrier is extremely complex in plant cells, and this project's protocol was unable to break through. This data reinforced that heat shock and heat shock adjacent transformations do not work on eukaryotic cells, due to the complexity of their cell barriers.

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

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

- [ ] human subjects
- [x] potentially hazardous biological agents
- [ ] vertebrate animals
- [ ] controlled substances

2. Student independently performed all procedures as outlined in this abstract. [x] Yes [ ] No
3. This project was conducted at a Registered Research Institution. [x] Yes [ ] No
4. Is this project a continuation? [ ] Yes [x] No
5. My display board includes photographs/visual depictions of humans (other than myself or my family): [ ] Yes [x] No

Word Count

255

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3144

Title: Therapeutic Potential of Neurokinin Receptor 1 Antagonist in Breast Cancer

Student Name(s): S. Vash

Abstract:

Breast cancer is the 2nd leading cause of cancer death among women in the United States, with many distinct molecular subtypes. This project studied three subtypes of breast cancer: triple negative (HCC1599), triple positive (MCF-7), and HER2+ (SKBR3). Common therapeutic treatments target HER2+, ER, or PR receptors responsible for cell functionality, but the absence/presence of receptors avoid common treatments. Al-Keilani et al reported that Neurokinin Receptor 1 (NK1R) contributes to cell proliferation. Our experiment targeted the NK1R pathway with the drug aprepitant. Aprepitant is an NK1R antagonist that prevents substance P, the NK1R agonist, from binding to NK1R. It was investigated whether higher aprepitant concentrations decrease cell proliferation, specifically through AKT and ERK pathways. We hypothesize that NK1R presents as a promising therapeutic target for breast cancer, and aprepitant inhibits breast cancer proliferation involving the AKT and ERK pathways. An SKBR3 cell titer was conducted to determine cell viability with increasing aprepitant concentrations. Western blots for each cell line were conducted to validate NK1R's expression and measure protein expression for controls AKT, ERK, and pAKT, pERK pathways in response to no treatment, substance P, aprepitant, and substance P and aprepitant. SKBR3 cell titer results indicated decreasing viability with increasing aprepitant concentrations. All cell lines demonstrated decreased protein expression in the presence of aprepitant and substance P in comparison to substance P alone and more expression than aprepitant alone. Aprepitant appears to decrease cancer cell proliferation pathway activation. Future studies will investigate the NK3R and test ZR-75-1 and CAMA-1 cell lines.

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
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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

Word Count

244

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3145

Title: Using Mathematical Algorithms to Optimize the Efficiency of an Inverse Computational Modeling Approach to Uncover How Mutations are Affecting Cardiac Muscle Contraction

Student Name(s): S. Wong

Abstract:

Specific mechanisms of proteins, including the stiffness and binding rates, are not well understood in cardiac muscle mutations; biological studies on cardiac muscle mutations typically record a force-pCa graph, which reveals cardiac muscle contraction sensitivity and strength. Data scientists assist biological researchers by designing a computational model of cardiac muscle - the inputs of the model are specific mechanisms of proteins, and the output of the model is a force-pCa graph. Inputs are tweaked until the biological study's force-pCa graph is reproduced, revealing specific mechanisms of proteins; however, this inverse computational modeling approach can span from weeks to months, delaying research progress; mathematical algorithms have been used for estimating inputs to achieve certain output values in other areas, so this is a promising approach to speed up this process. The mentor provided the student with a computational model of cardiac muscle, and subsequently the student decreased the runtime of the model by converting it to C++ to speed up experimentation and ensure feasibility. Then, the student tested the effectiveness of each mathematical algorithm in reaching the criteria for 10 different force-pCa graphs. The particle swarm optimizer and Optuna were used as mathematical algorithms and were able to successfully recreate the force-pCa graph within 24 hours, within a high degree of similarity. By using this inverse computational modeling approach, specific mechanisms of proteins could be uncovered by researchers at a higher rate, which can accelerate the research of heart muscle mutations.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) BC CS 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
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
155	LS	3146

Title: Effects of Dietary Sugars on Bone Mass and Mechanical Strength

Student Name(s): M. Marti

Abstract:

This study investigated how exposure to different dietary sugars influenced bone mass and mechanical strength using chicken wing bones as a model system. Bones were cleaned, weighed, and tested for baseline strength before being submerged in solutions containing glucose, fructose, or D-galactose at varying concentrations and exposure durations. Following treatment, changes in bone mass and structural integrity were measured to assess how each sugar affected bone properties under controlled conditions. By comparing the effects of multiple sugars, this research aimed to identify whether certain sugars had a more pronounced impact on bone weakening. This research found that while all sugars weakened bone health somewhat, glucose had the most detrimental effect on bone health, and this effect scaled with exposure time. The findings are intended to contribute to a broader understanding of how dietary sugar intake may influence bone health and may help inform future research on nutrition-related risk factors for reduced bone strength.

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

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

Word Count

170

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3150

Title: Unlocking Neurodivergent Focus Skills

Student Name(s): B. Veliz Ruiz

Abstract:

I was able to test a neurodivergent disabled child's focus skills; I found out that with noise this child can focus on their task and be able to finish it without getting distracted, without noise it takes a longer time for him to be able to focus on his task without getting distracted. Sometimes the presence of a parent can affect the way they react or do their tasks; they can be distracted or even get motivated to do their tasks, keeping in mind that they have their support and patience. Results can vary since different children have different reactions, but my brother can focus on noise and be able to finish his tasks. I made observations through making my brother do activities like coloring, drawing, playing with dough, and doing simple homework (tracing letters/numbers). I timed him in each activity with different environments. We did these activities once a week to make sure that he didn't feel overwhelmed doing too many in one day or in one week.

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):

- [x] human subjects
- [ ] potentially hazardous biological agents
- [ ] vertebrate animals
- [ ] controlled substances

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

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

4. Is this project a continuation? [ ] Yes [x] No

5. My display board includes photographs/visual depictions of humans (other than myself or my family): [x] Yes [ ] No

Word Count

172

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3152

Title: Engineered Probiotic OMVs Overcome IBD Therapeutic Barriers via Dual-Gene Editing & ClyA-SOD Membrane Fusion

Student Name(s): J. Wang

Abstract:

Inflammatory bowel disease (IBD), comprising Crohn's disease and ulcerative colitis, is a chronic gastrointestinal disorder with rising global incidence and regional disparities, driven by genetic and environmental factors. Pathogenesis is driven by a vicious cycle of oxidative stress and inflammation, mediated by intestinal barrier dysfunction, reactive oxygen species (ROS) accumulation, and pro-inflammatory cytokine (e.g., TNF-α, IL-6) overproduction. Current therapies face limitations, including systemic toxicity, poor mucosal targeting, and suboptimal bioavailability. Herein, we engineered outer membrane vesicles (OMVs) from Escherichia coli Nissle 1917 (EcN) via CRISPR-Cas9-mediated dual knockout of nlpI and degP, enhancing OMV production through metabolic reprogramming and stress-response activation. A ClyA-SOD fusion system enabled directional anchoring of functional superoxide dismutase (SOD) onto OMV surfaces for targeted ROS scavenging. In vitro, SOD-OMVs demonstrated superior superoxide anion clearance efficiency compared to free SOD. This study focueses on the genetic engineering of probiotic-derived OMVs and their functional validation in vitro, providing a technological foundation for future translational studies on their therapeutic use in curing IBD.

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):

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- ☐ 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

2026

Word Count: 197

Fair Category: LS

Project Number: 3153

Title: Classification of Migraine Subtypes Using Machine Learning: A Study of Data Bias

Student Name(s): K. Morton

Abstract:

Chronic migraines are a neurological disorder affecting 1-2.2% of the global population. There are many different types of migraines that people may experience. The seven classes of migraines (0-6 respectively)--migraine with aura, migraine without aura, basilar-type aura, sporadic hemiplegic migraine, familial hemiplegic migraine, typical aura without migraine, and other migraines--were considered. The objective of this study is to do an analysis on data bias seen in migraine studies by classifying seven subtypes of migraines using random forest (RF) and artificial neural network (ANN) machine models through Python. Nine different random forest machine models were created ranging in test-train splits from 35%:65% to 75% -25%. Data analysis included: precision, recall, and F1-score, confusion matrices, and feature importances of the attributes considered in the initial data. The results of this study indicate that there was data bias within the initial data set as patients, particularly in classes 2, 3, 4, and 5 as they were consistently insufficiently classified. These results suggest that data bias in migraine studies may contribute to disparities in clinical care, underscoring the need to decrease bias by including similar numbers of patients with each type of migraine being studied.

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

2026

Word Count	Fair Category	Project Number
246	LS	3154

Title: Chemical Detoxification as a Parameter of the Health of the New Creek Marsh

Student Name(s): T. Rajangam

Abstract:

Coastal salt marshes are vital ecosystems that perform essential functions such as carbon sequestration, nutrient cycling, and water purification; however, these habitats are increasingly threatened by human activities and environmental degradation. This study examines the chemical filtration capacity of the New Creek Marsh in Westport, Connecticut, as a measure of marsh health. The marsh's health was determined by employing microscopic phytoplankton analysis and organic carbon analysis on the soil. This research also investigated nitrate and phosphate reduction across six sampling sites within the marsh using a titration with a dichromate redox reaction.

Findings on the soil organic carbon percentage were between or greater than 10-20% suggest a healthy marsh that can perform as a carbon sink; however, the drastic reduction to 2% at the final location shows signs of erosion as the marsh flows into the sound. These findings are also compounded by the phytoplankton analysis, where the final location was found to have a drastic reduction in the number of phytoplankton per mm2. The Nitrate chemical test showed a reduction of 98.57%, which is a very good sign for the overall health of the marsh.

This research highlights the marsh's role in chemical detoxification and its resilience despite moderate degradation in some areas. Findings underscore the importance of proactive conservation strategies to mitigate the cascading ecological impacts of marsh decline, particularly in urbanized coastal areas. The study also contributes to understanding how anthropogenic activities and rising coastlines intersect with wetland ecosystems, informing sustainable management practices.

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

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

Word Count

226

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3156

Title: Capturing Carbon Dioxide with Chemical Solutions of Varying pH Levels

Student Name(s): A. Silverman

Abstract:

Carbon dioxide emissions are causing the planet to warm at an accelerated rate. One possible solution to this problem is to find a way to recapture the carbon dioxide emitted into the atmosphere. This experiment explores the effectiveness of four chemical solutions with varying pH levels in capturing carbon dioxide. It was hypothesized that a strong alkaline solution (calcium hydroxide) would capture carbon dioxide more effectively than solutions with lower pH levels (baking soda, distilled water, and egg shells and vinegar solution).The pH of each solution was recorded before and after bubbling air into the solution for two minutes to measure the difference. If carbon dioxide was absorbed by the solution, the pH would decrease. The calcium hydroxide solution showed the greatest decrease in pH, while all other solutions had minimal to no change. In review of the experiment, the hypothesis was proven correct. Future experiments can test additional strong alkalines to confirm this result and determine which solutions would be most environmentally friendly and usable on a mass scale. Potential applications include products that are able to capture carbon dioxide in the atmosphere in large quantities. Ideally, this research can be further developed to make a more practical, large scale solution to this pressing environmental challenge.

Note: This experiment used household chemicals that are potential irritants and was supervised by a parent for safety.

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

Word Count

239

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3158

Title: Evaluating Toxicity of Natural and Synthetic Dyes in Caenorhabditis elegans: Identifying Safer Options for Consumables

Student Name(s): V. Punia

Abstract:

Synthetic dyes have been associated with severe health problems such as cancers, reduced hemoglobin concentrations, allergic reactions, and hyperactivity (Dey & Nagabulu, 2022). While studies have used C.elegans to evaluate toxicity of synthetic dyes, none have compared a synthetic dye to a natural counterpart. Blue Dye #1 is used in >24% of all processed foods (Batada, 2016), its toxicity has not been studied and compared to a natural counterpart like blue spirulina. Using the literature review of past studies, touch response and reactive oxygen species were chosen to evaluate toxicity. C elegans were fed standard diet OP50 in the presence and absence of dye. In touch response, a measure of neurotoxicity is done by stroking a worm with an eyelash on the posterior or anterior body, correct movement is away from the site of stimulation. Both the control group and the natural dye, Blue Spirulina, recorded 0/ 30 worms to have incorrect movement, while the synthetic dye had 4/30 worms display incorrect movement ($p>0.05$). Reactive oxygen species (ROS) were measured in worm lysates using Chloromethyl-H2DCFDA. ROS levels correlated with fluorescence are normalized by BCA protein assays. Worms exposed to Blue #1 and Blue Spirulina showed higher ROS levels compared to the control group, both dyes nearly doubled the reactive species. The touch response suggests that Blue #1 may be more neurotoxic but the similar results for ROS levels suggest both may cause systemic issues. More research is required.

