CONNECTICUT SCIENCE & ENGINEERING FAIR

**77th Annual Fair**
**March 3-15, 2025**

# Student Abstracts

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 242 | LS | 3001 |

**Title:** The Effects of Gender, Age, and Costoclavicular Symmetry or Asymmetry on the Costoclavical Interval for Neurogenic Thoracic Outlet Syndrome (nTOS) Patients

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

**Abstract:**

Thoracic Outlet Syndrome (TOS) is a condition when there is compression in the thoracic outlet. Neurogenic TOS (nTOS) occurs when the brachial plexus nerve is compressed. The costoclavical interval, one of three passages that lead to the thoracic outlet, is also where compression occurs. nTOS is often misdiagnosed, leading to delay in proper treatment. This experiment aims to identify factors that affect the development of nTOS to help proper diagnosis by using MRI images. This is the first time MRI data has been used to examine the costoclavical interval and its relationship to nTOS. If women develop nTOS more frequently than men, then females will have a smaller costoclavical interval, as nTOS patients have a compressed costoclavical interval. Previous studies have shown that nTOS patients are predominantly ages 20-40. Examining the age of the patient at diagnosis may demonstrate that over time the costoclavical interval will widen as the ribs and shoulder girdle will change. Furthermore, previous studies have examined the costoclavical interval of the affected arm, but have not inspected this interval bilaterally. If nTOS narrows the costoclavical interval, then the affected costoclavical interval of nTOS patients is likely narrower than the unaffected costoclavical interval. Deidentified MRI data of nTOS patients was used to create correlation tests, one sample t-tests, and two sample t-tests. It was found that females have a statistically smaller costoclavical interval, the interval widens with age, and the affected side is narrower than the unaffected.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 191 | LS | 3002 |

**Title:** Investigating miR-30a-5p Modulation and its Impact on Glucose Uptake and Insulin Sensitivity in 3T3T3-L1 cells for Metabolic Disorder Research

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

**Abstract:**

Diabetes is a global health concern affecting millions, with its prevalence rising. Research has correlated adipocytes and their functions with metabolic disorders such as type 2 diabetes. An important area of research revolves around the manipulation of miRNA in adipocytes regulating energy expenditure to improve insulin sensitivity. This experiment explores miR -30a manipulation in mouse adipocytes and expects an increase in glucose uptake. This will be done by transfecting miR30a into mouse adipocytes in culture, alongside positive and negative controls. This is expected to induce better energy expenditure associated with brown adipocytes. Glucose uptake will be measured using fluorescent microscopy with 2-NBDG glucose analog for three groups. Previous research showed that miR-30a-induced cultures decreased blood glucose levels- which are inversely related to glucose uptake- from ~130 dg/mL to 50 dg/mL, enhancing insulin sensitivity. Therefore, this experiment expects a >50% increase in glucose uptake in miR-30a overexpressed cells, visible through higher fluorescence intensity. If confirmed, the anticipated increase in glucose uptake emphasizes the significance of miR-30a in cellular responses, offering a promising avenue for future therapeutic interventions in metabolic disorders such as type 2 diabetes.

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

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# CSEF Official Abstract and Certification
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| Word Count | Fair Category | Project Number |
|---|---|---|
| 257 | LS | 3003 |

**Title:** Implementation and Validation of a Novel Machine-Learning-Based Mobile Mechanocardiography System for Arrhythmia Detection

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

**Abstract:**

Irregularities in heart rhythm patterns, known as arrhythmias, may reveal various cardiac diseases. Currently, electrocardiograms (ECGs) are predominantly used to record heart rhythm, and abnormalities in these measurements can be indicative of underlying cardiac pathology. ECGs record electrical potential differences induced by the contraction of heart muscle fibers; however, they require time-consuming surface/electrode preparation and complex, multi-channel signal processing. The prevalence of inexpensive mobile devices containing integrated, high-precision accelerometers and gyroscopic sensors has presented cardio-mechanical monitoring techniques such as seismocardiography (SCG) and gyrocardiography (GCG), which record mechanical vibrations and movements associated with heart activity, as potential alternatives to ECGs with simpler preparation and processing requirements. This research project aims to implement and validate a machine-learning-based smartphone application for arrhythmia detection through gyroscope and accelerometer readings taken from a smartphone resting on the sternum. Two open-access datasets containing gyroscope and accelerometer readings taken from subjects with and without valvular heart diseases were obtained and statistically processed for use in machine learning training. Subsequently, a deep convolutional neural network (CNN) was developed and trained upon the processed dataset for the purpose of identifying arrhythmia in cardio-mechanical recordings. A statistically significant relationship between the training dataset and binary classifiers (healthy/arrhythmic) was hypothesized to yield a viable machine-learning model. Ultimately, evaluation of the trained model resulted in a satisfactory classification accuracy above 90%. The validated deep convolutional neural network was incorporated into a cross-platform mobile application for Android and iOS devices, providing an intuitive interface for future clinical testing.

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

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# CSEF Official Abstract and Certification
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| Word Count | Fair Category | Project Number |
|---|---|---|
| 153 | LS | 3004 |

**Title:** Generating Peptide-Linked Genetic Constructs for Mouse Major Histocompatibility Complex I

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

**Abstract:**

The purpose of this project is to create Major Histocompatibility Complex I (MHC I)-peptide tetramer complexes that can be used to identify peptide-specific cytotoxic (CD8) T cells. Currently, only high-affinity peptide tetramers exist, and this project aims to develop tetramers with low-affinity peptides. In order to do so, plasmids containing MHC I gene constructs with low-affinity neoepitopes were isolated from E. coli stocks. These plasmids were then subject to polymerase chain reaction to create wild type versions. The resulting plasmids were transformed into DH5α strain E. coli to be propagated and inoculated, then transferred to Rosetta-gami strains for the protein to be expressed. The resulting protein was purified from the insoluble fractions from the cells. These can then be used to create MHC I-peptide single chain trimers, which can be insightful in cancer immunology as they can provide valuable insights into immune recognition and tumor prevention.

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

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# CSEF Official Abstract and Certification
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| Word Count | Fair Category | Project Number |
|---|---|---|
| 99 | LS | 3005 |

**Title:** Fucus Vesiculosus Extract as a Biostimulant for Radish Plant Growth

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

**Abstract:**

Fucus vesiculosus, a brown algae, is commonly used in many different aspects. For instance, F. vesiculosus can be used in agriculture, pharmaceuticals, cosmetics, and food. F. vesiculosus extract can be used as a biostimulant, otherwise known as a fertilizer, for plant growth. Algae extract is high in nutrients, especially iron, zinc, and copper. These nutrients are crucial to help improve plant growth. With using F. vesiculosus extract at different concentration levels (25, 50, 75, and 100%), plant growth will be monitored for radish seeds. 25% and 75% showed the best growth after nine days between root and stem length.

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

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# CSEF Official Abstract and Certification
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| Word Count | Fair Category | Project Number |
|---|---|---|
| 301 | LS | 3006 |

**Title:** Targeted Delivery of Melittin Anti-inflammatory Peptides via a Eudragit-Coated Sporopollenin Exine Capsule for Effective Treatment of Crohn's Disease

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

**Abstract:**

Crohn's disease is an autoimmune/inflammatory bowel disease that causes the swelling of digestive tract tissues. Therapies for Crohn's have severe side effects and are limited in success, as their delivery is non-specific to the many possible sites of digestive-tract inflammation. A new, tunable, oral delivery system which selectively delivers therapeutic agents to a patient's site of inflammation is needed. Recently, melittin has demonstrated anti-inflammatory properties as an innovative therapeutic, but has yet to be investigated for Crohn's. This research designed a new melittin-based Crohn's treatment, whose drug-delivery is preprogrammed based on a patient's inflammation location, and corresponding digestive-tract pH. Spore-grain microcapsules, with an outer sporopollenin exine layer, were chosen as the melittin carrier, due to sporopollenin-mucoadhesion to the intestinal-wall. Lycopodium-spore-grains were first emptied of all protein/cellulosic content via acetone-reflux and KOH-wash, to produce 25um sporopollenin-exine capsules (SEC) carriers. 150mg-SECs were soaked in 1.8ml of 1.25mg/ml-melittin, and freeze-dried, to produce Mel-SECs. These were encapsulated with Eudragit-S100, an anionic-methacrylate copolymer with pH-7 dissolution, to provide large-intestine-selective delivery. Targeted-dissolution of these E-Mel-SECs was verified using ATR-FTIR. Incremental increase of E-Mel-SEC solution-pH from 2-to-7 demonstrated integrity of the coated-capsules until pH-7, where Eudragit-S100 disbands, and 95% of the melittin-load is released within 60min. The anti-inflammatory properties of free and encapsulated melittin were studied against budesonide (used for Crohn's), using albumin-denaturation. 500ug/ml of free-melittin, and equivalent concentrations within Mel-SECs and E-Mel-SECs, denatured ~70% of albumin, as did 500ug/ml-budesonide. This highlights melittin's exceptional anti-inflammatory properties, and the efficient release and function of the E-Mel-SEC delivery system.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
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| Word Count | Fair Category | Project Number |
|---|---|---|
| 255 | LS | 3007 |

**Title:** Assessing Hearing Risk: Analyzing Noise Levels of Hair Dryers and Effective Sound Dampening Techniques.

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

**Abstract:**

Everyday exposure to sound levels above 70 A-weighted decibels (dBA) increase the risk of hearing loss to humans. Hairdryers contribute to this risk, as the noise they produce can be harmful depending on the model and frequency of use. The goal of this experiment is to assess whether more expensive hairdryers offer better auditory protection by lowering the sound levels to which the ear is exposed. Utilizing a soundproof box equipped with a decibel meter, three hairdryers, ranging between twenty-five dollars to four hundred thirty dollars, were tested at various speed and temperature settings, both with and without two noise-dampening attachments: a bonnet and a blow dryer sock. The data suggests that the cost of the hairdryer does not correlate to its auditory safety. The more expensive hairdryer emitted the highest noise levels, ranging from 82 dBA to 101 dBA, while the more reasonably priced hairdryer produced noise levels between 74 dBA and 86 dBA. The sound levels recorded while using a dampening accessory ranged from 71 to 101 dBA, indicating that neither noise-dampening accessory effectively reduced the noise to a safe 70 dBA. Results show a modest seven percent increase to a twenty-five percent reduction in sound levels. While the exposure time was consistent across all trials, 20 seconds per recorded test, future experimental adjustments such as additional trials or more noise-dampening accessories could improve the results by examining the relationship between noise levels and airflow efficiency to further reduce the risk of hearing damage from hair dryers.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 260 | LS | 3008 |

**Title:** Evaluating LYVE1 Gene Expression in Breast Cancer Using qPCR Analysis and Comparing with Hyperparameter-Tuned Models for LYVE1 Gene Expression in Pancreatic Cancer

**Student Name(s):** N. Ananth Iyer

**Abstract:**

Cancer is a leading cause of death, with early detection rates at an all-time low. Blood tests, MRI scans, and biopsies for specifically pancreatic and breast cancer lack accuracy in early detection, with rates reaching only 87%. This study examines LYVE1, a gene with increased expression in cancerous tissues, as a potential early-detection biomarker. This study first evaluates LYVE1 expression in pancreatic cancer detection via AI models trained on a dataset published by the Spanish National Cancer Research Center. A feature importance graph generated from the dataset highlighted LYVE1 expression as the most significant factor contributing to model accuracy. LightGBM achieved 91% accuracy in cancer detection based on LYVE1 expression, performing better than the best models trained on other biomarkers, including Support Vector Machines for REG1B (80% accuracy) and Random Forest for TFF1 (85% accuracy). The second part of this study investigates LYVE1 expression in breast cancer cells using qPCR. MDA-MB-231 (breast cancer) and MCF-10A (healthy breast) cells were initially cellularly passed. Subsequently, RNA extraction and One-Step SYBR Green qPCR were performed using a validated LYVE1 primer pair and GAPDH as a reference gene. Results show LYVE1 is 54 times more active in breast cancer cells, mirroring its upregulation in pancreatic cancer. LYVE1's amplification, melt peak, and melt curve graphs indicate no cross-contamination. These findings suggest that LYVE1 may be a universal cancer biomarker in early detection and AI-assisted diagnostics. Future research will integrate LYVE1 expression data into AI models for breast cancer detection, further exploring LYVE1's role in metastasis.

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

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2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 245 | LS | 3009 |

**Title:** Determining if APOL1 Risk Variant Genes Increase the Expression of APOL1 in Human Kidney Tissue Among Patients with Proteinuria.

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

**Abstract:**

APOL1 G1 and G2 risk variants cause podocyte damage which has been shown to lead to urinary protein loss and chronic kidney disease. However, questions still remain whether APOL1 expression is increased in human kidney biopsies in patients who have documented proteinuric kidney disease. The purpose of this project is to compare APOL1 expression in human kidney tissue from patients with proteinuria, focusing on those with and without the APOL1 risk variants. The independent variable is the APOL1 risk status of the patient and the dependent variable is APOL1 expression levels of the podocyte cells. Genetic testing to confirm the presence of APOL1 risk variants within each sample was completed through Natera DNA tests. Immunofluorescent staining was performed using anti-apolipoprotein L1 antibodies (Sigma), and after twenty hours, the samples were stained with fluorophore-tagged secondary antibodies that bound to the primary antibodies. The stained samples were imaged under a spinning disc confocal microscope, and the immunofluorescence intensity was measured using the mean gray value of APOL1 in podocytes with Image J software to quantify whether its expression is increased in those patients with APOL1 risk variants. It was found that patients with 2 APOL1 risk variants had an increased APOL1 expression in their podocytes compared to patients with 1 or 0 variants. This provides useful information surrounding the correlation of APOL1 expression in human kidney biopsy samples with APOL1 risk variants. This can lead to more information to aid targeted therapies and future discoveries.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 169 | LS | 3010 |

**Title:** Analyzing the Impact of Ibuprofen on Planarian Regeneration: A Model for Pharmacogenomics and Advancing Healthcare Solutions in Underrepresented Communities

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

**Abstract:**

Over-the-counter (OTC) drugs like ibuprofen are widely used for pain relief, but their effects on cellular regeneration remain understudied. This experiment examines the effects of ibuprofen on planarian regeneration, testing whether higher doses slow tissue repair. During the study, Planaria were fed cow liver weekly, and housed in dark, cool conditions. Following 2 weeks of acclimation for the Planaria, trials began. They were amputated and exposed to four ibuprofen concentrations including: 0, 10, 20, and 40 µg/mL. Data showed that higher ibuprofen concentrations slowed regeneration. The control group exhibited the fastest regrowth, while the 10 and 20 µg/mL group showed minor delays. We observed that extended exposure to high concentration of Ibuprofen (40 µg/mL) resulted in halted reproduction as well as physical changes to the worms, showing potential toxicity to cells. These findings highlight ibuprofen's impact on tissue repair and its potential relevance to pharmacogenomics. Future studies could explore other Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) to further clarify drug influence on cellular regeneration.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 257 | LS | 3011 |

**Title:** A Novel Multi-Modal Deep Learning Approach with Attention Mechanisms for Early Detection of Alzheimer's Disease

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

**Abstract:**

Alzheimer's disease (AD) is a progressive neurodegenerative disorder that remains difficult to diagnose in its early stages. Current diagnostic approaches lack sensitivity to subtle early symptoms, delaying intervention. In this research, a novel multi-modal deep learning (DL) attention framework that integrates clinical, genetic, and MRI modalities was designed to improve early AD detection. Combining these modalities with attention mechanisms will enhance predictive accuracy compared to current models, as does the use of a neural network (NN) in place of conventional ML methods. MRI, genetic (APOE markers), and clinical data from the Alzheimer's Disease Neuroimaging Initiative (ADNI) were utilized to train and validate the model. A convolutional neural network (CNN) extracted spatial MRI features, while multilayer perceptrons (MLPs) processed genetic and clinical data. Two mechanisms, self-attention and cross-attention, were introduced to capture intra-modality dependencies and inter-modality relationships, enhancing the model's ability to identify subtle AD-related patterns. The model classified subjects into cognitively normal (CN), mild cognitive impairment (MCI), and AD categories. This proposed framework outperformed conventional uni-modal and multi-modal models, achieving an overall accuracy of 97.8%. This is likely due to attention mechanisms which improved feature representation. Notably, during statistical analysis, the framework discovered that MRI brain structure integrity (BSI) measures and the APOE genotype were significant predictive features, while ML methods did not. This study demonstrates the potential of multi-modal deep learning in early AD detection. These findings highlight the significance of attention mechanisms alongside the combined role of BSI and the APOE genotype in future diagnostic frameworks.