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

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

- ☐ human subjects
- ☒ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 243

Fair Category: LS

Project Number: 3159

Title: The Impact of Presentation Styles on Engagement in Math Classes

Student Name(s): S. Gara Grady

Abstract:

The post-COVID shift toward digital instructional tools in math classrooms has created a transitional period in which teachers must balance handwritten and digital presentation methods. Despite this shift, little research examines how these formats relate to student engagement during in-person instruction. This study investigates whether lesson presentation style is associated with measurable changes in student engagement, operationalized as Engagement per Minute (EPM). It was hypothesized that lessons utilizing more handwritten presentation styles would yield higher student engagement. An observational, non-experimental design was conducted between 2 different high school math classes, with 10 observation periods each. Presentation style was rated on a researcher-developed 1–5 Likert scale ranging from fully handwritten to fully digital. Engagement was quantified using a researcher-developed EPM formula: (student content questions asked + questions answered - interruptions) divided by lesson duration. Consistent time-sampling protocols were used for all observations to ensure data reliability.

Spearman's rho and regression analyses showed that lessons relying more on handwritten presentation tended to have higher engagement. This pattern was strongest in one class (ρ = -0.87, p = .001, R^2 = 0.66), while the other showed a weaker but consistent negative trend. Combined data confirmed a significant negative relationship between digitality and engagement ($\rho = -0.69$, $p < .001$). These findings suggest that prioritizing step-by-step handwritten explanations is a practical, low-cost strategy to optimize active learning in high school mathematics. Future research should explore these effects across larger samples and different subject areas.

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

2026

Word Count: 250

Fair Category: LS

Project Number: 3160

Title: The Investigation of Pro-Inflammatory Immune Cells Triggered By Exercise and Their Effect On Reproductive Cancer Tumor Models

Student Name(s): A. Davis

Abstract:

According to the American Cancer Society they estimated over 12,000 women died from ovarian cancer and over 300,000 men died from prostate cancer in 2025. This project hypothesized If CCL-2 is expressed in ovarian or prostate cancer patient's saliva when they exercise then there will be a negative impact on the cancer patients recovery rates. I designed an exercise intervention study based on collected research. There would be 10 participants who exercise daily and 10 participants who don't exercise daily. After a week I would collect saliva samples and put them through a PCR machine to amplify the cells. After the cells go through a gel electrophoresis to see if CCL2 is secreted in saliva. From researching studies I found from the International Journal of Molecular Sciences in 2024 that CCL2 is expressed in saliva when one exercises. Another study in 2021 at Yale's Department of Gynecological and Reproductive Sciences explains that CCL2 bins with CCR2 which grows the tumor cells. In future research I would like to put this experiment into effect by organising an exercise intervention study. I would also want to conduct a western blot to see if stained CCR2 proteins are expressed in prostate and ovarian cancer tumors. On the side I would also conduct flow cytometry to determine the amount of CCL2 and CCR2 in both cancerous and non cancerous patients. I would like to measure the expression of CCL2 to see if there is a correlation between this chemokine and pro-tumorgenic effects.

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

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

2026

Word Count	Fair Category	Project Number
244	LS	3161

Title: EXPERIMENTAL VALIDATION OF COMPUTATIONAL TOOLS FOR NANOBODY AFFINITY MATURATION

Student Name(s): A. Srivastava

Abstract:

Alzheimer's disease affects over 6.9 million Americans with no cure available. The disease involves protein misfolding, including hnRNPA2/B1, an RNA-binding protein that forms toxic aggregates in neurons. Traditional nanobody optimization through directed evolution and yeast surface display requires months of laboratory work to test thousands of variants. This project tested whether AlphaFold 3 confidence metrics (ipTM and pTM) correlate with nanobody-protein binding affinity, potentially enabling computational prediction of affinity-enhancing mutations prior to experimental validation. The study began by validating AlphaFold 3 accuracy through structural predictions for tauNb1-tau and Nb19-hnRNPA2/B1 complexes compared against published experimental structures. AlphaFold 3 incorrectly predicted the tauNb1-tau binding interface, likely due to tau's intrinsic disorder, but correctly predicted the Nb19-hnRNPA2/B1 complex with confidence scores exceeding 0.7. Targeted mutations were introduced to the Nb19 CDR3 region and modeled using AlphaFold 3 with multiple replicates to establish baseline confidence values. The N32S mutation, an experimentally validated high-affinity variant, showed increased confidence (ipTM 0.78, 6.8% improvement) supporting the hypothesis. However, V104I showed decreased confidence despite known affinity improvement, indicating complexity beyond static structure. Computational mutation screening using EVOB generated fifteen candidate mutations, with $\Delta\Delta G$ analysis identifying eight predicted to stabilize the complex. Results demonstrate that AlphaFold 3 accuracy depends on protein structural properties and confidence metrics show partial correlation with binding affinity. This hybrid computational-experimental approach can reduce the search space for nanobody optimization, potentially accelerating therapeutic development for neurodegenerative diseases.

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

2026

Word Count: 211

Fair Category: LS

Project Number: 3164

Title: Development of a Qualitative Measurement Method for Adolescent Anxiety

Student Name(s): P. Dwyer

Abstract:

Anxiety disorders are diagnosed with mostly qualitative data. The line between disorder and regular levels of anxiety is a thin one. For people who think their anxiety symptoms are normal, giving a qualitative display of how serious their disorder is helpful. Groups who struggle to acknowledge mental health issues would benefit from a way to diagnose Anxiety disorders without self reporting bias. Qualitative information about anxiety is mostly seated in self reporting and an increase in heart rate. This study aims to find a more reliable questionnaire than simply a self report questionnaire. Using change in heart rate to show a 'baseline' for anxiety, and two different questionnaires with 10 people each, I aimed to qualitatively measure anxiety in adolescents. I found that disguised as a personality test form yielded slightly more reliable results. However, the difference was not significant enough to truly warrant one being considered better than the other. Even then, these results suggest that there is a self reporting bias in anxiety screenings, and more 'underhand' methods would be more beneficial for adolescents with pre perceptions about their mental health. Finding a way to create a baseline for anxiety disorders will help validate the struggles of many, and hopefully increase the number of people who can get treatment.

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

2026

Word Count: 228

Fair Category: LS

Project Number: 3165

Title: Bayesian Optimization Enables Ultra-Rapid and Accurate DNA Detection Using qPCR

Student Name(s): E. Liu

Abstract:

During the Ebola Epidemic in West Africa, labs mainly used qPCR (quantitative Polymerase Chain Reaction) to diagnose cases. Yet if diagnostics results had been obtained 4 days earlier, infections might have dropped from 80% down to nearly 0%. This study applies Bayesian Optimization to accelerate qPCR condition optimization, enabling faster and more accurate diagnostic results for diagnostics. Reliable detection requires adjusting parameters carefully, specifically in this study the denaturation and annealing/extension temperatures were optimized across ranges of 94–98°C and 50–70°C. Yet the current optimization techniques of One-factor-at-a-time are insufficient, wasting resources, missing the global optimum, and slowing down progress. Bayesian optimization uses the Gaussian Process that is initialized with Latin Hypercube Sampling to spread the parameter space evenly. An acquisition function of Expected Improvement balances the exploration and exploitation to identify the next optimal point to test. After 5 runs, the Bayesian Optimization was able to identify the most optimal condition, yielding a Ct of 17.54 whilst meeting all MIQE requirements including sensitivity to 10 copies, efficiency of 107.4%, R^2 of 0.9968, and no NTC amplification. Compared to an OFAT strategy that required an estimated 12 runs, Bayesian Optimization saved over 14 hours and cut down on experimental trials by 58%. These results prove that Bayesian Optimization outperforms traditional qPCR optimization, delivering faster, more accurate diagnostics with fewer resources.

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

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CSEF Official Abstract and Certification

2026

Word Count: 233

Fair Category: LS

Project Number: 3167

Title: Assessment of Accuracy in Predicting Human Clearance for Linear Monoclonal Antibodies from Animal Models

Student Name(s): H. Peng

Abstract:

Accurately predicting human clearance (CL) from preclinical pharmacokinetic (PK) studies is critical for efficient development of monoclonal antibody (mAb) therapeutics. However, it remains unclear which animal model most reliably predicts human CL, particularly for newer half-life extended (HLE) antibodies. We hypothesized that human FcRn transgenic (Tg32) mice would more accurately predict human CL and better preserve rank order among candidate antibodies than wild-type (WT) mice or nonhuman primates (NHPs). To test this hypothesis, published PK data were compiled for standard and HLE mAbs with matched CL values across WT mice, Tg32 mice, NHPs, and humans, forming the largest dataset to date of corresponding animal and human CL values for these antibodies. Rank-order concordance analysis evaluated candidate performance, and optimal single-species allometric exponents were derived to predict human CL. Predictive accuracy was assessed by comparing predicted and observed human CL values. Results showed Tg32 mice most accurately preserved rank order and produced the closest human CL predictions for both standard and HLE mAbs. Tg32 mice exhibited the highest correlation ($R^2 = 0.922$), 100% of predictions within 2-fold error, and the lowest percent root mean square error (%RMSE = 22.39%). In contrast, WT mice and NHPs showed lower predictive performance. These findings support Tg32 mice as a superior model for nonclinical PK, improving candidate selection, reducing reliance on NHPs, lowering development costs, accelerating drug development, and enabling earlier patient access to therapies.

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

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

Word Count

194

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3169

Title: Explanatory machine learning modeling of a seven-molecular marker panel for immune checkpoint inhibition response per RECIST v1.1 in metastatic urothelial carcinoma

Student Name(s): M. Li, A. Reffai

Abstract:

Immunotherapy treatment has been folded into the standard of care for metastatic urothelial carcinoma (mUC). Immunotherapy, and more specifically immune checkpoint inhibition (ICI) has been known for its lower rate of side effects; however, only a small subset of patients exhibits any benefit. Prior work has evaluated complex genetic signatures, tumor mutational burden (TMB), clinical factors, and multi-omics machine learning models in this setting; however, the performance of a small molecular marker panel under realistic sample sizes is less represented. Here, we used the RNA-seq and RECIST v1.1-derived patient outcomes data from a subset of the phase II IMvigor210 dataset (n=193). The RNA-seq data for a prespecified panel of seven molecular markers was used in an L2-penalized logistic regression model. The model's results indicated positive relationships between the following molecular markers and shrinkage according to tumor burden: CXCL9, CXCL10, and IFN-γ, and negative relationships with the following: GZMA, GZMB, TGFB1, and CCND1. The model's overall accuracy in distinguishing cases between positive and negative outcomes was 0.683, with the ROC AUC/PR AUC values being 0.734 and .445, respectively, reflecting the constraints of the small cohort (n=193).

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

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

CSEF Official Abstract and Certification

2026

Word Count: 224

Fair Category: LS

Project Number: 3171

Title: Investigating the Impact of Governance Effectiveness on Economic Crisis Resilience: A Fixed-Effects Analysis of G-20 Countries During the Great Recession and COVID-19

Student Name(s): D. Babic

Abstract:

Global economic crises threaten national economies, yet countries show varying resilience in recovery trajectories. This study investigated whether governance quality– measured through World Governance Indicators (political stability, government effectiveness, and control of corruption)– influenced economic outcomes during the Great Recession (2008-2009) and the COVID-19 pandemic (2020). Using panel data from G20 countries spanning 2000-2022, we employed fixed-effects regression models with within country-level clustering to examine relationships between baseline governance indicators and two key outcomes: annual GDP growth and unemployment rates. Results reveal several distinct governance-crisis dynamics across events. During COVID-19, countries with medium-level government effectiveness demonstrated superior post-shock recovery compared to both low and high effectiveness nations, suggesting moderate institutional flexibility facilitates more adaptive pandemic responses. Conversely, the Great Recession favored stronger institutional strength, with high government effectiveness countries experiencing significantly better immediate GDP shock buffering. Political stability showed modest effects primarily during crisis onset rather than recovery phases. Notably, all governance indicators demonstrated weaker associations with unemployment outcomes across both crises. These findings suggest that governance quality operates through crisis-specific mechanisms, financial crises reward institutional robustness, while health crises may benefit from adaptive governance structures for mitigating GDP shock. This research contributes to understanding how institutional quality shapes economic resilience, offering insights for policymakers regarding governance investments and crisis preparedness strategies across different shock typologies.

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

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count 255

Fair Category LS

Project Number 3172

Title: Integrating Copy Number Alterations and Transcriptomics with Machine Learning Improves Survival Prediction in HPV-negative Head and Neck Cancer

Student Name(s): V. Mukku

Abstract:

HPV-negative head and neck squamous cell carcinoma (HNSCC) has a 5-year overall survival rate of 48%. Survival prediction models can identify high-risk patients who might benefit from intensified treatment regimens. However, the performance of these models is limited by their reliance on only clinical features or single-omic data. This project aims to train and validate a machine learning model integrating RNA-sequencing and somatic copy number alteration data with clinical information to improve overall survival prediction for HPV-negative HNSCC. The training approach employed the random survival forests (RSF) model with block-constrained univariate feature selection and hyperparameter tuning. Three classes of RSF models were compared: clinical-only, omics-only, and combined (clinical + omics). The training dataset was The Cancer Genome Atlas (TCGA) cohort (n = 390), and the test set was the Clinical Proteomic Tumor Analysis Consortium (CPTAC) cohort (n = 104). The use of the CPTAC data for validation assesses the model's generalization capabilities. Test set concordance indices (a measure of how well a model predicts relative ordering of survival time) were as follows: 0.538 for the clinical-only model, 0.626 for the omics-only model, and 0.664 for the combined clinical + omics model. Pathway enrichment analysis of the combined model's 74-gene signature revealed that survival prediction is driven by serine protease activity and extracellular matrix remodeling. These findings demonstrate that integrating multi-omics data for survival prediction significantly outperforms clinical staging alone and reveals survival-associated pathways, offering a more robust framework for risk stratification in HPV-negative HNSCC.

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

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- ☐ 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

2026

Word Count: 112

Fair Category: LS

Project Number: 3173

Title: Determining Salt Marsh Health using

Biological indicators of Dominant Species

Student Name(s): N. Garcia

Abstract:

The purpose of this project was to explore the use of dominant species as an indicator of health in salt marshes. Ribbed marsh mussels (Geukensia demissa) were selected for their ubiquity in marshes. Three major health indices were studied: the condition index, the visceral mass somatic index, and visceral mass stored glycogen. Mussels were collected from two Connecticut Salt Marshes: an impacted marsh in Stratford: Great Meadows, and a known healthy marsh in Stonington: Barn Island. Results indicate that there is more intraspecfic variation in marshes than interspecific variation. Mussels residing in low tide areas consistently showed less signs of stress than those at high tide areas compared to known impacted regions.

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

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

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
247	LS	3176

Title: Genetic diversity of aging and stress on breast cancer survival

Student Name(s): A. ASLAN

Abstract:

Background: A woman's genetic profile is an important contributing factor to breast cancer prognosis. Recent findings suggest that the complex interaction between genetic predisposition to accelerated aging and psychological stress response is a key risk factor for breast cancer outcomes. This project investigates transcriptomic and genetic variation of loci associated with longevity, and stress response.

Hypothesis: Women with breast cancer who have higher expression of genes implicated in longevity, tumor suppression, and stress response tend to live longer than those with lower expression.

Methods: Specific genes associated with aging, stress, and breast cancer were selected from previously curated and validated lists of causal loci. These were further investigated using principal components and survival analyses. Functional allele frequencies of the prioritized genes were compared across 26 worldwide populations available from the Human Genome Diversity Project.

Results: PTEN and NR3C1 gene expression was significantly lower in women who died of breast cancer, suggesting that reduced transcription of aging and stress exposure loci is linked to tumor cell growth. The survival time was significantly greater and the risk of death was significantly lower in women with low BRCA1, high PTEN and high NR3C1 expression.

Conclusion: Targeting longevity promoting genes like PTEN and adaptive stress response genes like NR3C1 for drug repurposing or discovery could help improve breast cancer outcomes. Further research is needed to replicate findings in broader populations of diverse ancestries and to additionally integrate patient-specific demographic and clinical data for improved breast cancer management for all women.

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

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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

2026

Word Count: 170

Fair Category: LS

Project Number: 3177

Title: Preventing Zoonotic Parasitic Growth in

Freshwater Aquaculture Using

Student Name(s): S. Sacks

Abstract:
Aquaculture provides almost 50% of the world's food fish supply, and zoonotic parasites pose an immense threat to fish and the humans that consume them. (NOAA) Anthelmintic drugs like Praziquantel (PZQ) have been used to neutralize these parasites; however, its poor water solubility and bitter taste have led to limited use in large scale fish farms. The purpose of this project was to encapsulate PZQ nanoparticles in digestible aerogel particles to mask PZQ's bitter taste, and once consumed, the process of digestion would release the PZQ and kill harmful parasites. Egg and silica-based aerogel blocks were pulverized, and the aerogel powder was loaded with PZQ. Spectrophotometry was used to determine concentration of PZQ within the particles and Planaria were used as a proxy test species for trematode parasites to observe the effects of the PZQ-loaded aerogels. In the end, both types of aerogels were able to absorb the PZQ, and read above baseline concentration, while also affecting Planaria behavior significantly, with egg protein-based gels performing slightly better.

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

2026

Word Count: 254

Fair Category: LS

Project Number: 3178

Title: A Multi-Modal AI/ML Platform for Neurodegenerative Risk Prediction: Integrating Epigenetic Signatures through cfDNA Methylation and Functional Mobility Data

Student Name(s): R. Doshi

Abstract:

Neurodegenerative diseases (NDs), including Alzheimer's disease (AD) and Mild Cognitive Impairment (MCI), are typically diagnosed after 50–80% neuronal loss. Existing diagnostics rely on invasive neuroimaging (~$7,000/scan) or subjective cognitive assessments with error rates up to 74%, driving the need for accessible, non-invasive screening. I developed a cross-modal artificial intelligence (AI) platform integrating quantitative gait biomechanics with cell-free DNA (cfDNA) methylomic and fragmentomic profiling for preclinical neurodegenerative risk stratification. Under IRB protocol Pro00086054, a prospective clinical cohort (n=100; 206 gait, 100 MoCA assessments) underwent standardized single- and dual-task locomotor testing via markerless motion capture. 47 spatiotemporal and kinematic features were extracted. Six supervised architectures were benchmarked using stratified 5-fold cross-validation. A Transformer-based attention model achieved superior discrimination (accuracy 93.4%, sensitivity 91.2%, specificity 94.8%, AUC-ROC 0.962), indicating multi-head temporal attention optimally captures stride variability and executive-motor interference signatures of early ND.Simultaneously, a cfDNA classification pipeline was trained on genome-wide methylation benchmarks (Illumina EPIC array; >850,000 CpG loci) using bumphunter-based DMR identification (FDR<0.05) and fragmentomic feature extraction. A radial-basis SVM achieved 94.0% accuracy and 0.978 AUC-ROC on independent test data. SHAP attribution demonstrated progressive CpG hypermethylation gradients and enrichment of short-fragment cfDNA in disease phenotypes. Cross-modal attention fusion achieved maximal performance (accuracy 96.7%, AUC-ROC 0.991), supporting complementary integration of biomechanical and epigenetic biomarkers. This non-invasive framework establishes a scalable pathway toward pre-symptomatic ND screening and precision longitudinal risk modeling, with prospective clinical validation underway.

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

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

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4. Is this project a continuation? [x] Yes [ ] No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

[ ] Yes [x] No

CSEF Official Abstract and Certification

2026

Word Count: 263

Fair Category: LS

Project Number: 3179

Title: Investigating the Neuroprotective and Stress-Modulating Effects of Oxytocin on Human Cells under Cortisol-Induced Stress Conditions

Student Name(s): E. Lee

Abstract:

Although cortisol is a primary stress hormone essential for acute adaptation, prolonged exposure is known to impair neuronal and glial health by disrupting molecular pathways involved in emotional regulation and social behavior. Oxytocin, a neuropeptide synthesized in the hypothalamus, is associated with prosocial bonding and stress buffering. This study aimed to investigate whether oxytocin can mitigate cortisol-induced stress in human glial A172 cells by observing changes in oxytocin receptor (OR) and brain-derived neurotrophic factor (BDNF) expression at protein and transcriptional levels. Dose-response MTT assays showed that cortisol reduced viability in a concentration-dependent manner, while oxytocin had minimal cytotoxic effects, leading to the selection of 1 μM cortisol and 3 μM oxytocin for doses. Treatment conditions included cortisol-only, oxytocin-only, co-treatment, and untreated control. Protein expression of OR and BDNF was analyzed using immunofluorescence staining followed by quantitative fluorescence intensity measurements. RT-qPCR was performed to quantify OXTR and BDNF mRNA expression. Despite the relatively low concentration, cortisol treatment markedly reduced OR and BDNF signals, accompanied by morphological stress. Contrastingly, oxytocin co-treatment resulted in widespread, intensified fluorescence, with OR expression increasing over 3.5-fold ($p = 0.0015$) and BDNF significantly restored compared to cortisol-only conditions. RT-qPCR analysis corroborated these findings at the transcriptional level. Cortisol significantly downregulated OXTR and BDNF mRNA, whereas oxytocin co-treatment produced robust recovery, with OXTR increasing approximately four-fold and BDNF upregulated ($p < 0.01$–0.001). These results demonstrate oxytocin's role in cellular rescue mechanism that counteracts cortisol-induced molecular damage and suggests potential relevance for stress-related social and emotional impairments.

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

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   ☐ Yes ☒ No

Word Count

278

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3180

Title: Determining the Accuracy of Biomarker TNF-α in Predicting Ketamine Treatment Outcomes for Veterans with PTSD & SUDs

Student Name(s): M. Mejnartowicz

Abstract:

Ketamine is a rapid-acting antidepressant used to treat PTSD (Post Traumatic Stress Disorder), a psychiatric condition affecting 11-23% of US Veterans. There are no clinically validated biomarkers that can predict ketamine treatment outcomes for veterans with PTSD, and no known biomarkers for populations with comorbid disorders such as Substance Use Disorders (SUDs). High levels of Tumor Necrosis Factor-alpha (TNF-α), an inflammatory cytokine impacting addiction symptoms, could increase ketamine treatment efficacy for veterans with comorbid SUDs. This project aimed to assess whether TNF-α levels could predict ketamine treatment outcomes in veterans with comorbid SUDs. It was hypothesized that TNF-α baselines and trendlines would accurately predict treatment response for veterans with PTSD. There was no IV or DV as this was a correlational study. All veterans(n=99) had PTSD and were treated with ketamine. The student-researcher used R-Studio to analyze de-identified data from the mentor's 2022 study. T-tests found that TNF-α baselines were not significantly different between Ketamine responders and non-responders(p=0.4), but there was a difference that approached significance in TNF-α slopes(p=0.065). Responders had positive slopes, while non-responders had negative slopes. Veterans with SUDs had significantly lower TNF-α baselines than veterans without SUDs(p=0.032), and TNF-α slopes in the non-SUD group trended towards significance in predicting ketamine response(p=0.078). Neither baselines nor slopes significantly predicted SUD-Group response. This research informs clinicians that TNF-α trendlines could be explored further as a potential predictive biomarker for those with PTSD, regardless of whether they have comorbidities, while also highlighting the need for additional biomarkers with greater predictive abilities.

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

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CSEF Official Abstract and Certification

2026

Word Count: 264

Fair Category: LS

Project Number: 3181

Title: Comparative optimization analysis of the performance proficiency between CRISPR-Cas9 and CRISPR-Cas12a in genome genetic modification

Student Name(s): A. Settembre

Abstract:

CRISPR-Cas systems are widely used for genome engineering; however, differences in cleavage behavior and specificity between nucleases remain critical for optimizing precision editing. This study comparatively evaluated CRISPR-Cas9 and CRISPR-Cas12a performance under controlled in-vitro conditions and through computation specificity modeling. Synthetic DNA fragments representing the Escherichia coli LacZ gene were incubated with pre-assembled ribonucleoprotein (RNP) complexes at defined RNP:DNA molar ratios (10:1 and 5:1). Cleavage products were analyzed with 2.5% agarose gel electrophoresis and densitometry to quantify substrate-to-product conversion. Although electrophoretic migration confirmed function reaction conditions, predicted cleavage fragments were not distinctly conclusive, limiting quantitative efficiency comparison under the staining sensitivity used. To complement experimental results, in-silico guide RNA analysis was performed using CHOPCHOP for both E.Coli LacZ locus (~4.6 Mb) and the Zea Mays C1 locus (~2.3 Gb). Off-target burden, predicted efficiency, and self-complementarity scores were compared across the top five ranked guides. In the bacterial genome, both nucleases demonstrated zero predicted off-target sites. However, within the complex maize genome, SpCas9 exhibited a measurable off-target burden (average = 0.4), whereas Cas12a maintained zero predicted off-targets. Additionally, Cas12a displayed lower self-complementarity scores, suggesting greater guide structural stability. Cas9 efficiency modeling revealed a specificity–activity tradeoff, where higher predicted efficiency occasionally correlated with minor off-target risk. These findings demonstrate that CRISPR performance is genome-context dependent, with genome size and repetitive content influencing mismatches. Integrated experimental and computational analysis suggests Cas12a may provide specificity advantages in complex genomes, emphasizing the importance of organism-specific guide optimization for precision genome engineering.