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

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2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 236 | LS | 3012 |

**Title:** Proving Microplastics Transfer From Water To Living Organisms Through Vegetation

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

**Abstract:**

After the discovery of microplastics in the stomachs of Albatross in the 1960s, the investigation of microplastics skyrocketed. In 2004 Professor Richard Thompson OBE FRS showed that microplastics have accumulated in our seas globally. Scientists began theorizing that microplastics could potentially be found in the tissue of other animals from their food sources and environment due to the microplastics found in major bodies of water. Based on previous discoveries this project aims to prove that microplastics can be transferred to living organisms through water sources and finally in the vegetation the organisms consume. Hydroponic systems with different water sources; tap water, rain water, waste water, and dH2O were used to grow wheatgrass and chia. The tap water and waste water contained microplastics prior to the experiment while the rain water and dH2O contained none. The wheatgrass and chia plants grown were tested for microplastics. Results showed that the vegetation grown in the tap water and waste water contained microplastics while the vegetation grown in the rain water and dH20 contained no microplastics. Prior to the endings of the experiment meal worms were tested; the resulting data led to the conclusion that the mealworms are free from microplastics prior to being fed the vegetation. The mealworms were then separated and fed the wheatgrass and chia that had grown. The mealworms that consumed the plant material; grown in the water that was contaminated with microplastics, had microplastics present.

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

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| Word Count | Fair Category | Project Number |
|---|---|---|
| 244 | LS | 3013 |

**Title:** Effect of Environmental Conditions on Accuracy of Gel Electrophoresis for DNA Sequencing

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

**Abstract:**

This research project investigates the effects of environmental conditions on Deoxyribonucleic Acid (DNA) through gel electrophoresis testing, aiming to understand how factors such as temperature, UV rays, and precipitation impact DNA integrity in forensic science. The hypothesis posits that these environmental conditions will cause observable changes in DNA when analyzed through gel electrophoresis. The experiment involved exposing raw beef liver to controlled environments of varied temperature, UV radiation, and precipitation. DNA was extracted from each sample, stored appropriately, and later subjected to gel electrophoresis to evaluate the effects. During the investigation, each environmental condition had a corresponding control to ensure accurate comparisons. The DNA extraction process was meticulously performed to maintain sample integrity, followed by storage under optimal conditions until gel electrophoresis analysis. Unfortunately, the results were inconclusive; the extracted DNA, when run through the gel, was not visible, indicating potential issues in the extraction process or the sensitivity of the gel electrophoresis technique used. Despite the inconclusive results, this research holds significant applications and extensions. Understanding environmental impacts on DNA can inform fields such as forensic science, biotechnology, and environmental biology. Future experiments could improve by optimizing DNA extraction and storage protocols, increasing sample sizes, and employing more sensitive detection methods in gel electrophoresis. Additionally, extending the range of environmental conditions and using different types of tissues could provide more comprehensive insights. Ultimately, refining these aspects could lead to conclusive results, enhancing our understanding of how environmental factors influence DNA stability and integrity.

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

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| Word Count | Fair Category | Project Number |
|---|---|---|
| 149 | LS | 3014 |

**Title:** Modeling Microalgae Growth and Ecosystem Dynamics Under Ocean Acidification: Logistic Mapping & LSTM Models and Complex-Plane Extensions of the Lotka-Volterra Equation

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

**Abstract:**

Ocean acidification significantly impacts marine ecosystems, particularly microalgae growth, which plays a fundamental role in carbon sequestration and marine food webs. This study develops a multi-layered mathematical modeling approach to predict microalgae growth and ecosystem stability under varying pH conditions. A logistic mapping model captures fundamental growth dynamics, highlighting population fluctuations under acidification stress. To enhance predictive accuracy, a hybrid model integrating logistic mapping with Long Short-Term Memory (LSTM) networks leverages experimental data to refine growth forecasts. Additionally, the Lotka-Volterra equation is extended into the complex plane to analyze nonlinear interactions between microalgae and other marine organisms. This approach reveals how acidification-driven changes influence species interactions and ecosystem stability. By combining traditional mathematical frameworks with machine learning and dynamical systems theory, this research provides a robust predictive model for understanding long-term ecological impacts, offering valuable insights for environmental conservation and climate change mitigation efforts.

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

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2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 223 | LS | 3015 |

**Title:** Correlation Between Depth and Transplantation Success Among 3 Coral Species

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

**Abstract:**

Coral reefs, essential for biodiversity and economic value, face significant threats leading to degradation and weakening of reefs. Coral transplantation has emerged as a potential strategy for damaged reefs, but its effectiveness varies based on species and environmental conditions, and specifics are not fully known. This study investigates the impact of the depth factor on coral health and growth during transplantation, measured by the area of live coral coverage (cm). Over 100 coral fragments from three species - Diploastrea heliopora, Favia abdita, and Pachsyseris rugosa - were transplanted at varying depths in the ocean - 6 meters, 9 meters, and 12 meters. Data was collected over a month-long period to asses coral growth rates. It was found that 2 of the species grew better in deeper waters and the other grew better in shallower conditions. The statistical analysis of the data will be conducted by performing a two-way ANOVA. This experiment aims to identify optimal conditions for successful coral transplantation and contribute to understanding coral resilience in changing marine environments. By examining the responses of different coral species to varying depths, this research aims to inform effective conservation strategies and improve overall coral reef restoration efforts. Results from this study will provide valuable information into species-specific transplantation success rates and guide future coral reef preservation initiatives in the face of ongoing environmental challenges.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3016 |

**Title:** The Effects of a Multiple-Day Period of Exercise-Induced Physiological Stress on Resting Heart Rate (RHR). Does Post-Stress Variation in RHR Correlate with Feelings of Fatigue?

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

**Abstract:**

Intentional training overload is an important component of athletic training, and increases athletic ability by stressing the body in a way which forces it to adapt to the demands of a sport. This stress is known to result in muscle soreness and fatigue, and it is expected that the internal systems of the body, including the cardiovascular system, are also affected. This study examined the effects of training overload on heart rate at waking, defined as resting heart rate (RHR) for the purposes of this study. It also sought to determine if RHR followed predictable patterns during training, making it feasible to use it as an index of recovery. Data was collected from athletes engaged in a swim training program, who were asked to provide RHR, and rate the following on a scale of 1-10: muscle soreness, overall fatigue, and workout intensity each day of a six-week period. In order to prevent possible affects on the data, subjects were asked to avoid specified circadian rhythm disruptors; deviations from this, as well as sleep quality, were recorded in their provided graphs. Graphs created from the data showed a positive correlation between increase in workout intensity and increase in RHR. However, RHR did not show a regular pattern during load and unload weeks, with irregularity within and between participants, and did not have either a strong positive or inverse correlation with muscle soreness and overall fatigue. This indicates that it is likely unfeasible to use RHR patterns to determine athlete recovery.

**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
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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 247 | LS | 3017 |

**Title:** Neural Network Interpretation of EEG Scans for Accurate Diagnosis of Asymptomatic Concussions

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

**Abstract:**

Concussions represent a significant public health concern, yet there is no objective diagnostic method available. Current approaches primarily rely on subjective clinical assessments and self-reported symptoms, leading to unreliable concussion detection. Imaging techniques such as MRI and CT scans are often ineffective unless the concussion is severe, resulting in frequent under diagnosis. Accurate diagnosis is crucial, as returning to activity too soon increases the risk of long-term complications, including cognitive impairment, neurodegenerative diseases, and second-impact syndrome— a potentially fatal condition caused by repeated head injuries. This research develops an objective, reliable concussion diagnostic method by using machine learning to analyze electroencephalogram (EEG) data. Studies have shown that concussions alter brain wave activity, particularly increasing delta waves (0.5-4 Hz) and reducing the mean alpha frequency (8-13 Hz), while gamma waves (30 -100 Hz) often increase. Six specific EEG channels were extracted to compute the delta, theta, alpha, beta, and gamma waves, along with their mean values, variance, and line length. Data from 91 subjects (57 concussed, 34 control) were sourced from an open dataset provided by the University of New Mexico Health Sciences Center (UNMHSC), and used to train a neural network for concussion detection. Using TensorFlow, the algorithm classified EEG patterns to determine concussion presence and severity, and achieved 93% accuracy on segregated training data. Ultimately, this research aims to provide a reliable, non-subjective diagnostic tool that could improve recovery outcomes and prevent long-term neurological damage in athletes and others affected by concussions.

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

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

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 179 | LS | 3018 |

**Title:** Assessing the Public's Awareness and Susceptibility to Cyber Attacks

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

**Abstract:**

In 2023, the Internet Crime Complaint Center reported over 21,000 Business Email Compromises with losses over $2.9 Billion. Even today, phishing stands as the most frequent method of cybercrime, with over 3.4 million baiting emails sent daily (Jumpcloud). Recent advancements in AI, such as ChatGPT, have enabled the creation of more sophisticated phishing emails and sites at unprecedented speeds (Jumpcloud). On average, worldwide, it is suggested that it takes more than 49 days to identify a ransomware attack (National University). Despite the increasing efforts for awareness against cyber crimes, many individuals fall victim frequently to cyber attacks. Given this information, it is clear that post-attack prevention to overcome these cyber threats are ineffective. This study surveyed the relationship between educational demographics, age, trust in technology, and the ability to identify phishing attacks. Results revealed consistent challenges in phishing detection across all demographics, with accuracy highlighting the need for improvement in cybersecurity practices. It is clear there is a universal vulnerability to phishing attempts, emphasizing the opportunity to develop targeted education in cybersecurity to enhance awareness about cyber threats.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 231 | LS | 3019 |

**Title:** The Effects of Polyester Microplastics in the soil on Lepidium sativum.

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

**Abstract:**

Microplastics are a growing threat to the environment, negatively affecting both the biotic and abiotic components of ecosystems. They disintegrate over time, leaching chemicals into the soil, altering its properties and its interactions with plants. This investigation aims to observe the impacts of microplastics, causing growth inhibition on garden cress (Lepidium sativum) grown in soil containing polyester (PES) fibers. Experimental soil was prepared by cutting PES yarn into 5mm fibers, mixed into soil, and covered with plastic wrap to maintain soil moisture then incubated for four weeks (19-22 °C). Seeds planted in experimental and control (non-PES) growing containers were grown for four weeks under the same conditions. Growth was monitored for signs of plant stress and growth inhibition at the end of every week. After four weeks, it was found that the average mass of the control group was 0.0986g, which is higher than the experimental group, weighing 0.077g. Plant height and leaf count were similar in both groups. No signs of plant stress were found, except for droopy stems in both groups. This investigation found that PES in the soil can affect aspects of plants' growth, such as mass. Future investigations can incubate PES for a longer time, potentially allowing for more breakdown, and affecting plant growth inhibition. These investigations are important because, in agricultural soil, growth inhibition due to microplastics may prove harmful to both animals and humans.

**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):

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 241 | LS | 3021 |

**Title:** Generating Novel Protein Sequences with Specialized Functions Using LoRA Finetuning

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

**Abstract:**

The purpose of this research is to develop a more cost-effective and time-efficient method for

generating functional protein sequences using generative AI. Current protein language models require

extensive computational resources for fine-tuning, making large-scale applications in biotechnology and drug development impractical. This study investigates the use of Low-Rank Adaptation (LoRA) fine-tuning on the Progen2 protein language model to optimize protein sequence generation while reducing computational demands. To conduct this investigation, protein sequences from three families PF0042 (Globin), PF15800 (Circadian Clock Proteins), and PF00194 (Carbonic Anhydrase) were selected from the Pfam database based on their biological significance. Individual models were fine-tuned using LoRA significantly reducing the number of trainable parameters to 0.5% compared to full-parameter fine-tuning. The generated sequences were then analyzed for functional relevance through sequence alignment using BLAST and HMMER, followed by structure prediction using ESMFold. The results demonstrated that LoRA fine-tuning effectively generated novel protein sequences with high functional similarity to the target families. The generated sequences achieved alignment identity percentages of 52.40% (PF00042), 55.71% (PF00194), and 58.98% (PF15800), indicating strong potential for preserving biological function. Additionally, structural analysis confirmed high-confidence predictions with mean pLDDT scores exceeding 70, further validating the structural integrity of the generated proteins. This study concludes that LoRA fine-tuning is a viable approach for improving the efficiency of protein sequence generation while maintaining functional relevance for applications in synthetic biology and drug development.

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

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

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☐ vertebrate animals ☐ controlled substances

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 226 | LS | 3022 |

**Title:** Hericium erinaceus and Ganoderma lucidum for Alzheimer's and Dementia: Neuroregenerative Effects on C. elegans

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

**Abstract:**

Alzheimer's disease and dementia are debilitating neurodegenerative conditions with limited therapeutic options, necessitating innovative research into potential treatments. In my study, I investigated the neuroregenerative properties of two medicinal mushrooms, Hericium erinaceus and Ganoderma lucidum, using Caenorhabditis elegans (C. elegans) as a model organism. The research focused on evaluating the effects of these mushroom extracts on lifespan, reproductive capacity, stress resistance in response to environmental changes, and their ability to stimulate the nerve growth factor (NGF) gene and β-NGF protein production, which are critical for neuronal repair. To conduct the study, I incorporated mushroom extracts into the agar-based food source of C. elegans. Extract solutions were prepared at varying dilutions (1:10, 1:50, 1:100) to identify optimal concentrations for promoting resilience, longevity, and neuroregenerative activity. Experimental groups of C. elegans were exposed to these diets, while a control group was maintained on standard agar plates without extracts. Data collection included assessments of reproductive output, lifespan extension and resistance to environmental stressors such as temperature fluctuations. The findings revealed that C. elegans consuming mushroom-supplemented agar exhibited improved stress resistance, increased reproductive output, extended lifespan, and evidence of NGF gene stimulation and β-NGF protein activation. These results suggest that Hericium erinaceus and Ganoderma lucidum may enhance physiological resilience and promote neuroregenerative pathways, indicating their potential as natural agents for mitigating the effects of neurodegenerative conditions.

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 249 | LS | 3023 |

**Title:** Age-Related Serotonin Degradation in the Hippocampus: Possible Implications for Cognitive Impairment

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

**Abstract:**

Serotonin is a neurotransmitter that functions to regulate mood, memory, and behavior. Recently, studies have supported that the quantity of tryptophan decreases with age. As tryptophan is the amino acid necessary to produce serotonin, it is hypothesized that serotonin will decline with age due to less availability of tryptophan. This possible degradation of serotonin would result in an impairment in functions serotonin works to regulate. It is predicted that with age, the density of serotonergic neurons and the amount of serotonin present in the brain will progressively decline. For this study, brain images of mice (age groups of 6M, 12M, & 18M) were obtained by Dr. Boltcreed at the Ansorge Lab for a separate study. For this study, these images were analyzed by collecting the optical density of serotonergic neurons in the Dorsal CA1 of the hippocampus. The following regions of the hippocampus were calibrated individually to determine the specific degradation over the stratums of the Dorsal CA1: Stratum Oriens, Stratum Pyramidale, Stratum Radiatum, Stratum Lacunosum Moleculare, and Stratum Moleculare. Once analyzed, the optical densities collected supported a significant decrease in serotonergic neurons from the 6M to 18M age group and from the 12M to 18M age group, but no significant difference from the 6M to 12M age group. This decrease in optical density from the 6M and 12M age groups to the 18M age group supports the degradation of serotonergic neurons seen with age. As a result, this degradation of serotonin may contribute to cognitive impairments associated with aging.

**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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3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 243 | LS | 3024 |

**Title:** Environmental Stressors' Impacting the Efficacy of Natural Antibiotics on Bacteria

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

**Abstract:**

The human gut microbiota consists of a complex community crucial to host digestion, immune modulation, and pathogen resistance. In our daily lives, we tend to rely on the usage of store-bought antibiotics whenever we face a problem. While synthetic antibiotics often display haphazard bactericidal effects which can disrupt mutualistic microbial populations, phytochemicals such as garlic, turmeric, and ginger may have beneficial antibacterial properties with less negative impacts. However, the exact effects that these antimicrobials have under certain environmental stressors may not be potentially understood. This project examines how pH and temperature affect these natural antimicrobials against yogurt-derived gut microbiota model organisms. A total of 125 agar plates were exposed to varying pH levels (acidic, neutral, alkaline) and moderately high temperature (85°F), room temperature (70°F) and cooler temperature (55°F) alongside selected phytochemicals. After 96 hours, bacterial growth was analyzed qualitatively and quantitatively using colony counting. Overall, garlic had the strongest antibacterial effect out of all three. However, the strongest bacteriostatic and bactericidal effect was displayed with ginger in a hotter alkaline environment and hotter acidic environment, significantly inhibiting microbial growth. These insights highlight the potential of using some variations of ginger and in general using garlic as a potent natural antimicrobial under favorable conditions, with applications in probiotic engineering, targeted antimicrobial therapies, and gut microbiota modulation. This project contributes to both the advancement and understanding of sustainable antimicrobial strategies, promoting precision-based interventions in gut health and infection control.

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

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 258 | LS | 3025 |

**Title:** Optimizing A Single Cell RNA-Based Fluorescent Biosensor in Escherichia Coli MG1655

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

**Abstract:**

Antibiotic treatment failure has become a growing concern, as patients with chronic bacterial infections relapse because of resistance or persistence to their medications. Hence, persister researchers are investigating why antibiotic treatment is failing.

Persisters are a small subpopulation that survive treatment among billions of antibiotic-sensitive cells. Currently, most researchers rely on time-consuming microscopy to track surviving cells post-treatment, limiting our ability to study their survival mechanisms.

This study aims to engineer a fluorescent single-cell system to track cells undergoing DNA damage from antibiotics for improved detection of surviving cells via fluorescence-based assays like microscopy, spectrophotometry, and flow cytometry.

We built a plasmid construct including a recA promoter driving expression of a minimally energetically costly fluorescent RNA, F30-Broccoli, which we transformed into Escherichia coli MG1655. Because recA is expressed in the SOS response to DNA damage, fluorescence should indicate antibiotic-induced stress. We use the fluoroquinolone levofloxacin to attempt to induce fluorescence. We screened several recA constructs in vivo for fluorescence levels but observed their signals were lower than the constitutively expressed controls, potentially suggesting F30-Broccoli RNA transcription issues or aptamer stability issues decreasing fluorescence. Consequently, we started qPCR to quantify levels of F30-Broccoli in the samples. One could also screen alternative structures to optimize fluorescence. Furthermore, the levofloxacin treated samples showed lower fluorescence than untreated cells, meaning it could potentially be interfering with the fluorescent signal.

By engineering this tool, scientists can use it to track persisters before, during, and after treatment, improving our knowledge about their mechanisms of survival.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** CB MI 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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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
5. My display board includes photographs/visual depictions of humans (other than myself or my family):

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 258 | LS | 3026 |

**Title:** Treating APOE4-induced TGFβ-mediated Perivascular Fibrosis-driven Blood-Brain Barrier Dysregulation in Alzheimer's Disease with Pulmonary Fibrosis

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

**Abstract:**

Alzheimer's disease (AD) is a debilitating form of dementia that affects 416 million patients worldwide. Present in 1-in-4 people, the most common genetic risk factor for AD is the APOE4 gene, with the APOE4/4 genotype being up to twelve times as likely to develop AD as their APOE3 counterparts. Literature has documented a close relationship between APOE4 and fibrogenesis, an umbrella pathology that causes TGFβ upregulation, which leads to pericyte-to-myofibroblast transition (PMT) and overall blood-brain barrier (BBB) dysregulation. The compromise of the BBB results in ischemia, microbleeds, and other AD-induced cognitive deficits. Thus, the goal of this study was to prevent BBB dysregulation by identifying and targeting a specific restriction point upstream on the disease pathway by using repositioned drugs: existing FDA approved drugs for other diseases with useful pharmacokinetic mechanisms of actions. To do so, cocultures of IPSC-derived pericytes and endothelial cells were differentiated and split into three treatment groups: APOE3 + Vehicle (Healthy control), APOE4 + Vehicle (Diseased control), and APOE4 + 300 nM of repurposed drug (Experimental group). Cells were then stained and imaged for αSMA, a canonical biomarker of PMT, via immunofluorescence microscopy and followed by statistical ANOVA in Graphpad Prism. Here, we report that Pirfenidone and Nintedanib, currently approved for idiopathic pulmonary fibrosis, reduced αSMA in mural cells, suggesting that these drugs could prevent BBB dysregulation-induced cognitive deficits. Given the cost advantage of launching repositioned drugs compared to de-novo drugs, our findings open up a promising and cost-effective direction for developing treatments for APOE4-induced AD.

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

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

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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):

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 249 | LS | 3027 |

**Title:** Determining the Correlation between Physicians' Perspective on Cannabis Legalization and Physician Comfort Discussing Cannabis Use with Youth Patients

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

**Abstract:**

In 2021, recreational cannabis use was legalized in Connecticut. While some studies suggest that recreational cannabis legalization has no impact on adolescent substance use, others show that adolescent cannabis use increases post-legalization. Early onset, heavy cannabis abuse while the brain is still developing is strongly correlated with decreased cognition, damage to brain structure, and lower IQ. Physicians, as primary healthcare providers in a youth's life, are crucial to identifying and treating youth cannabis abuse. This project will seek to identify if there is a correlation between a physician's personal opinion about recreational cannabis legalization and how comfortable physicians feel approaching the subject of cannabis abuse with their youth (child and adolescent) patients. The hypothesis is that if physicians have negative personal beliefs, they will feel more comfortable talking about cannabis abuse with their patients. The independent variable is participants' personal beliefs about legalization of cannabis and the dependent variable will be physicians' comfort towards approaching the topic of cannabis use with patients. Students examined participants' answers to two specific questions, "I think the legalization of cannabis is a step in the right direction" and "I feel comfortable discussing the risks of cannabis use especially in children or adolescents." Student used a correlation matrix to identify if there is a statistically significant correlation between participants' numerical answers to the IV and DV questions. This study will provide more information about the current state of physicians' comfort surrounding discussing recreational cannabis misuse with their youth patients, and potential correlating factors.

**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):

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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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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 246 | LS | 3029 |

**Title:** Invasive Disease Management and Climate Change Adaption

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


**Abstract:**

Ecosystems have evolved for millions of years, untouched by the threats they face today like Chestnut Blight, Emerald Ash Borer, Hemlock Woolly Adelgid, Oak Wilt, and Beech Leaf Disease,fueled even more by a rapidly changing climate, destroying the delicate balance nature has maintained.

Negative impacts include widespread keystone species death, disruption of forest ecosystems due to canopy loss, altered soil conditions, less shade in streams and waterways for aquatic species, loss of recreational and scenic resources, hotter temperatures, reduced biodiversity, and potential impacts on wildlife that rely on hemlock forests for shelter and food.

For this reason, it is important to develop means of identifying, managing, and controlling some of the most destructive organisms present in our ecosystems to this date. This will help save the remnants we have and prevent further destruction.

We can develop new methods or use existing methods to treat, eradicate, and prevent diseases like the ones named above by applying fungicides and soil injections, though ideally, noninvasive methods that don't have more negative impacts than they are meant to mitigate. These Methods can be applied in any setting where these species are present. They can be used by state parks and preserves, private landowners, and cultivators.

This project aims to help mitigate the negative impacts climate change has on biodiversity loss and to help protect, restore, and safeguard ecosystems with the long-term goal of increased awareness, knowledge, and resilience that will help us now and long into the future.


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

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

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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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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 254 | LS | 3030 |

**Title:** SEMI-CONDUCTOR: Sustainable Electronics using MIcrobe based CONDUCTOR

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

**Abstract:**

Did you know that an average person generates of about 17 lbs of electronic waste or e-waste every year. That is about 130 billion lbs of e-waste every year for the entire humanity and only a quarter of it is recycled. E-waste contains Hg, Pb and Cd that contaminate soil and water with far reaching risk to human and animal health

Biodegradable electronic devices are designed to decompose naturally and promise a path towards a greener and cleaner planet. Microbial fuel cells (MFCs) are an example of biodegradable devices that use microbes to produce electricity from organic materials. However, the power output is typically very low and not practical and scalable.

Cable bacteria are a unique kind of multi-cellular and filamentous bacteria found in aquatic environments, like the salt marshes along the Connecticut coast. They can transfer electrons over long distances, up to 3 cm, by connecting themselves together to form a long chain or cable.

The goal of this project is to build and test a novel MFC using cable bacteria and demonstrate significant improvement in power generation over traditional MFC. The experimental results clearly demonstrated that the cable bacteria MFC showed 3x improvement in output voltage, 13 x improvement in output power and about 4x improvement in power generation rate. This is a very promising result that shows the disruptive potential of cable bacteria. Also, it underscores the potential of CT salt marshes for creating an industry for biodegradable devices and making CT a leader in sustainable electronics.

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

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

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

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 209 | LS | 3031 |

**Title:** MTWSI-Net: Towards Improved Multi-Task Whole Slide Image Classification with Contrastive Learning

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

**Abstract:**

Pathology is a digital technology for the capture and analysis of high-resolution Whole Slide Images (WSIs). WSI entails scanning glass pathology slides, typically containing tissue samples, into a digital format. This facilitates comprehensive digital viewing, analysis, and interpretation by pathologists. Despite the undeniable utility of this method, the inherent time-consuming and labor-intensive nature of traditional pathology image analysis, which is heavily reliant on expert pathologists, is well-known. Recent years have seen a surge in research aiming to address these challenges through the development of automated systems using machine learning approaches. While promising, such systems often exhibit bias towards specific datasets and struggle to transition effectively to real-world scenarios. For this reason, there is a need to establish a uniform machine learning training approach for generating more robust and consistent results. In this paper, I introduce a contrastive learning-based multi-task whole slide image classification system. The proposed system excels at extracting consistently reliable features for identical cancer categories, thereby enhancing accuracy in downstream tasks. Through extensive experiments, the results demonstrate that the proposed system outperforms pre-existing state-of-the-art machine learning models. I expect that the proposed system can significantly contribute to pathologists by offering valuable cancer screening capabilities in WSIs.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 234 | LS | 3032 |

**Title:** Global Spatiotemporal Analysis of Interactions between Urban Heat Islands and Heat Waves

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

**Abstract:**

Heat waves (HWs) combined with urban heat islands (UHI) intensify extreme heat exposure, posing significant public health risks. Previous studies have provided limited regional insights, but global patterns of UHI-HW interactions and their underlying drivers remain unclear.

This study utilized the Community Land Model (CLM) to simulate global UHIs from 1985 -2013, analyzing their interaction with HWs across various climate zones. The CatBoost machine learning model and SHapley Additive exPlanations (SHAP) framework were employed to quantify contributions of energy fluxes, climate conditions, and land characteristics. Satellite and climate input data for the simulation was carefully selected and examined.

The study found distinct diurnal patterns in UHI-HW interactions, peaking at 6 AM and significantly stronger at night than during the day. Key drivers included local sensible heat flux, 10-meter wind speed, and urban-rural contrasts in net longwave radiation, though their impacts varied across Köppen–Geiger climate zones. Continental climates showed the strongest positive synergy, whereas tropical regions exhibited high variability due to moisture dynamics.

The findings underscore the complexity of UHI-HW interactions and emphasize the need for tailored region-specific urban climate strategies. Hourly analysis of UHIs offers valuable insights for targeted climate adaptation, public health interventions, and optimized energy management strategies. Combining machine learning with SHAP attribution provides a robust framework for understanding these complex, non-linear relationships, supporting more effective urban planning and policy development in a warming world.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 113 | LS | 3034 |

**Title:** Nanoparticle Encapsulation of Naloxone to Improve Potency and Longevity of the Opioid Antagonist

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

**Abstract:**

Although Naloxone has been the gold standard for opioid-related emergencies for the past several decades, it can be improved via nanoparticles. This experiment aims to determine if the PLGA, PEI, and PHEMA nanoparticles can encapsulate a Naloxone complex. The data was measured through UV-spectroscopy absorbance values. These values of the emulsified nanoparticle-Naloxone complex were then compared to various other control tests to determine if the encapsulation was successful. The PLGA had a high encapsulation efficiency, the PEI had a moderate encapsulation efficiency, and the PHEMA did not show signs of encapsulation. The data from this experiment can be used to measure the drug's performance with the PLGA and PEI nanoparticle.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** CH 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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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 247 | LS | 3035 |

**Title:** Comparing Patient Quality of Life in the First 12 Months Post-Op of Bone Regrowth and Metal Implant Surgeries

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

**Abstract:**

Sarcomas, a type of tumor, can develop in both hard and soft tissues of the body due to uncontrolled cancerous cell growth. When sarcomas affect bones, standard treatment involves a combination of chemotherapy and surgical intervention to excise the tumor. Two primary surgical approaches are employed in such cases: natural bone regrowth and metal implant surgery. It is generally assumed that metal implants offer a faster recovery compared to the natural bone regrowth method. This study challenges the prevailing assumption by investigating whether there is a significant difference in the quality of life and recovery rates between patients undergoing the two surgical methods within the first twelve months following surgery. It was predicted that there would be no statistical difference in the recovery of the two groups. Lab and on-site physical performance test data were collected from MSKCC 2018-2025 and analyzed in 2024/2025 using the coding language R for data organization and visualization. It was found that when looking at mineral concentrations in the bloodstream and performance on physical fitness and ability tests for range of motion and percent weight bearing on the affected limb, two signs of recovery and quality of life of patients, there was no statistical difference between patients who had undergone the two different surgery methods. Focusing on the initial twelve-month postoperative period is particularly relevant for patients with less favorable cancer treatment outcomes, as it may guide their decision toward a surgical option that optimizes short-term quality of life.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 264 | LS | 3037 |

**Title:** Impact of Comorbid Substance Use Disorders on Ketamine Treatment Efficacy in Veterans with PTSD

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

**Abstract:**

Veterans experience PTSD at significantly higher rates than civilians, with many showing resistance to traditional antidepressants. Ketamine is a novel treatment for PTSD and MDD; however, its efficacy may be influenced by biomarkers such as Brain-Derived Neurotrophic Factor (BDNF) and Interleukin-6 (IL-6), as well as comorbid substance use disorders (SUDs) like Alcohol Use Disorder (AUD) and nicotine dependence. This study aimed to determine whether baseline IL-6 and BDNF levels, along with AUD and nicotine dependence, could predict ketamine treatment response in veterans with PTSD and MDD. Methods: Data from a 2022 double-blind, randomized, placebo-controlled clinical trial were analyzed. The study included 152 veterans with moderate to severe PTSD who had failed at least three FDA-approved antidepressants. Baseline BDNF and IL-6 levels, along with AUD and nicotine dependence, were examined as independent variables, while ketamine treatment response was the dependent variable. Statistical analyses, including chi-squared tests and t-tests, were conducted to assess the relationships between these factors and treatment outcomes. Results: Chi-squared analysis found no significant difference in overall response rates between veterans with and without SUDs (p=0.357), suggesting that AUD and nicotine dependence alone did not strongly predict ketamine treatment response. However, IL-6 levels significantly differed between non-responders with AUD, nicotine dependence, and controls (p=0.03), indicating IL-6 as a potential predictor of non-response. BDNF levels correlated borderline significantly with treatment response for the PTSD control group. IL-6 and BDNF levels may serve as a biomarker for ketamine treatment response among veterans with AUD and only PTSD.