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

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☐ Yes ☒ No

Word Count

247

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3182

Title: Baby Connect: A haptic solution for deaf parents

Student Name(s): S. Das

Abstract:

A baby's way of communicating is limited, with only cries to indicate their emotions. For a newborn's needs to be met, parents need to hear when the child is crying and what kind of crying it is. Now imagine a child with deaf parents who can't hear the crying next to them. The problem persists as the child grows from a baby to a toddler. What if there was a way for the parents to "listen" to the baby's cry through a device that sends real-time haptic feedback on a wearable? What if there was a way for a toddler to communicate with their parents through a device so they didn't need to learn another language?

There are three parts to BabyConnect: a wearable device, a monitoring and detection system, and an app. The first part is the wearable device, which gives vibration signals that represent different types of communication cues. The second part is the monitoring and detection system, which uses machine learning to classify the cries in real time. Each cry type is mapped to a distinct vibration pattern, allowing the parent to immediately recognize the baby's needs, and the system sends the information to the wearable via Bluetooth. Finally, the app allows older children to communicate with their parents. By tapping icons or using simple voice commands on the app, the child can send specific messages. These messages are then translated into vibration patterns on the wearable, making family communication accessible and immediate.

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

2026

Word Count	Fair Category	Project Number
262	LS	3183

Title: Disrupting the Inflammatory–Fibrotic Circuit: Evaluating Galectin-3 Inhibition as a Novel Non-Hormonal Therapy for Adenomyosis

Student Name(s): Y. Jin

Abstract:

Adenomyosis is a progressive uterine disease characterized by chronic inflammation, fibrotic remodeling, and abnormal myometrial contractility. Molecular regulators integrating these processes remain unclear, and current therapies primarily alleviate symptoms without targeting underlying remodeling mechanisms. Transcriptomic analysis of human adenomyosis datasets identified significant upregulation of LGALS3, the gene encoding Galectin-3 (Gal3), particularly in the myometrium, where LGALS3–positively correlated genes were enriched in inflammatory, extracellular matrix, and contractility-related pathways. These findings suggest that Gal3 functions as a central node linking inflammation and fibrosis. We investigated whether Gal3 mechanistically mediates myometrial remodeling and hypercontractility using in vitro models of estrogen- and TGF-β–induced fibrosis in uterine smooth muscle cells (SMCs) and IL-1β–induced inflammation in endometrial stromal cells (ESCs). Gal3 inhibition, using the selective Gal3 inhibitor GB1211, was applied to evaluate effects on contractile behavior, signaling activation, remodeling phenotypes, and inflammatory mediator production. Functionally, Gal3 inhibition attenuated collagen gel contraction and reduced oxytocin-enhanced hypercontractility. Fibrotic stimulation activated Smad2/3 signaling and upregulated Gal3 expression; Gal3 inhibition reduced Smad activation, suppressed proliferation and extracellular matrix gene expression, and decreased α-SMA levels. In inflammatory models, Gal3 inhibition significantly decreased IL-1β–induced prostaglandin E2 (PGE2) secretion, a mediator frequently elevated in adenomyosis and dysmenorrhea, linking Gal3 to endometrial inflammatory regulation. These results identify Gal3 as a central hub integrating the three core pathological features of adenomyosis. Mechanistically, Gal3 connects TGF-β/Smad signaling with smooth muscle proliferation and ECM deposition while modulating inflammatory responses. Targeting Gal3 offers a potential disease-modifying, non-hormonal strategy to restore uterine function and reproductive health.

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

2026

Word Count	Fair Category	Project Number
255	LS	3186

Title: Using a novel Bidirectional Neural Network for early detection of Black Cutworms on Bush Beans

Student Name(s): E. Schwartz

Abstract:

The agricultural industry faces the challenge of safeguarding crop yields pests, which annually account for substantial economic losses and threaten food security(Oerke et al.,2006). Currently, pest detection is done through visual inspection. Pest detection based on multi-spectral data has been demonstrated on cannabis, but that study did not incorporate all wavelength bands into their analysis.(Fournier et al.,2023)This study aims to develop a segmentation network using 400-1100nm light that can segment a field for pest damage and improve detection. Each 35 day bushbean crop was infested with 4 black cutworms for 4 days, 400-1100nm images were collected every minute and batched by day. The goal was to develop a model that can identify early infestation of black cutworms to diminish future crop loss and reduce pesticide use. Two architectures, UNet and a novel BI-Net, used these multispectral images to detect pests. Model accuracy for infestation was compared to a U-Net trained on traditional spectrum images(400-700nm). This model is acting as a standard for manual inspection from what a human would be able to see by looking at the crops. It was found that the UNet which utilized multispectral images from the spectrum of 400-1100nm had better and earlier accuracy (97.14%) outperforming the UNet utilizing 400-700nm (69.22%). Using multispectral imaging coupled with deep learning allows for earlier and more accurate detection than manual inspection. This model has the possibility of enabling the agricultural industry to evaluate economically important crops, saving billions in pesticides and crop loss.(Mount,2022)

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

2026

Word Count: 253

Fair Category: LS

Project Number: 3188

Title: Characterizing Direct and Immune-Mediated Anti-Neoplastic Effects of Acute Exercise-Conditioned Serum on High-Grade Serous Carcinoma

Student Name(s): N. Solomon

Abstract:

Advances in exercise-oncology have demonstrated that acute physical activity influences soluble factors within the body. This project investigates whether serum collected following an acute exercise bout can influence the viability of high-grade serous carcinoma (HGSC) cells in vitro, and whether immune populations can further influence this effect. To investigate this, matched pre- and post-exercise serum, which was extracted from blood taken retro-orbitally from age-matched mice (blood taken by mentors), were used and HGSC cells were cultured under 3D and 2D conditions either alone or with immune cells present. In 3D models, post-exercise serum led to a direct statistically significant decline of ~9.07% ($p < 0.05$) and 8.7% ($p < 0.05$) reduction in HGSC cell viability in two experiments. Morphological observations revealed reduced cellular compactness in post-exercise groups, suggesting changes in cell-cell adhesion. Co-cultures of HGSC cells with peritoneal cells (PTNCs) had a cell viability reduction of approximately 21.7% ($p < 0.05$), but peripheral blood mononuclear cells (PBMCs) showed no statistically significant difference ($p > 0.05$). 2D co-culture experiments were also performed, and post-exercise serum again reduced cell viability, approaching statistical significance, by ~18.7% ($p = 0.2183$), but immune cell co-cultures produced variable effects, with increased viability at 1 HGSC cell:10 pooled PBMC/PTNC and 1 HGSC cell:20 pooled PBMC/PTNC ($p > 0.05$). Together, these findings demonstrate that acute exercise induces circulating factors with a consistent direct cytotoxic influence on HGSC, with the need for more refined immune co-cultures to uncover definite synergistic effects.

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):

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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

Word Count

250

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3189

Title: Pediatric School Stress and Biomarkers for Upper Respiratory Illness in Teenagers

Student Name(s): S. Iacovella

Abstract:

Stress is not easily avoidable, especially not for teenagers. School, pressure from friends, family challenges, and body image issues are among the most common with teens. So many young adults go through life thinking that stress is just something that is normal, a consequence that comes with life, not realizing the physical toll that it is doing to their body. An anonymous survey using the Perceived Stress Scale (PSS) was given to participants aging 15-25 years of age. The PSS Questionnaire ranges on a scale from 0-40, and the higher the number, the higher level of perceived stress. The most common total score was a 21, which was reported by 22% of the participants and indicates moderate stress. A secondary original questionnaire asked about how frequently they have gotten sick with an upper respiratory illness. 44% indicated that they did not have to miss school at all for having the common cold. Participants labeled school as the most significant stressor in their life. While a measure of the data statistically was scheduled, there weren't sufficient responses to determine the statistical significance at this time. There are numerous challenges of conducting surveys for anyone under the age of 18 and is difficult to obtain even if it is anonymous. When schools identify as social emotional schools (SES) the guidelines and protocols need to be driven by data within a district, not just nationally. This research is hoping to be a voice in these changes at the local level in the future.

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):

- [x] human subjects
- [ ] potentially hazardous biological agents
- [ ] vertebrate animals
- [ ] controlled substances

2. Student independently performed all procedures as outlined in this abstract. [x] Yes [ ] No
3. This project was conducted at a Registered Research Institution. [ ] Yes [x] No
4. Is this project a continuation? [ ] Yes [x] No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

[ ] Yes [x] No

CSEF Official Abstract and Certification

2026

Word Count: 223

Fair Category: LS

Project Number: 3191

Title: Investing Dietary choices in Homer's Americanus: Do lobsters prefer food with Astaxanthin?

Student Name(s): J. DeSabia

Abstract:
The purpose of this project is to dive deeper into the health of a lobster and study their preferences for foods with Astaxanthin. Astaxanthin provides them with pigments that help camouflage in their native environments. If there is a preference for foods with Astaxanthin, then Aquaculturists can regularly provide it in the lobster's diet to help support growth and pigmentation. This project is also going to help dive deeper into the health of lobsters inside captivity and how Astaxanthin can play a role in rebuilding the native population inside of the Sound once cultured lobsters are released. Initially, an experiment was set up with a batch of 12 juvenile lobsters in individual tanks with matching setups. The juveniles showed problems that could be tied in with stress of captivity or other related reasons, and the data came back inconclusive. A second experiment was set up with 6 adult lobsters. Each was provided with the option of a gel diet without Astaxanthin and Astaxanthin rich food. The adult lobsters have reacted good so far to the Astaxanthin, showing strong preference towards it over gel diet. Soon they should be showing visible signs of consumption as well. In conclusion, this experiment is aiming to determine whether American lobsters prefer Astaxanthin rich food compared to standard gel diet, and how this affects their health in captivity.

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

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

2026

Word Count: 245

Fair Category: LS

Project Number: 3192

Title: Exploring How Climate Change's Effect on Temperature and Larval Protein Availability Affects Life History Traits and Vectorial Capacity in Aedes Aegypti Mosquitoes

Student Name(s): L. Oshin

Abstract:

Female mosquitoes contribute to over one million deaths per year by transmitting diseases such as Dengue and Yellow fever to humans. As climate change occurs, the possibility for a global Aedes-borne virus epidemic drastically increases due to temprature influencing their window of activity and distribution/transmission of viruses. Additionally, the increased amount of CO2 in our atmosphere, will reduce the protein content in the microorganisms that mosquitoes eat, influencing the development of certain life history phenotypic characteristics, like developmental time, initial drive to feed, fertility, fecundity, and life expectancy, that impact vector control. By varying the temperature (22C, 28C, 33C) and protein content (Low and High) of six larval rearing environments, information about how the life history traits change was collected. Both temperature and protein concentration significantly influenced the life history traits examined in this study. Increasing temperature reduced total pupation time, while decreasing temperature delayed pupal onset, suggesting climate warming may accelerate mosquito population growth. Low-protein environments also delayed pupal onset, extended development, and reduced maturation uniformity, indicating insufficient protein limits successful transition to adulthood. Temperature did not significantly affect post-emergence survival, emphasizing protein concentration as the primary determinant of emergence success. Mosquitoes raised in low-protein environments demonstrated a faster initial drive to blood feed in afternoon assays, though time of day may have influenced results.
Future research could include completing the fertility, fecundity, and longevity assays, or exploring how genetic engineering approaches can mitigate larval temperature and nutritional stress.

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

2026

Word Count: 242

Fair Category: LS

Project Number: 3193

Title: Salt-Eating BioTiles: A Sustainable Solution to Combat Soil Salinity Using Halobacterium salinarum

Student Name(s): P. Mohanty

Abstract:

Soil salinity, the accumulation of soluble salts that limits plant water uptake, is a growing environmental problem that reduces crop productivity and degrades soil health worldwide. Conventional remediation methods, such as chemical soil amendments and excessive irrigation, are often costly or environmentally damaging. This project investigates a sustainable biological alternative using halophilic microorganisms, organisms that thrive in high-salt environments, to reduce soil salinity. The research examines whether BioTiles containing Halobacterium salinarum, a halophilic archaeon adapted to hypersaline conditions, can significantly reduce salt concentrations in saline soil. BioTiles were designed and constructed from biodegradable, porous materials, including cellulose sponge layers and jute, a plant-based fiber, with an internal agar growth medium to support microbial activity. The BioTile structure allows saline moisture to wick upward through the porous materials and interact with the microorganisms. Soil trays were prepared with 5%, 10%, and 20% salt concentrations, each with three treatments: soil with live BioTiles, soil with sterile BioTiles, and soil without BioTiles. Soil samples were measured for total dissolved solids (TDS) at 0, 30, and 60 minutes. Results showed that soils treated with live BioTiles experienced the greatest reduction in salinity, with TDS reductions of 54.08% at 5% salinity, 62.51% at 10% salinity, and 57.05% at 20% salinity, compared to 28.17% on average for sterile BioTiles and 0% for untreated soil. Peak effectiveness occurred at 10% salinity, demonstrating that BioTiles are a low-cost, sustainable, and environmentally friendly solution for reducing soil salinity.