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

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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 259 | LS | 3038 |

**Title:** Understanding Chemoresistance with Mouse Ovarian Cancer Cell Lines

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

**Abstract:**

Ovarian cancer causes ~206,956 deaths across the globe annually. Up to 70% of patients develop chemoresistant disease. New therapies are needed to target these resistant tumors. The lack of reliable in-vitro and in-vivo models for chemoresistant tumors, unknown molecular mechanisms of chemoresistance, and low chemotherapy drug bioavailability present major challenges to ovarian cancer treatments. Generation of syngeneic mouse models, identification of resistance-responsible genes, and development of nanoparticle drug delivery systems provide new therapies for chemoresistant ovarian cancer. We hypothesize that paclitaxel treatment can select mouse ovarian cancer cells with increased chemoresistance and exosomes may serve as unique enhancers of chemotherapy bioavailability. A chemoresistant cell line was established using BPRN101 cells treated with paclitaxel. The established chemoresistant (BPRN101 F2) and parent (BPRN101) cell lines were treated with 7 concentrations of 0-10 µM paclitaxel to compare chemo-response. A celltiter exhibited BPRN101 F2 increased viability with a calculated IC50 of 10,000 nM, a 5-fold increase in resistance compared to IC50 of 2,000 nM for BPRN101. A qPCR test exhibited 3-50 fold gene expression upregulation of BPRN101 F2 genes responsible for enhancing cancer cell survival and epithelial-mesenchymal transition compared to BPRN101. This provides an understanding of chemoresistance-responsible genes. In preliminary testing of nanoparticles, exosomes were produced from purified mouse adipocytes and treated BPRN101 cells. Exosomes did not promote proliferation in-vitro, as luminescence of 0 exosomes compared to 0.01 x 10^6 - 10 x 10^6 exosomes remained within 0.2-0.5 luminescence, indicating similar cell viability. This suggests the possibility of paclitaxel encapsulation to improve drug bioavailability.

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

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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: 261

# CSEF Official Abstract and Certification
2025

Fair Category: LS

Project Number: 3039

**Title:** NeuroScope 360: Development of an Integrated Machine Learning-Based Diagnostic Tool for the Early Diagnosis of Schizophrenia Through a Panel of Blood-Derived and Neuroimaging Biomarkers

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

**Abstract:**

Schizophrenia is a debilitating mental disorder affecting 24 million people. Early diagnosis is essential for treatment, yet nearly 33% of patients are left undiagnosed due to the complexity of diagnostic methods, which use a combination of neuroimaging, physiological evaluation, and family history analysis, making early diagnosis costly and inaccessible.

NeuroScope 360 is an integrated machine learning-based diagnostic tool that utilizes a meta-analysis of blood-derived and neuroimaging biomarkers to improve schizophrenia detection. Three machine learning models—linear regression, logistic regression, and convolutional neural networks (CNN)—analyzed biomarker data from public datasets and assessed their relative importance in diagnosis.

The linear regression model proved success through convergence. Its identified that a correlation between Gamma-Glutamylcysteine Ligase(GCLC) and Tetraspanin 6 (TSPAN6) genes, and tenomodulin(TNMD) and Pseudokinase 3(SCLY3) genes were the strongest indicators of schizophrenia in blood samples. The logistic regression model, trained on the same dataset, had a 92.3% accuracy in diagnosing patients as schizophrenia-positive or negative. The CNN model, trained on MRI scans of schizophrenia-positive patients, identified neuroimaging trends within binary classes to diagnose patients. It achieved a 66% accuracy, which is standard accuracy with an MRI scan.

The integrated model equally weights blood and neuroimaging biomarkers for a holistic schizophrenia prediction. On small test data, it achieved 100% accuracy, though this is expected to drop slight with larger test data. By utilizing machine learning, NeuroScope 360 enhances diagnostic accuracy, accessibility, scalability, and cost-efficiency, and creates a personalized approach to schizophrenia diagnosis, ultimately allowing for early intervention and improved treatment outcomes for schizophrenia patients.

**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):

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 218 | LS | 3040 |

**Title:** Use of Honey as a Microbial Agent Against Bacterial Diseases

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

**Abstract:**

This project is focusing on how well known health foods can be used against bacterial diseases. Right now the result of honey as a microbial agent against my bacteria of choice, Escherichia coli, shows that honey can be used as a microbial agent. I initially thought to use PCR (Polymerase Chain Reaction) to test for resistance but further research showed that using PCR would lead to false negative results.

Honey is a well known health food in many cultures. I wanted to use it as a microbial agent. Microbial agents are substances that can inhibit or kill microorganisms. In my experiment Escherichia coli K-12 strains were used. Petri dishes filled with LB (Luria-Bertani) Broth was used because of its rich amino acids. I tested 3 honey's and over the span of 2 days I saw that the local and manuka honey had the highest bacterial growth rather than the honey with the comb(beeswax).

Further research showed that beeswax does also have antimicrobial properties. This can show that the wax aided in the inhibition of the E.coli K-12 strain.

The data collected was a surprise. I believe that the manuka honey was the best for being a microbial agent. The wildflower honey with comb was the best because of its little to no bacterial growth.

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

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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 253 | LS | 3041 |

**Title:** The Effect of Nrf2 Inhibition Through Bexarotene on the Chemoresistance of Esophageal Squamous Cell Carcinoma and Esophageal Adenocarcinoma Cell Lines.

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

**Abstract:**

Esophageal cancer has a low chance of 5-year survival and successful treatment in its late-stages, with one of the reasons for this being chemoresistance. The activation of the KEAP1/Nrf2 pathway is one of the causes of chemoresistance of cancer cells to Cisplatin treatment. This study is comparing the effectiveness of Bexarotene in decreasing chemoresistance to Cisplatin treatment in an Esophageal Squamous Cell Carcinoma (ESCC) cell line and an Esophageal Adenocarcinoma (EAC) cell line through the targeting of the KEAP1/Nrf2 pathway. A Cell Proliferation Assay, IC50 Assay, Western Blot Analysis, and Combination and Dose Reduction Index will be conducted to compare the effectiveness of Bexarotene at decreasing chemoresistance in an ESCC and an EAC cell line. Additionally, the t-test will be used for statistical analysis. The results of this proposal could start to differentiate which type of esophageal cancer, ESCC or EAC, is best targeted and inhibited by Bexarotene, and by doing so also analyze which type of esophageal cancer is more dependent on the KEAP1/Nrf2 pathway. Therefore, this experiment could contribute to a more successful treatment plan and process for patients with esophageal cancer. Based on past research, the proposed result of this study is that Bexarotene will decrease chemoresistance more significantly in ESCC cell lines than in EAC esophageal adenocarcinoma cell lines. The subsequent research to this study should be making sure Bexarotene treatment is safe for the rest of the body and its protective biological processes as the KEAP1/Nrf2 pathway is a cytoprotective pathway.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 183 | LS | 3042 |

**Title:** Evaluation of Potential Bio-Filtration Enhancements Applied to Municipal Water: Assessing Potential Ways to Reduce Enterococcus Bacteria Levels Discharging From Wastewater Facilities

**Student Name(s):** B. Xochipiltecatl Cuahtepitzi

**Abstract:**

Municipal wastewater treatment efficiency is critical for mitigating environmental impacts, yet conventional chemical or bioremediation approaches often yield suboptimal results when applied independently. In this study, we evaluated three treatment strategies—chemical remediation, bioremediation using nutrient-removing plants, and an integrated approach combining both methods—to determine their effectiveness in fecal bacterial removal under controlled conditions. Our initial trial, conducted without agitation to limit physical mixing, revealed that the untreated control unexpectedly exhibited the highest bacterial removal efficiency, raising concerns that both chemical and bioremediation treatments, when used in isolation, may inadvertently reduce treatment performance. To address this, our second trial incorporated mechanical agitation to enhance the contact rate between chemicals and bacterial populations. Under these conditions, chemical treatment alone demonstrated a significantly diminished removal efficiency, while the integrated approach—characterized by increased circulation and moderated plant exposure—resulted in significantly improved bacterial reduction, 57,746 MPN (integrated) and 14,198 MPN (control) ($p < 0.005$). These findings suggest that optimizing physical mixing parameters and leveraging the fused effects of combined remediation strategies may offer a superior pathway for enhancing the efficiency of municipal wastewater treatment.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3043 |

**Title:** Light-microscopy based connectomics: Achieving dense reconstruction of brain tissue using pan-expansion microscopy and GFP expression

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

**Abstract:**

Connectomics, the study of neural pathways, traditionally relies on electron microscopy (EM) for high-resolution imaging. However, EM is costly and requires specialized expertise, limiting its accessibility. Recent advancements in expansion microscopy (ExM) provide an alternative by using polyelectrolyte hydrogels to expand brain tissue, allowing high-resolution imaging with standard light microscopy. This project studied the potential of pan-Expansion Microscopy (pan-ExM), an improved version of ExM, to enhance dendritic spine annotation accuracy using GFP expression and its implications in ML models. A Thy1-EGFP mouse brain sample was expanded and imaged using confocal microscopy, producing both a pan-channel and a GFP-channel. Annotation was conducted in two stages: a blind pass without GFP expression and a second pass incorporating the GFP layer. A (ML) model was trained using both manual annotations and dense segmentation data. Results indicate that GFP expression improves annotation accuracy, although statistical significance was limited due to small sample size. A McNemar's test showed a trend toward improved tracing accuracy with GFP, but further studies with larger datasets are necessary for validation. Additionally, the ML model demonstrated potential for automating segmentation, achieving Dice coefficients between 0.7 and 0.8. In the future, a 3d U-NET model could be explored due to its efficacy in image segmentation. If validated, this method could serve as a cost-effective alternative to EM, enabling broader access to high-resolution neural reconstructions. This technology could greatly aid connectomics and allow for research into the fundamentals of the human brain.

**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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- ☒ controlled substances

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 229 | LS | 3044 |

**Title:** Improving the Biological Accuracy of Gene Tree Simulations: Comparing Event Rates of Duplication, Transfer, and Loss in Real and Simulated Gene Trees with RANGER-DTL

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

**Abstract:**

Understanding gene family evolution is crucial for studying microbial adaptation, antibiotic resistance, and emerging pathogens. Phylogenetic reconciliation, a key computational technique, infers evolutionary events such as gene duplication, loss, and horizontal transfer within gene families. However, discrepancies between simulated and real evolutionary datasets challenge the accuracy of these models. This study evaluates the biological realism of simulated gene trees generated using RANGER-DTL, a phylogenetic reconciliation software developed in Dr. Mukul Bansal's computational biology lab at UCONN. The key research objective was to determine whether the simulated event rates align with real event rates. To address this, I developed a Python tool to automate the analysis of thousands of real and simulated gene trees using RANGER-DTL. Comparing the real event rates to the simulated rates revealed discrepancies, leading to refinements in RANGER-DTL's simulation parameters for greater biological accuracy of future simulations. My contributions are being incorporated into an upcoming publication, highlighting the importance of biological accuracy in simulations, software, and research. These improvements enhance the reliability of phylogenetic models used in evolutionary biology, leading to better predictions of gene duplication, transfer, and loss events. More broadly, these improvements guide future research in microbiology, genetics, and computational biology. By ensuring that simulated datasets reflect biological patterns, researchers can better understand gene family evolution and reliably study issues like microbial adaptation, the spread of antibiotic resistance, and pathogen evolution.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 123 | LS | 3045 |

**Title:** Predictive Mental Health Diagnostics in Chronic Disease Patients Using Multimodal Machine Learning: A Novel Early Intervention Tool

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

**Abstract:**

Mental Health disorders significantly impact an individual's daily functioning. How they behave, talk, how they feel, think, etc. Yet early detection of these problems go undetected, leading to worsened health issues and outcomes. By using diverse datasets - including those on physiological signals, behavioral trends, and medical history - the model will identify correlation between chronic conditions and mental health possibilities and provide insight on it directly. Using advanced machine learning techniques and various strategies, it is used to provide early detection, improving patient care and reducing healthcare burdens. This project shows the potential of how far AI - driven diagnostics in mental health management can go, connecting AI and technology together within the field of healthcare can ensure the safety and wellbeing of a person.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 197 | LS | 3046 |

**Title:** The Effects of Water Consumption on Polystyrene Consumption in Tenebrio Molitor

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

**Abstract:**

The irresponsible disposal of mass-manufactured plastic has caused widespread environmental damage, including soil degradation, marine life toxicity, and contamination of groundwater. While recycling efforts are essential, they remain insufficient as costly plastic processing plants are inaccessible to many developing countries. Tenebrio Molitor larvae have demonstrated the ability to degrade polystyrene, presenting a potential unique solution to plastic waste. This study investigates how varying levels of water availability influence the rate of polystyrene consumption and degradation in T. Molitor larvae. Six groups of larvae were provided with different amounts of water (0, 0.5, 1, 1.5, 2, and 2.5 mL) along with 15 grams of polystyrene foam. Water was added every four days, and polystyrene consumption and degradation were monitored for 12 days. The final masses of remaining polystyrene were compared to assess the effect of moisture levels. Experimental data suggests that moisture levels significantly impact the degradation efficiency of T. Molitor as results show that larvae with moderate water levels (1-2.5 mL) consumed more polystyrene than those in the 0 mL group, which also had significant larval mortality. Specifically, the group given 2.5 mL of water consumed 3 times more polystyrene than the group given 0 mL.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 189 | LS | 3048 |

**Title:** The Effects of Vitamin D Supplementation on Muscle Function in C. elegans with a Mutation in a Dystrophin Gene

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

**Abstract:**

Duchenne Muscular Dystrophy (DMD) is a genetic disorder that causes progressive muscle wasting and weakness. This occurs because of mutations in the dystrophin gene, which is essential for maintaining the integrity of muscle cells. DMD's impact extends beyond physical limitations, significantly burdening affected individuals and their families emotionally and financially. Vitamin D has improved muscle strength in children with DMD and in DMD mouse models. This research aims to investigate the potential benefits of vitamin D supplementation in a Caenorhabditis elegans (C. elegans) model of DMD. In this model, vitamin D3 (0.001-0.1 mM) improved longevity and locomotive behavior and reduced reactive oxygen species levels, suggesting potential protective effects against muscle damage. Although these initial findings are encouraging, more extensive research is necessary to comprehend the long-term advantages and molecular mechanisms underlying vitamin D3's therapeutic impact on DMD. This research provides promising preliminary evidence that vitamin D supplementation could be an affordable and accessible strategy to improve muscle function and potentially extend the lifespan of individuals with DMD. Further investigations in mammalian models are warranted to validate findings and explore vitamin D's full therapeutic potential in DMD treatment.

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 258 | LS | 3049 |

**Title:** RNA-Based Aptamers Targeting Claudin-5 Protein in Blood as a Biomarker for Suicidal Behavior

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

**Abstract:**

Suicide is a global public health crisis, with a pressing need for early detection markers to help at-risk individuals. Claudin 5, an essential protein in the blood-brain barrier, has been linked to neuroinflammatory processes implicated in suicide risk. Recently, the Claudin 5 protein has been identified in the blood samples of patients having suicidal tendencies and could be a potential biomarker of suicide. Aptamers are short, single-stranded DNA or RNA molecules that bind to specific targets with high affinity and specificity. In this research work, I will be working on computationally designing the aptamers that can bind to this protein and be used to detect these proteins. This research work aims to design aptamers that can be used as a detection tool for suicidal tendencies. I hypothesize that the aptamer binds to the extracellular loops of the Claudin-5 protein and can be used for the early detection of suicide risk. AlphaFold 3 was used to predict the structure of Claudin5 with high accuracy. VFOLD2D and VFOLD3D tools modeled the aptamer's structure to enhance its binding efficiency. The interaction between Claudin5 and aptamers was analyzed through molecular docking using HDOCK2.0. The aptamers were selected based on the aptamer binding to the Claudin-5 extracellular loops, binding energy by PRODIGY software and the number of interaction by PLIP analysis were computed. Results showed that aptamer NV_60 and NV_57 bind strongly to the Claudin-5 and could be used in detection. The research will help developing novel biomarker thus paving the way for diagnostic method.

**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):

☐ 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 256 | LS | 3050 |

**Title:** Equine and Human Heart Rate Variability Synchronization as a Model for Potential Atrial Fibrillation Treatment

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


**Abstract:**

Atrial fibrillation (AF), the most common type of cardiac arrhythmia, is a growing global crisis. In 2017, 37,574 million cases of AF were diagnosed and projections forecast an increase by more than 60% by 2050. Yet currently available treatments are invasive and yield poor prognoses. Relatedly, studies have shown that equine hearts synchronize with their herd members' heart rhythms, and cause nearby human hearts to transmit at their same frequency. But it was unclear if a specific beat-to-beat correlation existed between humans and equine hearts, such as would be applicable to AF treatment. This study began exploration of a novel AF treatment method, using the equine heart as an external "device" which can impact the rhythm of the human heart, non-invasively correcting an arrhythmia such as AF. It aimed to demonstrate that proximity to an equine's heart causes synchronization of the human participant's heart rate variability (HRV), or variability in heart rate inter-beat intervals, with the equine's. This study used Polar H10 electrocardiogram monitors to measure the HRVs of both equines and humans while in proximity. Kubios HRV analysis software calculated RMSSD, SDRR, and pNN50 ratios, which indicate heart rate beat-to-beat activity over time, for both data sets, and case study analysis indicated a statistically-significant correlation between these analysis values in the equine and human participants. This indicates the equine heart's ability to precisely influence human heart rhythms. This project contributes towards the eventual goal of building an equine heart inspired medical device which allows for effective AF treatment.


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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 251 | LS | 3051 |

**Title:** Differences in Proliferating and Non-Proliferating Oligodendrocyte Precursor Cell Morphologies

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

**Abstract:**

When axons are demyelinated, loss of motor function occurs and oligodendrocyte precursor cells must proliferate to replenish the pool of OPCs available to differentiate into remyelinating oligodendrocytes. For future therapies, it is highly ideal to find a way to identify and target the proliferating OPCs which are known to have diverse morphologies. This research was done to examine if there was an association between the complexity in branch morphology and OPCs' likelihood to proliferate as a potential way to distinguish between non-proliferating and proliferating OPCs. OPCs that have a higher proliferation likelihood were hypothesized to have simpler morphologies.

Six 10 days old and six 20 days old NG2 Tdtom mice brains were cut into 150 uM pieces and quadruple stained using IHC over 5 days with mcherry, brdu, for dapi and pdgfra. OPCs in the corpus callosum were imaged and the cells' 3d reconstruction were processed in Image J and quantitatively analyzed for differences in branch complexity. For the OPCs in P10 mice, proliferating cells seem to have simpler branch morphologies in that they have shorter total path length, fewer primary branches, and fewer total paths. As for the OPCs in P20 mice, there was no big difference in complexity. The primary limiting factor was the sample size. An extension of my research would be to obtain better visibility by using another channel/mouse line. In the future, knowledge of OPC morphology in relation to likelihood of differentiation can be used to elucidate the mechanisms for people suffering from demyelination.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 230 | LS | 3052 |

**Title:** How nutritive versus non-nutritive sweeteners affect sleep quantity in drosophila melanogaster.

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

**Abstract:**

Artificial sweeteners, widely used as low-calorie sugar substitutes, have become increasingly prevalent in modern diets over recent decades. While they are often associated with weight management benefits, their potential physiological effects remain underexplored. Sleep, a critical physiological process for maintaining metabolic homeostasis, cognitive function, and overall health, has not been widely studied in relation to artificial sweetener consumption. This study investigates the impact of nutritive (sucrose) and non-nutritive (sucralose, aspartame) sweeteners on sleep quantity in Drosophila melanogaster, a well-established model organism for sleep research. The hypothesis posits that artificial sweeteners may disrupt sleep patterns. The groups exposed to artificial sweeteners (sucralose, aspartame) will exhibit the most significant deviations in sleep quantity compared to the control group. Using a liquid food media system infused with 5% sweetener solutions, flies were divided into control and experimental groups. Sleep activity was quantified across three intervals (Days 1, 3, and 5) using infrared cameras to record 24-hour activity, with sleep operationally defined as periods of inactivity lasting five or more minutes. Preliminary findings suggest that artificial sweeteners alter sleep duration compared to the control group, highlighting potential physiological trade-offs associated with their consumption. These results may hint at a possible role of artificial sweeteners in disrupting the gut microbiome, a factor that warrants further investigation to better understand how dietary choices influence essential processes like sleep and overall health.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 203 | LS | 3053 |

**Title:** The Effects on Carbon Dioxide on Cognitive Function in Athletes

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

**Abstract:**

Cognitive functioning plays a crucial role in athletic performance, influencing decision-making, reaction time, and overall performance on the field. Many factors, including age, education, drugs, and diet, have been shown to impair or in some cases, improve cognitive function, but environmental factors, particularly air quality, remain understudied, especially in athletic settings. This research study focuses on how CO2 exposure affects cognitive performance in two groups of high school athletes—swimmers and track and field athletes—through cognitive assessments(Montreal Cognitive Assessment) and CO2 concentration measurements in playing facilities via the use of a CO2 probe. The study hypothesizes that higher CO2 levels will impair cognitive function and therefore athletic performance as well, with endurance athletes showing a greater natural tolerance for CO2 than sprinters and burst-activity athletes (eg throwers and jumpers). Data will be collected across each of the sport's respective seasons, and statistical analyses, including ANOVA and ANCOVA, will be used to assess cognitive variations between groups and other factors. The findings are expected to help contribute to a better understanding of how environmental factors can impact athletic performance and may inform strategies for bettering training environments for the sake of athletic performance as well as cognitive resilience among athletes.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 197 | LS | 3054 |

**Title:** Surgical Approaches for the Treatment of Cervical Spondylolisthesis: Current Evidence on Complications and Patient Outcomes

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

**Abstract:**

Cervical Spondylolisthesis (CS) is the slippage of one vertebra over another in the neck due to instability. It can lead to cervical myelopathy and radiculopathy, both of which may cause nerve pain and neurological symptoms. Although less common than lumbar spondylolisthesis, CS is still present, and there is limited evidence on its surgical treatment and patient outcomes. The aim of this study is to develop a better understanding of the incidence, severity, and surgical treatments of CS to determine the percent improvement after surgery. PubMed and Clinical Trials databases were used to find publications of 485 papers, and were then transferred to the portal Rayyan to conduct the three stages of elimination: title level, abstract level, and full-text level. The publications were narrowed down to six papers and the data was organized into three tables: demographics, radiological report, and patient reported outcomes. Additionally, the quality of each paper was assessed using the methodological index for non-randomized studies and bias was calculated when applicable. It was observed that there was no standard definition of treatment of CS. In addition, we found variability in what clinical measures were used to follow patients and determine if they improved.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3055 |

**Title:** Investigating the Impact of the Presence of Serotonin Neurotransmitters on Human Brain Development and Function through Ca++ Imaging

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

**Abstract:**

Serotonin is a hormone and neurotransmitter involved in various prominent roles, such as improving mental health, repairing damaged tissue, and regulating the central nervous system. Previous studies have developed GCamp6s proteins that demonstrate optimal performance for detecting and imaging serotonin dynamics, with increased sensitivity, resolution, and kinetics. Although these sensors are most effective in imaging neurotransmitter release and activity, specific targeting for high resolution of serotonin release in cortical brain organoids has not been discovered. This project aimed to examine brain neuronal activity based on serotonin application to cortical organoids through the treatment of a GCamp6s protein and Ca++ imaging. The hypothesis was that if there is a presence of serotonin neurotransmitters in cortical brain organoids, brain neuronal activity would have greater spontaneity as serotonin receptor activation is linked to downstream neuron membrane activity, visible through the fluorescent coloration in Ca++ imaging dynamics. The independent variable was the presence of serotonin neurotransmitters. The dependent variable was brain neuronal activity, monitored through a confocal microscope, demonstrating coloration of the brain organoids by the fluorescent sensors. In a lab, the cortical organoids were treated with GCaMP6s, calcium indicators that provide ultrasensitive detection of single neuronal action potentials. After serotonin treatment, the activity was measured through Ca++ imaging with a confocal microscope, with computational imaging data provided by the time and fluorescence of the neuronal activity. This project will enable the discovery of improved approaches to mental health problems, targeted drug development in neurology, and effective treatments to therapy psychiatric and neurological conditions.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 252 | LS | 3056 |

**Title:** Is My Medicine Making Me Sick? Linking Generative Pre-Trained Transformers with Python to Provide Insight on Side Effects of Medication

**Student Name(s):** P. Noe

**Abstract:**

Medications are used to treat diseases ranging from acute conditions like infection to chronic conditions like heart arrhythmias or high blood pressure. While medications are generally safe and helpful, in some patients adverse events can occur ranging from mild side effects to severe conditions requiring medical attention. Patients are typically provided with an information package at their pharmacy when they receive their prescription. However, serious side effects may begin long after a patient starts a medication, causing their association with the medicine to be missed, particularly if the information package has been discarded or was not read. Sometimes, side effects can masquerade as worsening of the underlying condition being treated. In these cases, the proper medical intervention may come too late or be missed altogether. MedGPT is a web-based tool that asks patients about their medications and adverse effects they are experiencing. It asks follow-up questions if needed, identifies what the patient may be experiencing and makes recommendations for resolution. MedGPT's accuracy was assessed by a panel of three physicians who simulated scenarios with seventeen different medications – typically probing 1-2 adverse effects for each medicine. In each case, MedGPT provided sound recommendations for patient follow-up with their physician. MedGPT can be an important tool for improving patient-physician interactions and the safety of pharmaceutical use. Future enhancements will focus on enabling access through health system patient portals and incorporating the web URL or a QR code on the medication label to facilitate contemporaneous access as adverse effects are suspected.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 237 | LS | 3057 |

**Title:** Evaluating the Antifungal Potential of Citronella and Cassia Essential Oils at Different Concentrations Against the Mycelia Growth and Sporulation of Bipolaris sorokiniana

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


**Abstract:**

The study investigates the antifungal properties of citronella (Cymbopogon nardus) and Cassia (Cinnamomum cassia) essential oils (EOs) against the mycelial growth and sporulation of Bipolaris sorokiniana, a pathogenic fungus responsible for spot blotch disease in wheat. This disease significantly impacts crop yields, particularly in warmer climates. The experiment aimed to evaluate the inhibitory effects of citronella and cassia EOs at three concentrations (0.01%, 0.1%, and 1%) in vitro. The findings revealed that cassia EO at 0.1% was the most effective in inhibiting fungal growth and sporulation, demonstrating comparable efficacy to the higher 1% concentration. This suggests that 0.1% cassia EO is a more efficient option, reducing costs and potential cytotoxicity while maintaining antifungal activity. The superior performance of cassia EO is attributed to its high cinnamaldehyde content, which disrupts fungal cell walls and inhibits reproduction. Citronella EO, containing compounds such as citronellal and geraniol, also showed antifungal activity but was less effective compared to cassia EO. These results show cassia EO's potential as an eco-friendly alternative to chemical fungicides, addressing the increasing demand for sustainable agricultural practices. However, the study's in vitro nature presents limitations, as results may not fully translate to in vivo agricultural applications. Future research should focus on testing cassia EO on plants to evaluate its cytotoxicity and efficacy under real-world conditions. This work contributes to the development of natural fungicides that are both effective and safe, promoting healthier crop management practices.


**Technical Disciplines Selected by the Student (Listed in order of relevance to the project):** 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 207 | LS | 3058 |

**Title:** Comparing the Intensity of Perkinsus marinus in the Eastern Oyster (Crassostrea virginica) against weight and size of the oyster.

**Student Name(s):** c. crain


**Abstract:**

Since the discovery of Perkinsus marinus as the cause of dermo disease in Crassostrea virginica ( Eastern Oyster), temperature and seasonality have long been identified as the main environmental drivers of parasite prevalence. The influence of host size and weight on infection intensity, however, remains poorly understood. This study aims to investigate how oyster height, weight, and water temperature affect the intensity of P. marinus infection. A total of 60 oysters will be collected from five locations along the Long Island Sound (n=12 per site). Infection intensity will be assessed using Ray's Fluid Thioglycollate Medium ( RFTM) method and quantified by evaluating the disease's volume and giving it a score using the Makin scale. By comparing pre- and post-magnification intensity scores, I expect to see a significant increase in intensity in oysters larger than the average weight and height during warmer testing months ( > 65 °F ). As P. marinus cells are released on a diurnal cycle, all oysters will be collected during the hottest and brightest period of the day between the months of January and May. I hypothesize that larger infected oysters contribute disproportionately to the abundance of transmissive parasites in the water column, highlighting their potential role in disease dynamics and the need for targeted management strategies


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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 212 | LS | 3059 |

**Title:** WakeWatch: Giving a peace of mind to sleepwalking patients

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

**Abstract:**

Sleepwalking poses significant risks to both the individual and those around them, affecting health by leading to sleep deprivation and disrupting daily sleep schedules. This can result in increased fatigue and insomnia. Developing a detection system to alert household members or emergency contacts could lower casualty risks and ensure safety.

The proposed handheld device features a Xiao NRF52840 microcontroller, an accelerometer to differentiate between movement and rest, a BPM sensor to determine sleep status, and a touch display for user interaction. It detects walking and checks the user's BPM. If the BPM is below a certain threshold, it classifies the user as sleepwalking and alerts them with a buzz. Initially, the threshold is set at 50 BPM, typical for a sleeping person.

To differentiate between walking and resting, raw data is collected from both activities and analyzed using a machine learning model. This enables the device to accurately identify movement patterns. The touch display allows users to prevent unnecessary emergency alerts if they are awake when the device buzzes. By integrating these features, the device aims to enhance safety and reduce sleepwalking risks. This approach could provide peace of mind for individuals and their families, ensuring a safer environment during sleep. The device's effectiveness relies on precise data analysis and user interaction.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 230 | LS | 3060 |

**Title:** Mitigation of Cyclohexane Concentrations in Drinking Water using Photosynthetic Chlorophyll

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

**Abstract:**

Over the past couple of decades, environmental issues have been rising, and one of the biggest issues faced today is the decline of water quality. Only 2.5% of the water on Earth is fresh and drinkable. Due to infrastructure and other issues, this fresh water gets contaminated with many harmful chemicals (Dhar 1). Cyclohexane is one of the many harmful toxic chemicals affecting water sources today; it can cause headaches, dizziness, lightheadedness, and even damage to the liver and kidneys. Titanium Dioxide is often used to "purify" water contaminated with Cyclohexane, but this method of purification can cause titanium dioxide nanoparticles to pollute the water. This can cause health hazards, such as the development of pathological lesions in the liver, spleen, kidneys, and brain. Titanium Dioxide requires UV light for photocatalysis, and its role as a radical producing photo-catalyst is similar to that of chlorophyll. This study explored how chlorophyll can be used as a cheaper and more sustainable alternative for degrading Cyclohexane in wastewater. The results show through gas chromatography readings that with varying exposure to light and varying amounts of chlorophyll, overall chlorophyll can be used to decrease the amount of cyclohexane in water. Future research should detail more research into how chlorophyll can be used to degrade other harmful chemicals in wastewater, along with more research into using chlorophyll as a degrading agent in wastewater overall.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 223 | LS | 3061 |

**Title:** The Determination of Effects due to 500 Hertz Anthropogenic Noise Pollution on the Behavior and Vitality of Diadumene lineata

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

**Abstract:**

Marine organisms such as corals are negatively impacted by sound pollution. With over fourteen percent of the world's coral reefs extinct, all measures must be taken to try to prevent their further irreversible impacts. It is proposed that unregulated noise pollution from boat traffic contributes to the synergistic impacts. This experiment aims to expose Diadumene lineata to five-hundred hertz sound to induce negative effects on their health. By being exposed to this sound for twelve hours each day, the organisms will become stressed and start to increase their metabolic activities and increase the ammonia and nitrite levels surrounding them. Across two trials, the ammonia and nitrite levels showed significantly higher concentrations in the water as compared to the control trials, with the ammonia reaching 2.0 mg/L in the first trial and 0.8 mg/L in the second as compared to the control trials only reaching 1.4 mg/L in the first trial and 1.2 mg/L in the second trial. Alongside this, the nitrite reached 0.4 mg/L in the first trial and 1.0 mg/L in the second trial, as compared to 0.05 mg/L in the first control trial and 0.5 mg/L in the second. This data supports the proposal that sound pollution from boat traffic negatively affects marine anemones and can help environmentalists better conserve coral reefs.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** AS 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 252 | LS | 3063 |