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

2026

Word Count: 165

Fair Category: LS

Project Number: 3195

Title: The Effect of Access to Healthcare on Stage at Diagnosis

Student Name(s): K. Massey

Abstract:

There has been much research on melanoma skin cancer but less on non-melanoma skin cancers such as BCC and SCC. It is important to understand what barriers stand between patients and a timely diagnosis and proper treatment. Possible barriers include less access to insurance, less access to transportation, living in more remote areas, and socioeconomic status. The objective of this study was to assess stage at diagnosis in high vs low healthcare access groups, to evaluate outcomes across the healthcare access spectrum for women, and to identify structural barriers contributing to access to healthcare. It was predicted that less healthcare access is directly correlated to later stage at diagnosis and greater prevalence of more severe/metastatic disease. The desired outcome of this work is to provide a robust structure upon which major policy recommendations can be made. This project may provide sound evidence for further resource allocation towards dermatologic screening and care particularly targeting groups that are underinsured and further away from healthcare facilities.

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

2026

Word Count	Fair Category	Project Number
180	LS	3196

Title: The Effects of Skincare Products on The Face Skin Microbiome

Student Name(s): E. Stimson

Abstract:

Skincare product use has been on a steady rise in popularity among adolescents and young adults. Emerging research suggests that topical products may influence the skin microbiome, the community of organisms residing on the skin's surface. Alterations to this microbial community may affect skin health and barrier function. However, the extent to which common facial cleansers alter dominant bacterial taxa remains unclear. This study investigated the impact of skincare products on the facial skin microbiome over a 5-day period. A split-face experimental design was used, with one side serving as a treatment and the opposite as a control. Samples were collected on Day 1 and Day 5 using sterile swabs. Microbial DNA was extracted, amplified using 16s rRNA gene primers, and analyzed via Sanger sequencing to identify dominant bacterial taxa. My results showed no clear shift in dominant genera following treatment. These results suggest that short term cleanser use may not significantly influence bacterial taxa on the skin. Further research should be conducted using Next Generation Sequencing and additional participants to see the larger impact of these practices.

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

2026

Word Count	Fair Category	Project Number
256	LS	3198

Title: Developing a Predictive App for Water Quality: Modeling E. coli Quantification through Spatiotemporal Variables

Student Name(s): C. Chang

Abstract:

Bacterial contamination of shellfish waters poses a public health threat that can be mitigated through citizen□focused risk communication. However, previous deep-learning approaches to modeling in-stream E. coli have reported a substantial need for training and limited accuracy. Thus, the purpose of this project is to design and test an adaptive app that predicts the concentration of E. coli in rainfall-affected shellfish waters by developing a novel integrated modeling framework that incorporates relationships between rainfall data, physicochemical properties, and land-use regression variables. Water samples collected in East Haven were analyzed for physicochemical parameters and bacterial counts, then combined with publicly available spatial and temporal environmental data; predictor variables were screened using correlation analysis and incorporated into a two-part regression model alongside rainfall and short-term lag conditions. Additionally, combining GIS□derived land□use variables with rainfall□lagged physicochemical indicators raised predictive performance to $R^2 = 0.92$, well above the 0.70 criterion. The resulting equation was implemented on a free, user-facing platform that requires only date and location inputs, enabling rapid risk estimation for thousands of people without specialized expertise. Future research could incorporate a greater range of predictor variables to create a more robust model. These findings evince that integrating rainfall-lagged physicochemical indicators with land-use predictors significantly improves microbial water-quality prediction accuracy. By uniting historically underutilized physicochemical indicators with spatiotemporal predictors in a single system, this project demonstrates a scalable, data-efficient approach for microbial water-quality prediction that can enhance public awareness, inform environmental decision-making, and support community health protection.

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

2026

Word Count: 252

Fair Category: LS

Project Number: 3199

Title: Impact of Increasing Water Temperatures on Strobilation Rates in Aurelia aurita

Student Name(s): C. Fletcher

Abstract:

Climate change is expected to increase ocean temperatures, including Long Island Sound. Moon jellyfish (Aurelia aurita) have a life stage called a polyp, which reproduces through a process called strobilation. The polyp splits into and releases baby jellyfish. The purpose of this project was to test whether higher water temperatures, like what scientists predict for climate change, increase strobilation rates. It is predicted that polyps exposed to increasing temperatures would strobilate more, producing more jellyfish. Warmer temperatures increase feeding rates and act as a signal for development. To test this, Aurelia aurita polyps were placed in two separate tanks. The control tank remained at room temperature; the experimental tank was heated to simulate warming conditions. Both tanks were observed daily, and the number of ephyra produced was recorded. In the control tank, some polyps started to change shape, and a few developing jellyfish were recorded, but progress was slow. Strobilation in the heated tank started within two days, while the control tank took four days for strobilation to occur. Overall, the warmer water increased both the speed of strobilation and the likelihood that polyps would complete development into jellyfish. These results support the hypothesis that higher water temperatures speed up strobilation in Aurelia aurita. This suggests that as ocean temperatures rise due to climate change, jellyfish populations in Long Island Sound will increase. This could affect marine ecosystems and possibly change food webs and local ocean environments in the future.

Tombs,r.(2020). Aurelia aurita.Animal Diversity Web. Aurelia aurita Animal Diversity Web

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

Word Count

231

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3200

Title: The effects of psychiatric service dogs on veterans with PTSD and co-occurring mental health disorders: A Meta-Analysis

Student Name(s): A. Buchesky

Abstract:

There is currently research about how veterans with PTSD have been able to benefit from psychiatric service dogs, but this study aims to examine the extent of those benefits not just for veterans with PTSD, but also for other individuals dealing with other mental health concerns such as anxiety and depression. We are planning to compile different research studies that have been done, and to compare the results about how psychiatric service dogs can help lower PTSD levels in veterans as well as how they can lower other mental health illnesses including, but not limited to, depression and anxiety. A sub goal of this study would be to evaluate if shelter dogs, which are more inexpensive and accessible than trained psychiatric service dogs, could provide similar effects on PTSD levels. We hope to find more concrete evidence over the articles that psychiatric service dogs are able to provide a safe, nonmedical treatment option for veterans with PTSD. This research could help open the research field to seeing the extent to how much psychiatric service dogs could benefit not only veterans with PTSD, but also people dealing with other mental health illnesses such as anxiety and depression. This research could also open up more research to see how shelter dogs, which are a more inexpensive and accessible option compared to service dogs, would be able to similarly decrease PTSD levels in veterans.

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

2026

Word Count	Fair Category	Project Number
251	LS	3201

Title: The effect of varying concentrations of PFOS on developing human hippocampus brain organoids

Student Name(s): D. Park

Abstract:

PFOS (perfluorooctanesulfonic acid), a widely used member of the PFAS (per- and polyfluoroalkyl substances) family, has become a widespread environmental contaminant. They are found in everyday products such as clothing, food packaging, and even in the air, continuously exposing humans to PFOS. Yet its long term health effects remain poorly understood. Recent studies suggest a possible link between PFOS exposure and neurodegenerative diseases, including Alzheimer's disease. This study aims to investigate how PFOS exposure affects the hippocampus, the brain region responsible for memory formation and one of the first areas impacted in Alzheimer's disease. To model this, we used human hippocampal organoids (hHOs), a three dimensional stem cell derived structures that mimic the developing human hippocampus. Our hypothesis is that PFOS exposure negatively affect hHOs. hHOs were exposed to 0, 10, and 100 µM of PFOS. At 3 and 7 days after PFOS exposure, hHOs were harvested to assess structural and cellular changes. Immunostaining was performed against neuronal markers MAP2 and apoptosis marker c-Caspase 3. RT-qPCR was performed for neural progenitor markers PAX6, SOX2, and ZBTB20, and mature neural markers DCX and MAP2. We found that exposure to PFOS led to a decrease in MAP2 expression and an increase in c-Caspase 3 levels, suggesting the neural damage by PFOS. However, the expression of neural progenitor markers increased by PFOS exposure, suggesting that neural progenitors are resistant to PFOS. Together, damages in hippocampal neurons by PFOS explains the growing evidence linking PFOS exposure to dementia and other neurodegenerative conditions.

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
- [x] potentially hazardous biological agents
- [ ] vertebrate animals
- [ ] controlled substances

2. Student independently performed all procedures as outlined in this abstract. [x] Yes [ ] No
3. This project was conducted at a Registered Research Institution. [x] Yes [ ] No
4. Is this project a continuation? [ ] Yes [x] No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

[ ] Yes [x] No

CSEF Official Abstract and Certification

2026

Word Count: 224

Fair Category: LS

Project Number: 3203

Title: Hearing Loss's Correlation to Anxiety

Student Name(s): H. Blackwell

Abstract:

Over 1.5 billion people worldwide—about 20% of the global population—live with some degree of hearing loss. Research has linked hearing loss to psychological challenges, particularly anxiety and anxiety disorders. This study examined the relationship between hearing loss and anxiety to determine whether greater severity of hearing loss was associated with higher anxiety levels. Understanding this connection is important because untreated anxiety can significantly affect daily functioning and overall well-being. Additionally, aspects of hearing loss management, such as audiology appointments and the use of hearing devices, may contribute to increased stress.

A survey was created using Google Forms and distributed to adults with hearing loss. It included questions about hearing loss severity, anxiety symptoms, environmental influences, and life circumstances. Participants were recruited through Facebook groups focused on hearing loss, where eligible individuals were invited to complete the survey.

Results showed a positive correlation between hearing loss and anxiety, supporting the original hypothesis. Participants with more severe hearing loss reported higher levels of anxiety. These findings aligned with prior research and suggested that the degree of hearing loss may play a significant role in psychological well-being.Overall, this study highlights the need for greater attention to mental health in individuals with hearing loss. Future research should explore specific factors that contribute to anxiety in this population to improve awareness, support, and intervention strategies.

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

2026

Word Count: 229

Fair Category: LS

Project Number: 3207

Title: How environmental factors (UV light intensity) affect planarian's regeneration?

Student Name(s): T. Luan

Abstract:

Planaria regrowth, after amputation, driven by neoblasts, is a classic model for stem-cell regeneration. With nearby environmental pressure harshing, understanding how the UV (ultraviolet) light influences the basic cells' renewal is important. This project investigates short-term daily UV light with different strengths on the rate of regeneration and morphological accuracy of bisected planarians, hypothesizing that increased strength exposure will significantly elongate the time of completion and induce abnormal physical changes, such as size or rate of growth. To test this, planarians' mid was transected and randomly assigned into three groups of environments: No UV light exposure as a control group; one or two minutes exposure as experimental groups. The planarians are placed into freshwater habitats, and their progress of regeneration is recorded, including the rate they alive, degree of regrowth, and vitality. The data indicate a negative correlation between UV light exposure duration and the efficacy of planaria regeneration. After nine days, we find out that the control group has 100% alive, completely healed, and high vitality; 1-min group has 90% alive, start scab but not completely healed, and moderate vitality; 2-min group has 83.3% alive, not healed (cutting wound remained), and low vitality. In conclusion, short-term UV exposure disrupts planar stem-cell-driven regrowth and delays repair of tissue, stunting normal morphogenesis. These findings contribute to detrimental biological impacts on invertebrate regenerative pathways.

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

2026

Word Count	Fair Category	Project Number
178	LS	3208

Title: From Learning to Read to Reading to Learn: How Picture Books Affect Retention and Comprehension Rates In Greenwich Country Day Fourth Graders

Student Name(s): T. Filicetti

Abstract:

As Fourth Grade students transition from "learning to read" to "reading to learn", it remains unclear whether illustrations continue to meaningfully support the comprehension and retention of information. While prior research demonstrates that visuals enhance learning in early elementary students, fewer studies examine their impact during later elementary years. This study investigates whether illustrated texts improve reading comprehension and retention among approximately 34 Fourth Grade students at Greenwich Country Day School. Using a crossover experimental design, students will read two short stories, The Pied Piper and the Ugly Duckling, either illustrated or text-only formats. After each reading, students will complete a ten-question assessment measuring both main-idea comprehension and recall of minor details. Scores will be analyzed using factorial ANOVA to examine differences across format and classroom groups. It is hypothesized that illustrated texts will result in higher comprehension and retention scores, as well as greater engagement. Findings from this study will inform instructional design and curriculum development by clarifying whether visuals continue to play a critical role in supporting literacy at the fourth-grade level.