**Title:** Investigation of the Effect of Different Microplastic Concentrations on Seed Production and Growth of Brassica rapa, the Wisconsin Fast Plant

**Student Name(s):** N. Iwasaki-Medzhitova

**Abstract:**

Microplastics are introduced into the agricultural system, where it enters the soil of the plants, which goes up to the roots, stems, leaves, and fruits. However, the impact of microplastics on seed production remains unclear. Previous research only demonstrates microplastics' negative effects on seed germination, but not seed production. In this study, we examine the impact of microplastics on the growth and seed production of Wisconsin fast plants in a dose-dependent manner. Three conditions have been set up; 0%, 1%, and 5% microplastic concentration in soil. For each concentration, eight independent wells were seeded with four seeds per well. The wells were placed in a self-watering system underneath a LED light with 24-hour exposure. The growth of each seedling was measured every other day. The data collected showed a significant decrease in the growth and seed and pod production of the 5% microplastic concentration group, while both 0% and 1% concentration groups had similar results. The control group produced 7 pods and 31 seeds, while the 1% concentration group produced 6 pods and 30 seeds, and the 5% group produced 1 pod and 2 seeds. Results have led to the conclusion that microplastics have a negative effect on plant growth and seed production in high concentrations, but have less of an effect in lower concentrations on the growth and seed production of plants. It is possible that plants exposed to microplastics in low concentrations are able to overcome inhibiting effects of the stressor and acquire resistance to the microplastics.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** PS 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 251 | LS | 3064 |

**Title:** Using Computer Modeling to Determine the Most Accurate and Predictive Trading Stocks Strategy for Market Direction in Terms of Profit

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

**Abstract:**

Trading stocks is buying and selling shares of a company to make short-term profit. Trading strategies are used to aid in determining whether to buy or sell shares in order to gain profit by predicting the market direction. In this study, the goal is to determine which trading strategy, Auto Fibonacci Retracement (AFR), Reversal Signals (RS), Support and Resistance Levels with Breaks (SRLB), or Trendlines with Breaks (TB), earns back the most money from predicting market direction the most accurately. Data was collected by using a computer modeling system, TradingView, and was done by evaluating the stocks Apple from the year 2024 to 2025, Tesla from the year 2022 to 2023, and Amazon.com from the year 2024 to 2025. ANOVAs were performed to compare each total profit and win-rate for each company. Results of the ANOVA indicated no statistical significance between each of the samples. All of the means of the trading indicators compared with one another mostly had P-values greater than 0.05, making all results, including AFR compared to RS, AFR compared to SRLB, AFR compared to TB, RS compared to SRLB, RS compared to TB, and SRLB compared to TB, nonsignificant. Essentially, there was no discernable result, possibly due to the varying and inexact times of clicks. Since the data is nonsignificant and has proven to have a low likelihood of getting the same results per experiment, the trading strategy that earns back the most money from predicting market direction the most accurately cannot be determined.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 230 | LS | 3065 |

**Title:** The role of glucose transporter 4 in cardiac virus infection

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

**Abstract:**

Myocarditis is a potentially life-threatening condition manifested commonly as chest pain, shortness of breath, and irregular heartbeat, which can last from hours to months. It affects millions of people worldwide, especially children and male young adults. Viral myocarditis is the most common myocarditis, accounting for approximately 50-70% myocarditis in developed countries, 10% of unexplained heart failure cases and the second leading cause of sudden death in young adults. Most of the viral cases are caused by single-stranded RNA viruses, Coxsackie viruses (especially Coxsackie B3 and B5). The goal of this project is to explore whether a human gene, named glucose transporter 4 (GLUT4) can contribute to CVB3 pathogenesis by suppressing antiviral immunity. GLUT4 is the predominant, insulin-activated glucose transporter in the adipose, skeletal and cardiac muscle tissues. It plays an important part in keeping our blood glucose level normal. But when it is hijacked by viruses, it can help viruses replicate by inhibiting antiviral immune responses. Using cell culturing, western blotting and qPCR, I compared the mRNA expression levels of several important antiviral genes and CVB3 viral loads between wild type (WT) and GLUT4 knockout (KO) mouse muscle cells. The results show that CVB3 replication was significantly reduced, while antiviral immune responses were upregulated in GLUT4KO cells, compared to WT cells. In conclusion, GLUT4 helps CVB3 replicate in muscle cells, and GLUT4 could be a therapeutic target.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 93 | LS | 3066 |

**Title:** Measuring C.elegan health with hyperglycemia to better understand blood health

**Student Name(s):** P. Ferguson


**Abstract:**

The project will test C.elegans as a model for human blood. The C.elegans will be induced with hyperglycemia by creating a 20% dextrose solution within the Nutrient broth that the E. coli are cultured in. The E.coli will be cultured on a petri dish, then the C.elegans will be chunked on the dextrose concentrated E.coli and their health will be tracked over the next 2-3 weeks. Their health will be tracked by a rating. The goal of the project is to see hyperglycemia effect on age and use its data to better hyperglycemia research


**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 252 | LS | 3067 |

**Title:** Targeting Telomerase Activity in Malignant Cancer Cells: RNA Interference and Enzymatic Inhibition to Induce Growth Arrest, Senescence, and Block Metastatic Dissemination

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

**Abstract:**

This study aimed to address cancer by targeting telomerase, an enzyme overexpressed in 80 -90% of cancers. The research explored whether AI could generate optimized telomerase inhibitors with statistically significant molecular differences while maintaining strong binding affinity. The hypothesis proposed that AI-generated ligands would exhibit structural variation and comparable or improved docking performance against telomerase compared to known inhibitors. Telomerase and ligand structures were obtained from the Protein Data Bank (PDB) and preprocessed in UCSF ChimeraX for molecular docking. PyRx (AutoDock Vina) was used to dock known inhibitors, yielding binding affinity scores and RMSD values. These results were used to train an AI model in Google Colab using DeepChem and RDKit, allowing the AI to assess, optimize, and generate novel ligands. The AI also generated a series of statistical tests and generated charts based on results. The AI created new ligands that met predefined molecular property constraints and underwent Mann-Whitney U statistical analysis. The test confirmed that AI-generated ligands were statistically distinct from original inhibitors. However, BIBR1532 remained the most effective inhibitor due to its superior binding affinity and RMSD values.This study confirms AI's role in drug discovery by generating statistically distinct telomerase inhibitors. While AI ligands showed meaningful differences, BIBR1532 was the most effective, highlighting the need for further optimization. A future application is AI-powered personalized drug discovery, where AI could design patient-specific telomerase inhibitors to enhance precision medicine and extend the use of AI to solve multiple diseases, making drug development faster and more cost-effective.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LS | 3068 |

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

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

**Abstract:**

Using Sunscreen as a way to distribute Beneficial Microorganisms for Corals (BMCs). Beneficial microorganisms have been shown to help strengthen corals against the effects of coral bleaching. When corals are exposed to long periods of heat stress or other stressful conditions, it disrupts the relationship between the coral host and its endosymbiotic zooxanthellae. This then leads to the loss of a coral's coloration, and the coral becomes weaker and potentially leads to death. When swimming in the ocean sunscreen naturally washes off a body, therefore if a sunscreen was to have BMCs in it, the BMCs would wash off too, sink to the coral reef bed and inoculate the corals strengthening them against heat stress anomalies. To test the concept of a BMC enriched sunscreen multiple sets of serial dilution were performed using three different variables: just bacteria, Bacteria+Glycerol (a component of chemical sunscreen) and Bacteria+Glycerol+Zinc Oxide (a component in mineral sunscreen). The bacteria used was microencapsulated to protect them from the zinc oxide so that growth would still occur when plated. After the serial dilution was performed and bacteria was plated. When examining the plates it was found that the bacteria grew really well in Glycerol. After examining the plate with glycerol and Zinc Oxide it was found that the microencapsulation was beneficial and there was positive growth in thesplates. Currently the idea of a BMCs sunscreen compound is being supported by the data. More testing will be preformed to further support this idea

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** EA 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 252 | LS | 3069 |

**Title:** Mitigating Heat Stress in Saccharina latissima and Gracilaria mammillaris: The Role of Nutrient Additives in Enhancing Resilience to Climate Change

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

**Abstract:**

Saccharina latissima and Gracilaria mammillaris are ecologically important primary producers that provide essential nutrients to surrounding ocean ecosystems, including habitat, protection, and structure for abundant marine life. However, due to anthropogenic changes such as increased water temperatures and ocean acidification, these algae are predicted to experience higher mortality rates, eventually leading to cascading and catastrophic impacts in surrounding ecosystems. Here, we show the effect of various nutrient additives, namely vitamin C in the form of L-ascorbic acid, zinc gluconate, and manganese gluconate, on the growth rates and photosynthetic efficiency of algae. The statistical analysis did not reveal any significant differences between experimental groups during a 4-week controlled growth experiment; however, the additives were successful in mitigating mortality under heat stress. Vitamin C benefited both species' photosynthetic efficiency under thermal stress, implying a general ability to function as an antioxidant, while the manganese and zinc treatment only benefited G. mammillaris. These additives likely facilitated growth through increasing pathogen resistance and functioning as a redox buffer. These results demonstrate the potential for nutrient additives as a possible method of mitigating the effects of rising ocean temperatures on kelp in the era of climate change. In the future, these results could be applied to offshore wind turbines as an additive to a limewash or tile, boosting the functionality of these existing structures to farm seaweed in open waters. This support to seaweed communities can help offset carbon emissions and facilitate a balanced surrounding ecosystem, which will become increasingly critical as climate change progresses.

**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):

☐ 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
## 2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 204 | LS | 3070 |

**Title:** The Study on the Effects of Nomophobia

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

**Abstract:**

In my project I will be doing a vivid study of research on the foundations of nomophobia, and its effects on people's physical and physiological state. In this study, I will have researched what makes up the foundation of nomophobia, how nomophobia works, and some ways to avoid it. I will also be examining the medical implications that are indirectly caused by nomophobia. I will be looking to see how it impacts a person's daily life, and how it can also impact the lives of students by providing a 10 item survey for teachers to evaluate the academic standing of those with constant smartphone use, and those without. I will use shared information from professionals who have done similar research, and from those who advocate for informing the public on this matter. After all is done with this project, I will continue to study this, I will create more surveys, and I will attempt a mass distribution of a 20-item survey that was conducted by professionals and shared by their consent. This will be done in the hopes to get either similar result, or to see if these questions can still be used to identify nomophobia in our cyber age of our technology.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 249 | LS | 3071 |

**Title:** Examining The Cognitive Impact of Lower Inhalation Levels of Chlorine Gas on Drosophila Melanogaster

**Student Name(s):** T. Stephenson


**Abstract:**

Chlorine, commonly used for pool sanitation, can be released and inhaled as a gas during pool cleaning. Once inhalation occurs, chlorine gas reacts with moisture in the respiratory tract to form hydrochloric and hypochlorous acids, similar to those found in pools. These reactions can cause a range of respiratory symptoms depending on gas concentration. Studies show that exposure levels between 1 and 10 ppm can cause physical symptoms such as eye and nasal irritation or sore throat. However, limited information is available on the cognitive effects. Exposure above 15 ppm, on the other hand, can result in severe cognitive impairments, including impaired balance and slower reaction times, as well as physical symptoms like visual disturbances and breathing difficulties. This study addresses a critical gap in understanding the long-term cognitive effects of low-level chlorine gas exposure. Using Drosophila melanogaster as a model organism, it examines the impact of two controlled chlorine gas exposure levels, 3–10 ppm (average 6.5 ppm) and 10–20 ppm (average 15 ppm), on cognitive and motor functions. Response tests, including a Volatile Chemical Assay and a Negative Geotaxis Assay, were used to gather data. These results were compared to unexposed control groups to assess potential cognitive decline. The study hypothesizes that higher chlorine gas exposure will result in decreased behavioral responses in Drosophila melanogaster, indicating cognitive impairment, with longer exposures causing greater declines. These findings could inform future research and regulatory measures to enhance public safety regarding chronic low-level chlorine gas exposure.


**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** AS 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 251 | LS | 3073 |

**Title:** Measuring the Effect of Nitrogen Enrichment on the Stimulation of Temperate Coral, Astrangia Poculata, from Quiescence

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

**Abstract:**

Astrangia Poculata, a species of coral native to Newport, Rhode Island, can tolerate a wide range of temperatures, with and without symbionts. Cold stress reduces polyp behavior in A. Poculata, and at around 7°C, enters a dormant state. Nitrogen is an essential nutrient for photosynthetic marine organisms; however, it becomes a pollutant in excess. Previous studies have shown that elevated nitrogen levels increase corals' susceptibility to bleach during heat stress, but little is known about its effect on the dormant state of A. Poculata. To uncover the effects, I studied six fragments of A. Poculata from the University of Chicago Marine Biological Laboratory. Precounts of the polyps on each fragment were taken before my experiment began. Half of the fragments were kept in a solution mimicking their natural environment, and the other half were exposed to high nitrate ($NO_3$) levels. The corals were forced into dormancy; over nine days, the temperature was slowly increased. Polyp behavior was monitored daily, and each colony was given a score based on polyp extension. Statistical analysis revealed a moderate positive correlation between temperature and polyp extension for both groups, but no significant difference between the groups. Both groups also showed a strong positive correlation between temperature and grade of polyp extension, but again, no statistically significant difference between them. These results suggest that while cold stress induces dormancy in A. Poculata, nitrogen pollution does not significantly affect this relationship. Understanding how nitrogen pollution impacts dormancy could provide insights into anthropogenic effects on stony corals.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 247 | LS | 3074 |

**Title:** Investigating Possible Relationships between Features of EEG and Distortions of Speech and Thinking associated with Delta-9 Tetrahydrocannabinol (THC)

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


**Abstract:**

The purpose of this project was to investigate relationships between specific EEG features and cognitive distortions of speech and thinking associated with THC in humans. The hypothesis for this experiment was that if the amount of THC administered to a patient was increased, then the E/I ratio would go up, while the relationship with cognitive distortions would also be positive. This proposed study is based on data previously collected by the mentor for a project focused on understanding the psychosis-like effects of 2 doses of THC in humans. The dose of drug received was unknown to participants, and included placebo, low dose, and high dose. The parent study included rating scales of THC effects (PANSS) and raw EEG data collected before and after the drug administration. The parent study examined an EEG measure called Neural Noise and correlated it with psychotic effects of THC. The goal of the student's project was to examine a more novel EEG measure called E/I ratio, and cognitive distortions of speech and thinking due to THC, thus distinct from the parent study. The results of this study's experimentation was a positive correlation of THC with the PANSS scale, and a lack of correlation with E/I ratio. The study holds implications and questions as to what affects E/I ratio, and whether cannabis, when taken naturalistically, would have a different effect. It could also raise questions about E/I ratio's connection to other neural features such as neural noise.