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

Word Count

248

CSEF Official Abstract and Certification

2026

Fair Category

LS

Project Number

3209

Title: TRACK I-S: An Interactive, Climate-Integrated Computational Simulation via the Scratch Programming Platform for Predictive Modeling of Lyme Disease Risk Across Connecticut Counties

Student Name(s): C. Chidiadi

Abstract:

Lyme disease is the most prevalent vector-borne illness in the United States, with an estimated 476,000 people potentially infected each year, though official reports for 2023 totaled 89,468 cases due to the issue of underreporting. The primary vector, Ixodes scapularis (blacklegged deer ticks), transmits the bacterium Borrelia burgdorferi. With climate change driving environmental factors such as temperature and precipitation, Lyme case rates have increased fivefold since 2001. This research developed TRACK I-S (Transmission Range Assessment and Climate-Driven Kinetics of Ixodes scapularis), an interactive simulation built using the Scratch programming platform to visualize historical data and predict future Lyme risk across Connecticut counties. Users input annual county averages for temperature and rainfall, while case counts from 2001–2023 obtained from CDC datasets reporting county-level Lyme incidence were integrated into the simulation. County-level tick density, forest cover, and deer population data from CAES were used to externally validate simulation predictions, ensuring that calculated risk levels reflected observed environmental conditions. Counties are represented as interactive sprites, with future risk levels calculated using a formula incorporating temperature, precipitation, and humidity. Risk is visually displayed through color coding (green: low, yellow: medium, red: high). Simulation predictions were validated against historical CDC case data (2000–2020), with an overall accuracy of 97.705% reflecting the proportion of counties where predicted risk matched observed case trends (r=0.996391181). Future enhancements aim to extend predictions to other regions of the United States and adapt the methodology to additional vector-borne diseases worldwide.

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 247

Fair Category: LS

Project Number: 3210

Title: Cortisol-Induced Epigenetic Changes in Skin Cells and the Potential of Plant-Derived Exosomes for Reversing Stress-Induced Skin Aging

Student Name(s): E. Jahng

Abstract:

Psychological stressors like academic overload have been shown to increase systemic cortisol levels, and those levels can adversely affect the skin. The objective in this study was to investigate the molecular mechanisms by which cortisol modulates the expression of collagen degradation genes MMP1 and MMP3, collagen synthesis gene COL1A1, and skin aging through epigenetic alterations (DNA methylation). We developed a new potential therapy using plant exosomes to reverse stress-induced skin changes and promote skin regeneration.
In human dermal fibroblasts (HDF), increased levels of collagenolytic MMP1 and MMP3 were observed following cortisol treatment, and expression of COL1A1, a major collagen synthesis gene, was decreased. The induction of collagen degradation and suppression of its synthesis caused by increased levels of collagenolytic MMPs contribute to the decreased levels of collagen. In addition, EM-seq analysis unambiguously confirmed that MMP1 and MMP3 promoter demethylation and COL1A1 promoter methylation were the major epigenetic mechanisms involved in these transcriptional changes.
Furthermore, when exosomes produced from calluses of Camellia japonica and Rosa spp. were used together, they had a synergistic effect during treatment. The combination treatment with exosomes also considerably reduced the MMP1 and MMP3 expressions, but highly induced COL1A1 expression. The exosomes can reverse the changes of DNA methylation induced by cortisol, restore collagen metabolism, and have the potential to reverse skin aging. These results reveal the molecular basis of stress-induced skin aging and the potential use of exosomes derived from plants as a new class of biotherapeutics against skin aging.

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

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

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- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

235

CSEF Official Abstract and Certification

2026

Fair Category: LS

Project Number: 3211

Title: The Effect of Formaldehyde on Microorganisms in Soil

Student Name(s): A. Hancock-Braun

Abstract:

Formaldehyde can come in contact with soil through pesticides, composite wood, and embalming. In this experiment, I aimed to determine how different concentrations of formaldehyde would affect the presence of bacteria in soil over time. In order to conduct this experiment I dug 200 grams of soil from nearby woods, which I homogenized by sifting, and I left it out on a baking pan at room temperature. I distributed that soil evenly into 3 replicate jars for 3 concentrations of formaldehyde, and a control group. I plated these jars by performing 2 washes on 0.25 grams of soil, and creating four dilution of each sample, two of which I plated. I found that the presence of higher doses of formaldehyde causes a decrease in fungi. While the presence of fungi decreases overtime regardless of environmental toxins, the presence of 0.5% formaldehyde causes fungi to be completely absent within 8 days. Meanwhile, bacteria decreases over time when formaldehyde is present. However, soil which was treated with 0.005% formaldehyde had more bacterial colonies than soil which was not treated with formaldehyde, although that number decreased over time.The presence of formaldehyde in soil negatively harms the growth of both fungi and bacteria over time. Precautions should be taken to avoid exposure of formaldehyde to soil, and planting should not occur near likely sources of formaldehyde. Further research may aim to determine the species of microorganisms present in soil.

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

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

- ☐ human subjects
- ☒ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

254

CSEF Official Abstract and Certification

2026

Fair Category: LST

Project Number: 3501

Title: The Influence of Chronotype and Lifestyle on Cognitive Performance

Student Name(s): A. Mishra, S. Sadlowski

Abstract:

This study investigated whether chronotype (morningness–eveningness preference) is associated with differences in cognitive performance among adolescents and whether lifestyle factors help explain these differences, with the goal of helping schools maximize their students' cognitive performance. We hypothesized that cognitive performance would change across chronotype groups and be influenced by duration of sleep, stress, physical activity, and caffeine use. 36 participants (ages 14 to 17) completed the Morningness-Eveningness and four cognitive tasks: Digit Span (for working memory), Stroop Color-Word (for cognitive control), N-back (for updating ability) and a reaction time test. Participants also submitted their average amount of sleep, stress, physical activity, and caffeine consumption. One-way ANOVA revealed significant differences between chronotype groups on multiple lifestyle variables and cognitive results, especially Stroop interference time and overall cognitive performance. Post-hoc comparisons showed that differences were greatest between Morning and Evening chronotypes, whereas more moderate groups had much more overlap. Pearson correlation analyses highlighted that decreased stress had the strongest association with increased overall cognitive performance followed by physical activity and decreased caffeine intake. Chronotype was not significantly associated with N-back accuracy. These findings suggest that cognitive performance differences across chronotype groups are strongly related to lifestyle patterns (especially stress and physical activity), which may help explain variation in peak cognitive performance among adolescents. Future studies hope to expand sites with additional school and sample size recruitment as well as conduct more sophisticated statistical testing as some factors measured (caffeine and sleep duration) may not be independent of each other.

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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- ☐ 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

2026

Word Count: 141

Fair Category: LST

Project Number: 3502

Title: Comparing Photocomplexes of Spinach and Cyanobacteria in Biophotovoltaic Devices

Student Name(s): S. Apple, C. Inman

Abstract:

Photosynthetic organisms convert light energy into usable electrical energy through the use of redox reactions. In this study, a biophotovoltaic cell was constructed to measure the electrical output of Photosystem I in isolation, and compare that output to an organism that uses Photosystem I, plus Light Harvesting Complex I (LHCI) in combination. LHC I, as found in many species of blue-green algae, contain xanthophylls which absorb blue-green wavelengths that chlorophyll captures inefficiently, so LHCI was expected to broaden light absorption, increase the availability of electrons for transfer, and increase voltage. The first biophotovoltaic cell used the cyanobacterium Spirulina, which relies solely on PSI for photosynthesis, while the second biophotovoltaic cell used Chlorella, which contains LHCI enriched with xanthophylls to function alongside its PSI. Results indicate that the xanthophylls increase voltage significantly by increasing light absorption in blue-green wavelengths.

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

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

2026

Word Count: 226

Fair Category: LST

Project Number: 3504

Title: How Eyewitness Testimony and Hair Analysis Contribute to Crime Scene Investigation within Forensic Science

Student Name(s): S. Wilson, M. Martinez

Abstract:

This project is a presentation/demonstration of eyewitness testimony and hair analysis; their effectiveness and usefulness in court. The question was, "Is hair analysis a better form of evidence, and if so, why?" Our research methods were researching eyewitness testimony flaws and hair analysis techniques, and studying previous court cases to know how eyewitness testimony was effective/ineffective. We then created a mock crime video that we used to put (school science fair) audience members in the perspective of one of these eyewitnesses. We found that audience members had a hard time keeping their own opinions, with their testimonies being mixed up when they talked to each other and watched a mock eyewitness testimony video that had false information. We also found that once audience members were given the chance to look through the microscopes to see the hair, they felt more confident in their own opinions. Our conclusion was that eyewitness testimony is a less useful form of evidence as compared to hair analysis, as it is easier to change and manipulate due to it being fully based on a human's memory, whereas hair analysis is dealing with concrete material. We recommend future studies spend more time analyzing the possible flaws of hair analysis, and spend time studying the other factors that play into eyewitness testimony, such as the other senses including smell and hearing.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) 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
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 254

Fair Category: LST

Project Number: 3505

Title: Foods Containing Allicin Effect on Killing Resistant Bacteria, Escherichia coli K-12

Student Name(s): A. Rogers, M. Vasquez

Abstract:

Though there have been many advancements within the medical field, a common concern has been the lack of solutions for battling against resistant bacteria due to it being a major factor in certain diseases and illnesses. As a possible solution, researchers have begun to utilize certain compounds to implement their antibacterial properties. One such compound is Allicin, commonly found in foods such as onions, garlic, leeks, scallions, and chives. This compound specifically has been known to kill certain gram-positive and gram-negative bacterias. Some of these gram-positive bacterias include Streptococcus pyogenes (causing strep throat) and Staphylococcus aureus (causing pneumonia and skin infections). Some of the bacterias that are gram-negative include Escherichia coli, Salmonella typhimurium, and Pseudomonas aeruginosa. In this study, we advanced the research of the compound Allicin by testing the vegetables' ability to kill the resistant bacteria Escherichia coli K-12. Tests were done on each petri dish containing the bacteria and along with it were fragments of onions, garlic, leeks, scallions, and chives. Two trials were performed to evaluate the effectiveness of allicin on the bacteria by using a petri dish grid to measure the percentage of bacteria infected petri dishes. The results demonstrated that chives produced the strongest inhibitory effect, significantly reducing bacterial growth compared to the control samples. In contrast, leeks did not effectively inhibit growth and showed signs similar to the growth of the control. These findings help us determine the potential at which natural compounds like allicin can help to fight off antibiotic resistant bacteria.

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

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

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- ☐ vertebrate animals
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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

Word Count

118

CSEF Official Abstract and Certification

2026

Fair Category: LST

Project Number: 3507

Title: Antioxidant Delivery using Food Grade Nanoclay as a strategy to emulsify lipids and potentially reduce LDL oxidation

Student Name(s): N. O'Connor, T. Ostrowski

Abstract:

Plaque buildup is a leading cause to heart and cardiovascular diseases. It is caused when free radicals, extremely reactive particles, react with LDL and other lipids and molecules in the bloodstream. A solution to this is to deliver antioxidants into the bloodstream to neutralize the free radicals. With other, not efficient, methods to deliver antioxidants, this project aims to find a healthier option to deliver these antioxidants through food-grade nanoclay. A lipid emulsion was made and mixed with the nanoclay infused with antioxidants and tested in a TBARS Assay. Absorbance was measured in a plate reader and it showed that solutions with nanoclay had lower absorbance meaning the antioxidants stopped the free radicals from oxidizing the lipids.

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
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☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count: 249

Fair Category: LST

Project Number: 3508

Title: Not All Collagen Concentration Is The Same: A Gel Strength Investigation

Student Name(s): Z. Khawaja, A. Ehmad, N. Hassan

Abstract:

Main objectives: The purpose of this project is to determine whether collagen can be substituted for gelatin in gel. Recently, collagen products have been in the health industries as an alternative to chemical products, used by many athletes and workers. This project will provide insight into how gelatin ignites the gel substance, and how collagen may be used to increase the quality and firmness of gel.

Methods: Eleven bowls will be gathered, each having a gel base created from water and sugar. Each bowl of gel base will be mixed with either 100% gelatin, gelatin and collagen (from 100 -10% and 10-100%), and a base with 100% collagen. Moreover, we will use tissue, a hard version of napkins to test the firmness and the binding properties of the gel. All the results will be recorded and organized to compare.

Data: After collectively experimenting on each gel base with a percentage of collagen, gel, or both, we collected shocking data. The gel bowl with 50% collagen and 50% gelatin sparked bewilderment among our group: Noor said that collagen isn't an effective substitute, Zaynab said that the chemical composition in gelatin binds better with the gel base, and Aleeza said that there was a pungent smell, and that collagen wouldn't work

Conclusion: Concludingly, the results proved that gelatin should remain the binding substance of gel. When 100% collagen was mixed with 0% gelatin and the sugar gel base, the gel remained liquid and 40% collagen and 60% gelatin was the best one.