**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 260 | LS | 3075 |

**Title:** Early Cancer Diagnosis: A Multi-Stage Deep Learning Model for the Detection, Segmentation, and Classification of Circulating Tumor Cells

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

**Abstract:**

Circulating tumor cells, or CTCs, are cells released from the primary tumor during the early development of cancer. It has quickly become a promising biomarker for cancer diagnosis, prognosis, and treatment monitoring. Their presence in the bloodstream in the early stages of cancer enables detection when traditional methods fail through noninvasive extraction via liquid biopsy—increasing recovery rates and minimizing detection risk. A novel CTC capture system, TUMORFISHER, enhances detection using EpCAM-based nanomagnetic beads for higher targeting affinity. Despite these improvements, biopsy samples contain thousands of normal cells, leading to a severe cell-to-CTC imbalance. With hundreds of high-density scans per patient but only a few CTCs overall, manual identification is inefficient and error-prone, making deep-learning models crucial. This paper proposes a new multi-stage deep-learning framework tailored to overcome these challenges. After the scans of the TUMORFISHER biopsy are processed, an enhanced YOLOv8 network modified with Spatial-to-Depth (SDP) and Spatial Group-wise Enhance (SGE) modules detects cells with higher accuracy. Next, an optimized dual-domain UNet segments nuclear and whole-cell contours. Finally, Extreme Gradient Boosting (XGBoost) and Support Vector Machine (SVM) classify cells as CTCs or non-CTCs. Results show the detection model achieves 64.57% mAP50-95 in high-density cell environments and exceeds 95% in mAP50. The segmentation model achieves over 95% in IoU and Dice metrics, while the XGBoost-SVM classifier improves sensitivity and specificity to 0.9559 and 0.9375. After clinical validation, the full model outperformed Metafer by 48.2%, identifying nine previously undetected CTCs—potentially lifesaving in clinical applications.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 238 | LS | 3076 |

**Title:** Caffeine or Sugar? The True Stimulant in America's Coffee Consumption

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

**Abstract:**

This research examines the differential effects of caffeine and sugar on cognitive performance. A review of literature combined with self-experimental insights reveals that caffeine enhances alertness and accelerates cognitive processing by antagonizing adenosine receptors, thereby increasing the release of neurotransmitters such as dopamine and norepinephrine. In contrast, high sugar intake results in a rapid blood glucose spike that triggers an insulin response, often followed by reactive hypoglycemia. This cascade leads to diminished cognitive performance, as observed through slowed reaction times in Stroop tests. Empirical evidence indicates that caffeine-only beverages, such as coffee without a high sugar content, yield faster cognitive processing times (500–550 ms) compared to high-sugar drinks like orange juice, which frequently exceed 600 ms. Green tea, which combines caffeine with L-theanine, offers a balanced cognitive enhancement by moderating caffeine's stimulatory effects, resulting in steadier performance without abrupt declines, which can occur under caffeine. These findings suggest that while sugar may provide an immediate energy surge, its subsequent crash undermines sustained cognitive function. For instance, a Starbucks Venti Caffè Vanilla Frappuccino contains approximately 510 calories and 63 grams of sugar, highlighting the significant sugar content in popular beverages. These findings suggest that while sugar may offer an immediate energy boost, its subsequent crash undermines sustained cognitive function. Conversely, caffeine provides a more consistent enhancement of attention and alertness. Understanding these effects is crucial for making informed dietary choices to optimize cognitive health.

**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: 189

# CSEF Official Abstract and Certification
2025

Fair Category: LS

Project Number: 3077

**Title:** A Novel Treatment for Gut Epithelial Barrier Preservation via Sulforaphane Derived from Broccoli Seeds to Reduce Opioid Tolerance

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

**Abstract:**

In 2023, opioid overdoses claimed 81,083 lives in the United States. Chronic opioid use compromises gut health, and opioid tolerance is influenced by the gut and the epithelial barrier, a key component of the immune system. This project explores a novel, natural treatment for opioid tolerance by targeting the epithelial barrier using sulforaphane from broccoli seeds. Sulforaphane helps preserve the epithelial barrier and mitigates morphine-induced damage, reducing the need for higher opioid doses to achieve the same analgesic effect. A broccoli seed-based treatment, combined with methylcellulose, was developed and administered to mice for six days. A control group received only methylcellulose. To assess pain perception, a tail flick test was conducted. Mice receiving the broccoli treatment consistently took longer to react to heat, suggesting increased morphine effectiveness. Fecal sampling and sequencing were also performed, which further revealed microbiome changes, visualized through a heatmap and lactobacillus distribution graph. Additionally, pH testing confirmed the broccoli treatment's natural, non-pharmaceutical approach to addressing opioid tolerance. These findings demonstrate that sulforaphane from broccoli seeds can offer a safe and effective method to combat opioid tolerance, potentially reducing dependency and overdose risk.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project):** 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
- ☒ vertebrate animals
- ☐ controlled substances

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 229 | LS | 3079 |

**Title:** Allyl isothiocyanate as a prophylaxis treatment to listeria

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


**Abstract:**

Listeria monocytogenes is a pathogenic and extremely harmful bacteria. Listeria can be found in the air and in soil. In the past 10 years there have been 18 reported outbreaks of listeria in food products, three of which were with leafy greens. In 2018 an outbreak in deli meats lead to 10 fatalities and 61 others sickened. It is proposed that Allyl isothiocyanate (AITC) can be applied as a prophylaxis treatment to listeria. A preventative to kill of listeria on ready to eat leafy greens. To determine the efficacy of AITC, AITC is extracted, it is run through a sensitivity test to determine the zone of inhibition and is run through poor plate test. Extraction of AITC was done by steam distillation, and a filtration separation process. Steam distillation extracted a natural solution, the solution was combined with a resin Amberlite XAD7. The filtration separated the resin from the solution and AITC was extracted from the resin. Purity of AITC was determined through UV spectrophotometer analysis. A Cecil 3000 at lambda max of 240nm demonstrated an absorbance of 1.374. The sensitivity test to determine the zone of inhibition resulted in a circumference 3 – 5 mm wide around the AITC. This data verifies AITC can be extracted through steam distillation and proves AITC is antibacterial. Future applications with AITC include developing a foliar spray to be applied to food products.


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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 216 | LS | 3080 |

**Title:** Sports Nutrition -- Approaches Amongst US Junior Squash Athletes

**Student Name(s):** O. Hecker

**Abstract:**

The foods and fluids that athletes consume impact their athletic performance. This project will interview junior US squash athletes aged 15-18 competing in sanctioned tournaments run by US squash. Questions will be asked about their thoughts and on if they have a current nutritional plan in place.This experiment will be both an in-person and an online survey, which has been created through the SurveyMonkey application. Regression analysis will be used to track the player's results through their ranking and rating, which can be accessed through my US Squash portal. This research will be useful in many ways. Squash is a smaller sport, but in recent years, it has been growing rapidly, especially in the US. We know that there is a lot of information about nutritional plans and professional athletes, but there is less research done to an extent at the junior level. My project will try to answer the question on whether junior squash athletes playing at the highest level have nutritional plans or not. My central hypothesis going into my research is that athletes with a nutritional plan perform better over time than those athletes who do not have a nutrition plan.Hopefully, this study will be an initial study that could blossom into more research being done in this field in the future.

**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):

☒ 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 215 | LS | 3083 |

**Title:** Fabrication of an Antimicrobial, Heat Resistant Gelatin Hydrogel Delivery Mechanism for Atopic Release of mRNA Vaccines.

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

**Abstract:**

The development of a heat-resistant, antimicrobial gelatin hydrogel for transdermal delivery of mRNA vaccines addresses critical challenges in global vaccination efforts, particularly in isolated and resource-limited regions. This study presents a gelatin hydrogel crosslinked with squaric acid, incorporating chlorhexidine for antimicrobial properties, to enable atopic release of mRNA vaccines without the need for refrigeration. pH-dependent diffusion studies revealed optimal release at pH 7, with 41.5% diffusion efficiency, while pH 5 and pH 9 showed 17.2% and 21.6% diffusion, respectively. A lipid nanoparticle (Lipofectamine 3000), fluorescently tagged with fluorescein, was used to confirm the hydrogel's ability to deliver mRNA vaccine components effectively, achieving a 43.8% release rate. The hydrogel demonstrated heat resistance, maintaining structural integrity at 40°C and achieving a 64.1% diffusion rate of fluorescein under elevated temperatures. Ex vivo studies using porcine skin models validated the hydrogel's transdermal delivery capability with chlorhexidine, showing minimal effect on diffusion, achieving 39.1% release compared to 42.8% without chlorhexidine. FTIR analysis confirmed the hydrogel's stability post-heating and diffusion, as well as its ability to protect temperature-sensitive drugs like tetracycline hydrochloride from degradation. This research highlights the gelatin hydrogel's potential as a needle-free vaccine delivery system capable of operating in high-temperature, low-sanitation environments, offering a versatile solution to global vaccination challenges.

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

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

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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):

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 213 | LS | 3084 |

**Title:** Microplastic Influence on Microbial Strength Against Disinfection

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

**Abstract:**

The purpose of this experiment is to investigate whether the presence of microplastics (MPs) increases the resistance of Escherichia Coli (E.coli) to disinfection with bleach and hydrogen peroxide. MPs are an environmental contaminant, and their potential to act as a protective barrier for microorganisms against disinfectants is an untested, but critical issue. In this project, E.coli was grown in nutrient broth in an incubator at 37°C for 24 hours, before being combined with varying concentrations of polyethylene microspheres (0.00g, 0.01g, 0.03g, 0.05g) and being incubated again for 24 hours. The cultures were then exposed to either bleach or hydrogen peroxide for 2 minutes. Bacterial survival was measured using a spectrophotometer at 600 nm, the wavelength for detecting bacteria. The results from 3 trials indicated a trend towards increased bacterial survival with higher concentrations of MPs. For instance, in the samples containing 0.05g MPs, bacterial survival increased by 368% for bleach and 248% for hydrogen peroxide, compared to the samples with no added MPs. This suggests that MPs provide a protective shield for E.coli, increasing their resistance to common disinfectants. These findings imply dangers for public health, highlighting the potential for MPs to affect the efficiency of disinfection in places like homes, hospitals, and many environmental sanitation systems such as wastewater treatment facilities.

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

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 203 | LS | 3085 |

**Title:** Feeding Growth: Exploring the Effect of Nutrient Solutions on Hydroponic Lettuce

**Student Name(s):** M. Gates, M. Stewart

**Abstract:**

I've always been fascinated by the concept of hydroponics, growing plants without soil seems almost like something out of science fiction! For my project, I wanted to explore how different nutrient solutions affect plant growth, specifically focusing on lettuce in a simple hydroponic system.

The purpose of this study was to determine which nutrient mix (balanced, high-nitrogen, or diluted) produces the healthiest and fastest growing plants. To do this, I set up a hydroponic system with three groups of lettuce, each receiving one of the three nutrient solutions. Over several weeks, I measured the plants' growth in terms of height, leaf count, and overall health. The data collected included daily observations of growth rate and plant condition, as well as measurements taken at regular intervals.

Based on the results, I found that the balanced nutrient solution produced the healthiest plants with the fastest growth, while the high-nitrogen solution led to rapid initial growth but caused some leaf burn. The diluted solution, while less effective overall, showed promising results in terms of long-term plant health. This project demonstrates how hydroponic systems can be optimized for more efficient and sustainable farming practices, especially in regions where traditional agriculture is difficult or impossible.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 177 | LS | 3086 |

**Title:** RNA Editing Strategy Proposal for Correcting USH2A Mutations Associated with Usher Syndrome

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

**Abstract:**

This research paper proposes a novel gene therapy strategy to address mutations in the USH2A gene by combining the functional regions of both alleles into a single wild-type copy. This approach involves using allele-specific CRISPR-Cas9 editing to target mutations in exon 6 of one allele and exon 13 of the other. After precise excision of the mutated regions, the unmutated portions of the two alleles will be recombined into a single, functional gene through homologous recombination or a donor DNA repair template provided as part of the editing machinery. By retaining native regulatory elements and splicing patterns, this therapy aims to ensure proper gene expression and functionality in tissues like the retina and cochlea. The paper focuses on delivering CRISPR/Cas9 using direct electroporation or similar non-viral delivery techniques and validating the repair through sequencing and functional assays. This strategy overcomes the limitations of existing therapies by avoiding the need for large viral vectors, ensuring permanent and precise correction of USH2A mutations, and providing a tailored solution for patients with unique mutational profiles.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** EN MI 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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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 246 | LS | 3089 |

**Title:** Rate of Evaporation of Thymol in Thyme

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


**Abstract:**

Thymol is one of the major essential oils of thyme. It is beneficial by helping treat acne, cough and antibacterial activity. However, when left uncovered the essential oils can evaporate or degrade faster. This proposed study will investigate the effect of temperature on the evaporation rate of thymol in thyme leaves. In this experiment, the thyme leaves were placed in plastic containers at two different temperatures: room temperature (18 °C) and refrigerated temperature (0 °C). The thyme leaves were stored at these temperatures over the course of two weeks. Thyme leaves extraction was done every two days with 91% isopropyl alcohol. A gram of leaves was placed in a vial and soaked in 20 mL of isopropyl alcohol for an hour. The absorbance spectrum of each extracted sample was scanned from 200 nm to 700 nm in PerkinElmer Lambda 365 UV-Vis spectrophotometer. Quantification of thymol absorbance for all extracted samples was recorded at 282 nm, where thymol oil absorbs. The hypothesis that storage temperature impacts the rate of thymol evaporation was supported by the experiment as the room temperature samples were losing thymol absorbance signal at a faster rate compared to the sample stored at 0°C over time. The results demonstrated that the rate of thymol oil evaporation was at least 2.8 times faster for thyme stored in room temperature than that of in the refrigerator. Based on this experiment, it is recommended to store thyme leaves in a plastic container at cold temperature.


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

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 134 | LS | 3092 |

**Title:** Examining the Effects of Interactive Learning on 2nd Grade Students' Academic Engagement and Retention

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

**Abstract:**

With times constantly changing, schools are always working to improve their curriculum and adapt to new technology, studies, and findings. While prior research has shown the benefits of interactive learning, particularly digital methods, most studies have focused on older students. This study examines whether a non-digital interactive element (an art project) positively affects 2nd-graders academic engagement and retention. Each class received a lecture lesson on one historical figure and then a lesson with an art project on another figure. This ensured that both classes experienced both methods. Results will be analyzed using ANOVA to compare lecture types and class combinations. It is predicted that the class who receives the interactive element will score higher across both categories. The results from this study could be presented to school boards to improve curriculum development.

**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
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☒ Yes ☐ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 232 | LS | 3093 |

**Title:** Effects of Exosomes Secreted by Bone-Marrow Mesenchymal Stem Cells and Hydroxyapatite/Collagen Paste on the Acceleration and Promotion of Tendon-Bone Tunnel Healing in an ACL Reconstruction.

**Student Name(s):** L. San Jose

**Abstract:**

After an ACL reconstruction, integration of the grafted tendon into the bone tunnel is not always successful, and therefore, there is often the need for revision surgery. Exosomes from bone-marrow mesenchymal stem cells (BMSC-Exos) have been found to promote angiogenesis, and therefore reduce bone loss at the graft site. Similarly, hydroxyapatite/type I collagen (HAp/Col I) paste has been found to promote tendon-bone interface regeneration. However, these promising approaches have never been combined. This study will use these two injectables together to create a faster and more effective healing process after ACL reconstruction. Angiogenesis will be evaluated by observing capillary-like structures using optical microscopy, the viability of cells evaluated with fluorescent microscopy, and cell proliferation determined by cell counting KIT-8 and a spectrophotometer. Experiments will be tested on cells injected with BMSC-Exos and HAp/Col I paste together and separately to determine if the injectables together are more effective than individually.

It is projected that the total tube length of capillary-like structures will be around 8mm, the intensity of green fluorescence will increase, specifically around day 7, and the relative absorbance of the cells at 450 nm will have a final value of around 4.0 optical density.

If the results are successful, this study could be translated into in vivo experiments, and it could be a novel and successful method of healing ACL reconstructions.

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 189 | LS | 3094 |

**Title:** Intelligent Soft Finger Exoskeleton Designed for AI Prediction & Dexterity Enhancement in Degenerative Cervical Myelopathy via phone APP

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

**Abstract:**

This study developed a prediction platform integrating a soft finger exoskeleton and AI technology to objectively assess myelopathy hand. Utilizing retrospectively collected data, a browser-based interface was designed for data analysis and prediction. The Lomb-Scargle preprocessing method combined with the Random Forest algorithm demonstrated optimal performance, achieving an AUC of 0.947 and accuracy of 0.9 when trained on Lomb-Scargle-processed middle finger data. Combining data from four fingers further enhanced model performance. The exoskeleton captured hand activity data, which was uploaded to a dedicated evaluation platform. This platform provided predictive outcomes and personalized rehabilitation recommendations through a comprehensive AI model incorporating objective hand function metrics and subjective clinical assessments (mJOA, NDI) curated by spine surgery experts with over 20 years of experience. Patients could either seek hospital care based on predictions or use the exoskeleton's software for daily rehabilitation exercises.