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

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☐ vertebrate animals ☐ controlled substances

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

CSEF Official Abstract and Certification

2026

Word Count: 229

Fair Category: LST

Project Number: 3510

Title: Influence of Wavelength of Light on Growth Rate in Gracilaria tikvahaie: An Investigation into Improving Growth Rate to Increase Agar Yield for Commercial Use.

Student Name(s): C. Ricketts, J. Ball

Abstract:

An experiment was conducted to determine how wavelength of light influences the growth rate of Gracilaria tivikahie. Red algae, commercially grown for agar production, is grown under fluorescent white lights. This experiment simulates natural conditions in contrast to commercially grown seaweed attempting to attain a higher yield of biomass. This is being done to change the standards of the industry to potentially increase yield in growth along with reducing the cost of growth by using a specific wavelength. Identifying the optimal wavelength to improve growth of Gracilaria will allow you to have more successful growth. To find the optimal wavelength for growth, multiple wavelengths of different colors from a LED light array were used to see which would grow the seaweed and increase agar production the best. Three identical flasks of a starting mass of 4.0 grams of Gracilaria were were set up in the same area with aeration and their different colors. Once every week for eight weeks the Gracilaria was water changed then weighed and also given fertilizer. In the end, the different colors changed the grow rate and agar production of seaweed. Out of the colors red, orange, and green, which were the colors compared for the most growth, and agar production, orange had the most growth overall.

Dennis Hanisak, M.,Ryther,J.H. Cultivation biology of Gracilaria tikvahiae in the United States. Hydrobiologia 116, 295-298(1984).

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS EN 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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4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
196	LST	3511

Title: How different sugars impact CO_2 production in fermentation

Student Name(s): A. Rojas, K. Salazar

Abstract:

We decided to conduct an experiment on sugars and yeast to discover how the process works and figured it would be a cool experiment to try out as we both like to bake together. This project explores the process of sugars and yeast and the fermentation process while also measuring the carbon dioxide production. This experiment tested the glucose, fructose, and sucrose which is combined with yeast and warm water. Balloons were attached to water bottles, which is how we were able to see how they would get filled with CO_2 and measure the circumference of each balloon over the span of 3 hours. Results showed that the white sugar with warm water had the most balloon inflation, meaning that the fructose and glucose surpassed the sucrose. The white sugar with yeast came to have the largest average diameter of 12.41 cm while the second largest being the honey with a diameter of 11.93 cm and the third largest being the 8.83 cm. From our research we found that the white sugar was able to produce the most carbon dioxide due to it being more easily broken down by yeast into simple sugars for quick energy.

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

2026

Word Count: 146

Fair Category: LST

Project Number: 3512

Title: Modeling Aerosol-Albedo Interactions: The Effect of Smoke Above a Simulated Ocean

Student Name(s): E. Prato, A. Medvecky

Abstract:

This experiment explored how the height of smoke aerosols above an ocean surface impacts reflectivity, representing aerosol–albedo interactions. A 5-gallon bucket containing 4 inches of water representing the ocean, while a lamp and a lux meter imitated sunlight and measured reflected light. Smoke was released for two and a half minutes at three different heights above the water, at 2, 5, and 8 inches, using a bee smoker to produce the smoke. The results showed that reflectivity increased when the smoke was farther away from the water's surface, implying that aerosols farther from the surface boost albedo and scatter more light. This data shows that aerosol height plays a significant part in changing ocean surface reflectivity. This can help people understand how aerosols can affect climate change. If there are high aerosols, they will reflect more sunlight back into space, creating a cooling effect.

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

Word Count

81

CSEF Official Abstract and Certification

2026

Fair Category: LST

Project Number: 3514

Title: A Comparative Analysis of Equine Nutritive Supplements Utilizing In-Vitro Gas Production as a Proxy for In-Vivo Microbial Fermentation

Student Name(s): B. Sickles, R. Keller

Abstract:

This Project employs in vitro gas production and analysis to evaluate commercial digestive support supplements and to develop a homemade formula. By measuring Carbon Dioxide as a proxy for microbial fermentation efficiency, this research aimed to provide evidence-based guidance towards the purchase of equine gut supplements. Results indicate microbial fermentation efficiency, as visualized by gas production, was most effective in the presence of Gut Powder, suggesting this supplement would be the most beneficial in replicating a roaming horse’s hind gut.

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

2026

Word Count: 181

Fair Category: LST

Project Number: 3515

Title: Testing the Efficacy of Non-Toxic Substances on the Destruction of Lanternflies and Egg Masses

Student Name(s): M. Egbuzie, S. Polanco

Abstract:

The infestation of spotted lanternflies in the Northeastern United States is a growing concern. This experiment aimed to tackle the spotted lanternfly (SLF) infestation by determining whether non-toxic treatments (eucalyptus oil, lavender oil, vinegar, and neem oil) can kill the adult SLF and their egg masses. Lampshade traps, which encourage SLF oviposition, were constructed to gather SLF egg masses. After collecting the egg masses, the treatments were sprayed onto the egg masses in quadruplicate. Samples were then placed in a refrigerator for 23 days to simulate winter. Next, the samples were transferred to an incubator that was between 11 and 15 degrees C for 33 days to simulate spring. Adult SLFs were also tested with the same treatments. Results on egg masses were mixed. Vinegar and lavender oil were the most effective in delaying the progress of egg mass development. The findings from the adult SLFs showed that the most potent treatment was vinegar, as 75% of the SLFs that received the vinegar treatment died during the first check-up and the remaining 25% died during the third check-up.

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

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

- ☐ human subjects
- ☐ potentially hazardous biological agents
- ☐ vertebrate animals
- ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
253	LST	3518

Title: Cyanopanels

Student Name(s): D. Shajith, S. Natti, A. Luci

Abstract:

This project aims to evaluate how bioengineered cyanopanels could be optimized to reduce Urban Heat Island effect (UHI), an issue faced in many cities with a large accumulation in CO2. Since 2000, CO2 emissions in the US have increased by 50%, 74% of these emissions being a direct result of human interference such as burning fossil fuels and industrial activity. Cyanopanels incorporate a nontoxic photosynthetic cyanobacteria, synechocystis sp pcc 6803 (Syn6803) to reduce UHI. The main compartment is a microbial fuel cell (MFC), with panels containing Syn6803. To improve real-world feasibility, changes were required to shift the panels from a fixed position to oscillating to optimize sunlight exposure for maximum energy and oxygen production. Improving system practicality, an application was produced. Solar movement data across different geographic locations and time periods were analyzed and inputted into a processing AI to predict optimized panel orientation and tilt, maximizing sunlight exposure. The sun tracking projects a 20% increase in sun intake and 10% increase in photosynthesis. An extension of the application includes a sensor-based system that monitors the biofuel in the MFC to alert when maintenance is required, improving photosynthetic efficiency and operational practicality. A formula was produced to calculate the amount of oxygen production in optimal conditions per panel in different regions using average solar irradiance and seasonal daylight. This data was synthesized into a map predicting change across the United States. Cyanopanels proposes an improved approach to UHI reduction, by utilizing bioengineering and application-based computation, enhancing worldwide application and practicality.

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

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

- ☐ human subjects
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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

2026

Word Count: 115

Fair Category: LST

Project Number: 3519

Title: Comparative Analysis of Biopolymer Hydrogels: an Investigation of Degradeability, Nitrogen Leaching, and Plant Growth.

Student Name(s): C. Pedlow, G. Levy

Abstract:

Our project evaluated biodegradable methacrylated biopolymer hydrogels as controlled-release carriers for urea fertilizer to improve nitrogen use efficiency, reduce leaching-driven eutrophication, and enhance soil water retention in arid and sandy environments where losses are most severe. Hydrogels composed of gelatin methacrylate (GelMA), alginate methacrylate (AlgMA), and chitosan methacrylate (ChitoMA) were synthesized, incorporated with urea, and photochemically crosslinked into hydrogel networks . Sandy-soil plant columns were used to collect data including the spectrophotometric analysis of leachate, measurement of plant biomass; and lastly for hydrogel degradation. Results indicate that polymer chemistry governed nitrogen release, GelMA produced the most controlled profile, AlgMA degraded and released nitrogen rapidly, and ChitoMA showed limited effectiveness due to low swelling.

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

Word Count

239

CSEF Official Abstract and Certification

2026

Fair Category: LST

Project Number: 3521

Title: Structure-Based Drug Design to Discover Potential Hit Molecules for the IL-1β protein to prevent Dry Age-Related Macular Degeneration.

Student Name(s): J. So, J. Ho

Abstract:

Age-related Macular Degeneration (AMD) is a progressive retinal disease linked to chronic inflammation that leads to central vision loss. AMD is a disease that affects 1/10 Americans, with a 46.6% chance of developing in people 85 or older. The objective was to evaluate potential therapeutic candidates that modulate IL-1β activity to reduce inflammation associated with AMD progression, especially Dry AMD, which currently lacks known therapeutics. Standard precision docking was used for initial screening of compounds, followed by extra-precision docking. ADME (absorption, distribution, metabolism, and excretion) properties were assessed using QikProp to calculate relevant molecular descriptors. Qikprop calculates pharmacokinetic profiles for drug candidates, including BB penetration, solubility profile, and metabolites. Virtual screening of 400 compounds against the IL-1β NHL domain identified compound 5750-2701 as a top-ranked candidate, with a predicted docking score of −6.374 kcal/mol compared to −6.091 kcal/mol for the native fragment. Ligand interaction analysis indicated that the hit compound formed multiple interactions with active site residues, including Lys74, Gln81, and Thr79. ADME prediction showed that the compound can passively diffuse across cell membranes, has acceptable aqueous solubility, and is low-toxicity. These results suggest that compound 5750-2701 may be a viable small-molecule inhibitor of IL-1β. In this study, we have identified a hit compound, 5750-2701, from the ChemDiv Ocular Screening Library as a potential inhibitor of the IL-1β NHL domain, demonstrating favorable predicted binding affinity and toxicity profiles.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) BI CB 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
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count

158

CSEF Official Abstract and Certification

2026

Fair Category

LST

Project Number

3523

Title: The Effect of Rising Sea Levels on the Germination and Survival of Lathyrus Japonicus (Beach Pea)

Student Name(s): C. Gleason, E. Speicher

Abstract:

Rising sea levels caused by climate change increase salt concentrations in coastal environments, which may affect native shoreline plants. This experiment examined how increased salt concentration impacts the germination and survival of Lathyrus japonicus (Beach Pea). It was hypothesized that seeds exposed to higher salt concentrations would have lower germination, survival, and growth rates. To test this, Beach Pea seeds were planted in three trays of sand collected from Penfield Beach and watered with either distilled water, distilled water with added salt, or natural seawater from Long Island Sound. The plants were grown under a growth lamp and watered every two days for five weeks, while germination, survival, and growth were recorded. In our results it is shown that when the Beach Pea plants are grown in distilled water, they have a higher growth rate then when grown with saluted water. This mirrors the effect of rising sea levels on shoreline plants contributing to the lack of growth.

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

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
161	LST	3524

Title: Investigating Genetic Correlations Between Trisomy 21 and Congenital Heart Defects Through Biostatistical Analysis to Develop a Informative Website

Student Name(s): A. Corbett-Cousins, G. Golas

Abstract:

In people with Down Syndrome (Trisomy 21), there is a 50% chance of a person being born with a Congenital Heart Defect (CHD) (Down Syndrome and Heart Defects - Children's Health, 2020). The genetic cause behind this high rate of Congenital Heart Defects is not well known, and specific genes that are correlated with both Down Syndrome and Congenital Heart Defects are not easily accessible and understandable to the public. We hypothesize that there are specific mutated genes that is correlated with CHD in Trisomy 21. Our goal is to identify some of these genes and analyze each gene and mutation and include this data in a website accessible for the public. We have found through extensive research that there are three genes, NOS3, CRELD1, and NKX2-5 that when mutated are correlated with CHD in Trisomy 21 patients. We have also confirmed our prediction that Down Syndrome patients are very likely to have a Congenital Heart Defect due to a genetic correlation.

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

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

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- ☐ 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

2026

Word Count: 84

Fair Category: LST

Project Number: 3525

Title: Linking Bacterial Contamination to Public Water Sources to Daphnia Behavior and Health

Student Name(s): O. Bartoszek, A. Williams

Abstract:

In order to source and track pollutants, sophisticated water labs exist to test local water quality, but many rural areas and those that are heavily farmed, may lack regular access to these water-testing resources, even though these are the areas that need it most. Researchers sought to develop Daphnia-based water-testing protocols based on movement, heart rate, and phototaxic response. Pre-mixed stock solutions were created and analyzed using "sophisticated lab methodologies" as well as "Daphnia-protocols" and compared for statistical relevance.

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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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

2026

Word Count: 227

Fair Category: LST

Project Number: 3526

Title: Development of a Novel LAMP Assay for Rapid Molecular Detection of Hydrilla verticillata

Student Name(s): J. Acevedo, A. Hackett

Abstract:

Since 2016, Hydrilla has become a major threat for various Connecticut waterways. Loop mediated isothermal amplification (LAMP) is a rapid detection method that has been used in the identification of several invasive species such as the Common House Gecko, Northern Pike and Fall Armyworm. Currently, no studies have used LAMP to detect the presence of hydrilla in any bodies of water. This study aims to develop a novel LAMP assay to detect Hydrilla verticillata DNA for use as an early identification system. LAMP primers were designed to amplify the phytoene destaturase (PDS) gene in the three closely related subspecies of hydrilla found in Connecticut. Multiple primer sets were evaluated and final primers were selected based on their specificity to hydrilla and thermodynamic stability. Purified genomic DNA was obtained from dioecious, monoecious and Connecticut River hydrilla substrains. Primers were tested against three dilutions of DNA to determine LAMP sensitivity. The LAMP assay successfully amplified hydrilla DNA under isothermal conditions at 65oC. Serial ten-fold dilutions from 1ng/ul demonstrated consistent amplification down to 1.5pg/ul of input DNA. This study demonstrates that the newly designed LAMP primers can rapidly and sensitively detect Hydrilla verticillata DNA at picogram concentrations. With further specificity testing against closely related species, this assay has the potential to serve as a rapid, field-deployable tool for early detection of invasive hydrilla in Connecticut waterways.

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

Word Count
232

CSEF Official Abstract and Certification

2026

Fair Category
LST

Project Number
3527

Title: Development of an Offline, Low-Cost Embedded Health Guidance System with AI-Driven Triage and Integrated Safety Protocols

Student Name(s): M. Thalapaneni, S. Rajesh, A. Tiwari

Abstract:
Many digital health tools require continuous internet access or are designed for trained healthcare professionals, limiting accessibility in low-resource environments. This study investigated whether a low-cost embedded system could deliver safe, structured, AI-assisted health guidance while intentionally restricting outputs to prevent diagnostic or liability-generating medical advice. A portable prototype was constructed for $55.96 using a Raspberry Pi Zero W, touchscreen interface, microSD storage, and battery power. A structured symptom database was developed from established medical references and categorized by urgency level (common, moderate-risk, emergency red flag) to reduce alarmist bias. A constrained AI triage layer was designed to map user-entered symptoms to this database and generate simplified, safety-bounded educational guidance while omitting diagnoses and prescription instructions. The system architecture was engineered to support offline inference; however, hardware memory limitations required cloud-based model execution during testing. Validation involved structured input scenarios designed to trigger escalation logic, ambiguity handling, and medication omission safeguards. In all tested cases, the system correctly identified red-flag symptoms, escalated when appropriate, and maintained liability-free educational framing. Results demonstrate that structured AI triage with embedded safety constraints can be implemented on low-cost hardware. Although full offline deployment was limited by RAM capacity, the architecture supports offline execution on higher-memory embedded platforms. This work establishes a scalable framework for safe, accessible AI-assisted health guidance in low-connectivity settings.

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

CSEF Official Abstract and Certification

2026

Word Count	Fair Category	Project Number
235	LST	3528

Title: The Effect of Formaldehyde on Microorganisms in Soil

Student Name(s): A. Hancock-Braun

Abstract:

Formaldehyde can come in contact with soil through pesticides, composite wood, and embalming. In this experiment, I aimed to determine how different concentrations of formaldehyde would affect the presence of bacteria in soil over time. In order to conduct this experiment I dug 200 grams of soil from nearby woods, which I homogenized by sifting, and I left it out on a baking pan at room temperature. I distributed that soil evenly into 3 replicate jars for 3 concentrations of formaldehyde, and a control group. I plated these jars by performing 2 washes on 0.25 grams of soil, and creating four dilution of each sample, two of which I plated. I found that the presence of higher doses of formaldehyde causes a decrease in fungi. While the presence of fungi decreases overtime regardless of environmental toxins, the presence of 0.5% formaldehyde causes fungi to be completely absent within 8 days. Meanwhile, bacteria decreases over time when formaldehyde is present. However, soil which was treated with 0.005% formaldehyde had more bacterial colonies than soil which was not treated with formaldehyde, although that number decreased over time.The presence of formaldehyde in soil negatively harms the growth of both fungi and bacteria over time. Precautions should be taken to avoid exposure of formaldehyde to soil, and planting should not occur near likely sources of formaldehyde. Further research may aim to determine the species of microorganisms present in soil.

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

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

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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

2026

Word Count	Fair Category	Project Number
247	LST	3529

Title: Potential Impact of Plastic Leachate on Marine Phytoplankton Nitrate Uptake

Student Name(s): V. Sibley, G. Belizaire

Abstract:

Ever increasing microplastic pollution threats to our coastal estuaries have been well documented in the literature. The potential threats due to the leached polyethylene terephthalate (PET) from these microplastics is understudied in the literature but frequently identified as a potential threat needed for a more comprehensive assessment of our footprint on this already ecologically sensitive habitat. This study was designed to evaluate that very question with the foundation of these ecosystems, marine phytoplankton. These organisms survive mainly through nutrients in the surrounding waters, and as such replicated treatments were used to evaluate potential inhibition of nutrient uptake. A gradient of plastic exposure (5 -90%) was used to also assess any threshold that might exist ($n=5$ for each treatment). After 48 hours of exposure, significant drops in nutrient uptake occurred across all levels of exposure (3.5ppm down as low as 0ppm taken up, $p=0.032$, $\alpha = 0.05$). The fact that minimal exposure significantly impacted nutrient uptake indicates a potentially catastrophic impact if not properly managed. Coastal estuaries serve as a biological filter and often the last line of defense in mitigating our impacts. In addition, the energy and biomass at the foundations of these systems is essentially supporting the entirety of the rest of the system. If we are having a measurable impact on the base of this system, we may be having a cascading affect up the food chain. This is important in that coastal estuaries serve as nursery habitat for both ecologically and commercially important species.

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

Word Count
135

CSEF Official Abstract and Certification
2026

Fair Category: LST
Project Number: 3530

Title: An investigation of Methylene Blue's Neuroprotective ability to Inhibit Excess Glutamate Production

Student Name(s): J. Montanez, C. Holl

Abstract:

Neurotransmitters enable synaptic communication throughout the nervous system, and glutamate serves as the brain's primary excitatory messenger, essential for learning and cognition but harmful in excess. Elevated glutamate has been linked to neurodegenerative disorders such as Alzheimer's disease and Parkinson's disease through excitotoxicity, a process in which overstimulation damages neurons. To investigate whether methylene blue modulates glutamate levels, Sigma-Aldrich Glutamate Assay Kit was used to establish standard curves, then exposed Daphnia magna to varying methylene blue concentrations and quantified glutamate via ELISA. Statistical analysis revealed significantly lower glutamate concentrations in all treated groups compared with the control group. This reduction followed a clear dose-dependent pattern, with the 1:1000 dilution producing the greatest suppression. Although limited by sample size and potential procedural error, the consistent concentration-response relationship supports a biologically meaningful inhibitory effect

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

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

☐ human subjects ☐ potentially hazardous biological agents
☐ vertebrate animals ☒ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

Word Count
141

CSEF Official Abstract and Certification

2026

Fair Category
LST

Project Number
3531

Title: The Effect of Climate Change on Asclepias Incarnata and its Impact on Danaus Plexippus

Student Name(s): L. Accinelli, S. Accinelli

Abstract:

Climate change is rapidly affecting plant growth and survival, with rising temperatures that are threatening native species like Swamp Milkweed (Asclepias Incarnata). This study aims to investigate the impact of varying temperature on seed germination rates and growth. The swamp milkweed seeds are going to be cold-stratified and planted in different temperature environments. All other variables, such as light exposure, watering, and soil type, are being kept constant to isolate the effect of temperature. Data is going to be collected over two months should show that the seeds kept in the higher temperature environment displayed decreased plant health. These findings highlight the urgent need for awareness about climate change's impact on the ecosystem. Promoting solutions like solar energy, forest conservation, and reducing fossil fuel usage can help protect plant species and support sustainable agriculture in the face of climate change.

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

2026

Word Count: 238

Fair Category: LST

Project Number: 3533

Title: The affect of acetaminophen on children during pregnancy and risk of neurodevelopment disorders.

Student Name(s): D. Pereira, S. Pereira

Abstract:

Acetaminophen or Tylenol is the most used drug during pregnancy for pain and fever control. There have been concerns regarding a possible connection between prenatal acetaminophen use and neurodevelopmental disorders (NDDs), such as autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), and intellectual disability (ID). This study aimed to determine whether the use of prenatal acetaminophen during pregnancy independently causes NDDs.

This research project gathered data from large-scale studies, including a large study for the nationwide cohort of 2,480,797 children, as well as likelihood and biomarker based studies. In the nationwide cohort study, 185,909 children (7.5%) were exposed prenatally. The crude absolute risks at age 10 were slightly higher in exposed children than in unexposed children, autism (1.53% vs. 1.33%), ADHD (2.87% vs. 2.46%), and ID (0.82% vs. 0.70%). Changing population based models showed small risk increases (hazard ratios 1.05-1.07) with very small absolute risk differences (+0.04% to +0.21%). Even so, siblingl analyses, which take into account shared genetics and environmental factors, showed no statistical significant associations (hazard ratios 0.98-1.01) and no dose response relationship.

Although some prospective and biomarker studies showed increased connection for ADHD, these results were not confirmed after making changes for familial affects in the analysis. Overall, there is no support for a definite relationship between prenatal acetaminophen exposure and neurodevelopmental disorders based on the current high quality evidence. The evidence supports that acetaminophen use in pregnancy does not independently cause NDDs.

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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- ☐ 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

2026

Word Count: 238

Fair Category: LST

Project Number: 3534

Title: Wavelet-Based Multiscale Anisotropy-Aware Cell-Cell Communication Inference

Student Name(s): S. Mankala, J. Su, S. Chen

Abstract:

Cell–cell communication (CCC) inference in spatial transcriptomics (ST) ideally integrates ligand–receptor abundance with constraints imposed by tissue structure. Existing approaches, however, often neglect anisotropic, or direction-varying, features of structures such as extracellular channels, instead assuming isotropic signaling. Here, we present WACCCN, a computational workflow for anisotropy-aware CCC inference and niche segmentation based on a wavelet–based multiscale integration of spatial transcriptomics and histology. From wavelet-derived orientation and histology features, we construct anisotropic kernels that steer ligand dispersion along tissue fibers while compressing across them. These kernels are used to build communication networks, further modulated by a morphology-based similarity gate. For downstream clustering, we segment macro- and micro-niches with a U-Net and fused features. . We then integrate molecular and histological inputs, wavelet-derived representations, and communication-aware graph signals within a multi-view graph autoencoder, enabling the discovery of niches organized by both morphology and intercellular signaling. Applied to cancer datasets, WACCCN revealed realistic, anisotropy-driven flows and morphologically consistent niches. It produced communication patterns that correlated with histology and were more spatially coherent than those from isotropic baselines and existing CCC tools. In practice, this yields sparser, more interpretable signaling networks in which communication is directionally coherent and traces along histological landmarks. Thus, our framework provides intuitive summaries of where and how signaling is concentrated and highlights anisotropy-aware modeling as a promising direction for next-generation spatial omics analysis.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project): BC CS 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
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 136

2026

Fair Category LST

Project Number 3536

Title: Investigating Biochar as a Bioremediation Method to Inhibit Microplastic Effects on Agricultural Crops

Student Name(s): Q. Cunningham, G. Cuesta

Abstract:

In commercial agricultural settings, plastic mulches, primarily used for moisture conservation of crops, can release microplastic particles into the soil medium over time by degradation. However, biochar, a carbon-rich charcoal produced by the pyrolysis of biomass, has shown to immobilize microplastics by adsorption, and also to assist plants by enhancing nutrient uptake and water retention. The purpose of this study was to investigate biochar's ability to immobilize microplastic particles and observe microplastic impact on chlorophyll production and overall plant growth. Results indicate that plants grown in the microplastic solution absorbed a higher number of microplastic particles than the plants grown with both microplastics and biochar solution. However, the microplastic plants also managed to generate the highest chlorophyll content, with the plants grown in just biochar having the lower concentration. Overall plant growth data was inconclusive.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project) PS EV 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
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4. Is this project a continuation? ☐ Yes ☒ No
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