The proposed model shows promise in objectively evaluating myelopathy hand and guiding clinical decisions. Future large-sample validation studies are required to confirm its efficacy and generalizability. This innovation bridges wearable technology and AI-driven clinical tools, potentially improving accessibility and precision in hand function rehabilitation.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 182 | LS | 3095 |

**Title:** Water Purification: Removing E. Coli from Water Using Cotton T-Shirts

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

**Abstract:**

Data from United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) estimates every year approximately 830,000 people die from diarrheal diseases acquired by unsafe drinking water (UNICEF, 2023). When water is considered contaminated WHO and the Centers for Disease Control (CDC) suggest boiling, adding bleach, or filtering with a 1 micron or smaller filter can remove potential harmful pathogens. However, people living in war zones or resource limited areas may not have access to even these simple options. Previous work has demonstrated that in areas with poor access to acceptable filtering and sterilizing materials, locally woven cloth, called saris, could be used to filter water and limit the diarrheal disease (Yunus, A. et al.2010). The focus of this study was to assess whether cotton t-shirts could similarly filter bacteria from a water source. The results of this study could provide a possible alternative filtration system in resource limited areas. Results demonstrated here show preliminarily that using a cotton t-shirt significantly improved the purity of the water, however it was not as effective as a 0.5-micron filter.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 257 | LS | 3096 |

**Title:** The Effect of the Nutritional Supplement, Curcumin, on Vulval Induction in C. Elegans to Determine its Potential Role in EGF Driven Cancers

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

**Abstract:**

Cancer, a leading cause of death globally, will result in 30 million yearly deaths by 2040 (National Cancer Institute, 2024). Many epithelial cancers stem from overactivation of the Epidermal Growth Factor Receptor(EGFR) signaling pathway(Liu, 2018). While there are therapeutics targeting the EGFR pathway, the impact of natural compounds on cancer is less understood. Curcumin, a natural antioxidant, is in widespread use. It is thought to downregulate EGFR expression in some cancer cells, however studies are small(Zoi, 2021). Caenorhabditis elegans have a receptor tyrosine kinase, LET-23, closely related to the EGFR, making it a powerful whole organism model to study these cancers(Gauthier & Rocheleau 2017). Over-stimulation of the LET-23 pathway results in a Multivulva(Muv) phenotype, a tumor-like symptom(Liu, 2018). To test curcumin's impact, Muv let-60(gf) C. elegans were fed OP50 E. coli±curcumin until adulthood. After four generations, wildtype vs Muv phenotype was scored. The wildtype phenotype was expressed by 15%, 47.8%, 47.4%, 50%, and 70% of worms in the control, 25µM curcumin, 100µM curcumin, 250µM curcumin, and 500µM curcumin groups, respectively. A two-tailed z-test indicated $p<0.05$ for all concentrations. Additionally, ROS accumulation was quantified using fluorescent dye(Liu, 2016). The control group contained 17units/µg, while the 25µM curcumin group contained 34units/µg, indicating that the antioxidant increased ROS. This implies the partial reversal of the Muv phenotype was by pro-oxidant properties, rather than the known antioxidant properties of curcumin. Given the positive results, widespread use of curcumin is not contraindicated.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 197 | LS | 3097 |

**Title:** The Influence of Sleep Duration on Memory Consolidation and Emotional Well-Being in High School Students at Greenwich Country Day School

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

**Abstract:**

Sleep has been said to be critical to cognitive function, particularly memory. This claim is rooted in the findings that learning causes physical changes in the brain, some of which occur during certain phases of the sleep cycle. Therefore, it is believed that sleep plays a significant role in optimal cognitive functioning. In addition to memory, sleep also serves as an important factor in one's mental health, as inadequate rest has shown to result in greater negative emotions. This study focuses on the impacts of high school students' sleep quality on their memory and their emotional well-being, aiming to demonstrate results through a comparison of well-rested and sleep-deprived students. Students between the ages of 14-17 will fill out a monthly survey reflecting on their sleep quality and their current mood. In addition, they will complete a short-term, long-term, and visual memory test. I predict that the results of my study will demonstrate that a lack of sleep and low mood will be closely related within high school students and students who do not receive adequate sleep both before and following a day of learning could negatively impact their memory of certain concepts.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 143 | LS | 3099 |

**Title:** The Growth of Prevotella Melaninogenica in Different Alimentative Solution

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

**Abstract:**

Prevotella melaninogenica is a bacteria that plays a role in gut health through its ability to degrade complex carbohydrates. The objective of this project was to determine how dietary factors can influence the growth of Prevotella Melaninogenica to provide insight on how it can play a role in a healthy gut microbiome. Prevotella melaninogenica was cultured anaerobically at 35° C in a 24 well plate containing either homogenized beef juice or vegetable juice. After 3 days of anaerobic incubation the bacterial growth was analyzed using a spectrophotometer. The results indicated that there was a difference in growth patterns depending on the nutrients. This could suggest that there is a dietary impact that can impact proliferation. These findings contribute to a better understanding of how diet can shape that gut microbiome and highlight the need for further research on the relationship between Prevotella melaninogenica

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 215 | LS | 3100 |

**Title:** Cellular and molecular biomarkers to predict immunotherapy outcomes in melanoma patients

**Student Name(s):** T. Shi


**Abstract:**

Melanoma remains one of the deadliest skin cancers, despite accounting for only a small proportion of overall skin cancer diagnoses. Although immune checkpoint inhibitors (ICIs) have significantly improved outcomes in advanced melanoma, nearly half of all patients fail to respond, highlighting the urgent need for clinically actionable biomarkers. In this study, we leveraged single-cell RNA sequencing (scRNA-seq) data from a publicly available melanoma cohort to dissect the mechanisms driving therapeutic resistance. Our analyses revealed a prominent enrichment of macrophages in non-responders, prompting the development of a macrophage-focused gene signature that was strongly associated with poor overall survival across multiple independent datasets, including The Cancer Genome Atlas (TCGA). Importantly, this signature demonstrated high predictive accuracy (AUC = 0.896) for identifying patients unlikely to benefit from ICIs. Functional validation using an in vitro co-culture model showed that M2-polarized macrophages robustly suppressed T cell proliferation, reinforcing their immunosuppressive role in the tumor microenvironment. These findings offer immediate translational relevance: the macrophage-derived gene signature could be incorporated into clinical workflows to guide therapeutic decision-making, sparing patients the financial and physical burdens of ineffective treatment. Moreover, targeting the immunosuppressive M2 macrophage axis may open new avenues for combination therapies, ultimately paving the way for more personalized and cost-effective management of advanced melanoma.


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

☐ Yes ☒ No

Word Count: 275

# CSEF Official Abstract and Certification
2025

Fair Category: LS

Project Number: 3101

**Title:** Restoration of Sleep Cycle and Activity Interruption of Alzheimer's Rivastigmine Treatment with the Addition of Labetalol

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

**Abstract:**

Rivastigmine is often used to treat mild to moderate dementia of Alzheimer's Disease (AD), by improving the thinking ability of those treated. However, use of rivastigmine produces side effects, the most notable being sleep function. In this research, the synergistic effect of adding labetalol to rivastigmine, using a Drosophila AD-model, was investigated. Using offspring from genetically-modified Drosophila BDSC #33773 and #39171 as the AD-model, with parent flies as normal controls, both AD and Normal Drosophila were given normal, 10mM rivastigmine (Riv), 0.65mM labetalol (Lab), or 10mM/0.65mM Riv/Lab-infused food, and their activity and sleep function was measured for ~120 hours using a TriTech Drosophila Activity Monitor.

Activity profiles were created for normal and AD flies, for each food condition, as a function of day/night lighting. Regarding normal Drosophila, the addition of Riv increased fly activity/min from 0.31 (control) to 0.89, while interrupting sleep, highlighted by an increase in Night/Day activity from 0.41 to 0.55. While the addition of labetalol-only to the normal fly food decreased overall activity, with little effect on sleep cycles, the synergistic addition of Lab to Riv in normal fly food reduced activity from 0.89 (Riv-only) to 0.50 (Lab/Riv), while restoring the sleep

rhythms that were lost with administration of Riv-only. For AD-Drosophila, the addition of Riv to food caused a 4x- increase in activity/minute (1.52-Riv vs 0.37-Normal), however synergistic addition of Lab-to-Riv reduced AD-fly activity/minute from 1.52-Riv-only to 0.75, while once again restoring sleep function. The Lab/Riv combination-therapy increased activity by 2x, while restoring the sleep-loss.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 215 | LS | 3102 |

**Title:** AI in High School Writing: Evaluating Its Role in Enhancing Conceptualization and Writing Quality

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

**Abstract:**

With the recent expansion of AI tools such as Chat GPT and Claude, there has been dense research looking into their ability to write. This study specifically looked into how AI-assisted writing impacts students comprehension and writing, and how different methods of using AI may yield different results in a students educational experience. Students were split into three groups, each with differing degrees of AI capability: AI full, students had complete autonomy to use AI however they wished; AI partial, AI could not produce any writing but could instead assist tasks such as editing and outlining; and no AI. Students wrote short essays based on a short film they watched. Once finished, they submitted their essays, along with their chat GPT feed (if they used it.) After writing, the students were given a short break followed by a reflection question, asking them to recall the structure and argument of their paper. The data was then analyzed by two teachers and a students, in terms of pre established grading rubrics. The data ultimately revealed that writing quality had a positive correlation with amount of AI given; and reflection accuracy had a negative correlation with amount of AI used, proven by the negative correlation between the quality of the AI conversation and the AI full group.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 249 | LS | 3104 |

**Title:** Natural Air Purifier-Greenhouse gases away!

**Student Name(s):** N. Ganesh Kumar

**Abstract:**

For my project, I wanted to see how much plants can reduce the amount of carbon dioxide in the atmosphere (most common greenhouse gas). I created a closed environment to showcase how a plant absorbs carbon dioxide in carbonated concentrations (soda) vs a jar with water and seeds.

I used a carbon sensor to see how much carbon was in each enclosed space, to track the amount of carbon change, while also factoring plant growth.

The results of the procedure showed the container with less carbon resulted in more plant growth. The first few days they had the same growth, although the one with the carbonated solution did not grow as much after 2 days. Both containers started out at 1000 ppm and gradually the amount of ppm in the containers reduced, the one with the carbonated drink reducing at a slower rate than the other.

To conclude the research, plants find it harder to survive in less than ideal situations such as an increase in Carbon in the air- if it were in more ideal conditions the plant in the carbon solution would've been able to survive. This prevents the ability to perform photosynthesis and cell respiration at a normal pace, causing the plant to die and the environment to continue to have high concentration of carbon. This pertains to current environmental factors as it demonstrates how the high carbon concentration causes drastic changes in the livable environment, causing perfectly healthy organisms to be unable to function normally.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** EM BC 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 254 | LS | 3105 |

**Title:** Biomimetic Filtration: Applying the Voronoi Pattern of Sea Urchin Shells to Remove Lead from Connecticut's Water Supply and Combat Marine Desertification

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

**Abstract:**

Due to its aged constructions and service lines, Connecticut currently faces a critical environmental challenge due to its increased lead concentrations in rivers reaching approximately 15 ppb. This study explored sea urchins, a species attributed to coastal desertification, and how their unique pattern resembling the Voronoi structure contributed to their effectiveness regarding lead adsorption as a natural solution. Along with sea urchins, shrimp and crab shells, commonly found as waste products in nearby oceans, have also been examined. Shrimp and crab shells contain chitosan which is an antimicrobial polymer. Due to their unique pattern and porosity, raw sea urchin shells that have not gone through structural manipulation demonstrated effectiveness in lead adsorption along with raw and heat-treated shrimp shells, while crab shells lacked sufficient porosity for lead adsorption. Beyond lead adsorption, both sea urchin and shrimp shells were also able to decrease bacterial growth and inhibit the ammonia-based odors that emerge when eutrophication increases nitrogen levels in lead-contaminated water. The Urchin-Shrimp Purifier (USP) was developed based on these findings, integrating the most optimal qualities of sea urchin and shrimp shells for enhancing water quality. It can be directly placed into large bodies of water to purify natural water sources or be integrated into household water systems for daily usage. By repurposing shell wastes from nearby oceans, the device simultaneously addresses two environmental concerns: reducing lead contamination and managing overpopulated sea urchins. The USP provides a cost-effective and environmentally friendly solution that benefits both the ecosystem and inhabitants of Connecticut.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LS | 3106 |

**Title:** The Bioavailability of Lead (Pb) in Tampons

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

**Abstract:**

Objective

This experiment was performed to determine if lead in tampons was bioavailable in conditions mimicking the internal environment of the vaginal canal.

Methods

The tampons were placed in cups of 6 mL solution of white vinegar and distilled water of a similar pH to a vagina (around pH 4.0). Distilled water was added to the vinegar until the appropriate pH was achieved, measured with a pH meter. Three cups of vinegar solution with 4 mL of solution each with no tampon was the control. Each was soaked for 4 hrs. in 6 mL of solution. Solutions were then extracted from the tampons using a makeshift centrifuge. The centrifuge contained a plastic bottle with a mesh wire net in the middle of the bottle and a string coming out of the top. The collected solution was tested with a lead testing strip to indicate the presence of lead, and control solutions.

Results

Lead was not detected in any of the tampons.

Conclusions

Even though the design of this experiment was unable to detect the level of lead women are exposed to when using this menstrual product, they could still pose a danger. The negative results could indicate sensitivity of the lead strips wasn't enough to detect the level of lead leached from the tampons. Additionally, altering the conditions of the solutions used to extract lead from the tampos could be further investigated to determine if there are better conditions to properly simulate the environment of the vaginal canal.

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

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3107 |

**Title:** Studying Autism Spectrum Disorders by Developing Human Pluripotent Embryonic Stem Cells - derived Cerebral Organoids

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

**Abstract:**

Autism Spectrum Disorder (ASD) is a genetically linked neurodevelopmental disorder that affects approximately 1 in 59 children in the US. Symptoms of ASD include learning disabilities, impaired social interactions, and changes in brain size. This disorder severely impacts children's upbringing, mental health, and places a significant financial burden on families. Due to the difficulty of directly studying the brain during children's development, research in the field is limited. CRISPR-editing of human pluripotent stem cells (hPSC) and differentiation of hPSC to 3D cerebral organoids allow human brain disorder investigation to be modeled in vitro. The Autism Susceptibility Candidate 2 (AUTS2) is a key epigenetic regulator for human brain development and a variant of the AUTS2 gene is associated with ASD. In this project, I utilized Cerebral Organoids derived from hPSCs carrying a deletion in AUTS2 to model ASD and identify phenotypes related to the AUTS2 variant in vitro. We observed that cerebral organoids carrying the AUTS2 variant are significantly smaller than the wild type. We found that AUTS2 variant organoids formed significantly less organized neuronal rosettes and developed less differentiated neurons than the wildtype. Furthermore, my functional analysis showed that neurons carrying the AUTS2 variant displayed significantly less spontaneous electrical activity. Ultimately, my results suggest that the AUTS2 mutation impairs the early development of the brain, impacts cerebral organization and neuron lineage, and reduces neuronal function. My results demonstrate measurable phenotypic differences, establishing that cerebral organoids are an effective model to study and develop therapies for ASD in the future.

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

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

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☐ vertebrate animals ☒ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 184 | LS | 3108 |

**Title:** Determining the Relative Effectiveness of Post-Cancer Treatment Physical Therapy on Pain Reduction

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

**Abstract:**

Breast cancer is the leading cause of cancer death among females, with rates of survival nonetheless improving; yet many of the patients develop persistent pain post-treatment. In this project, the effectiveness of different exercises undertaken in physical therapy to eliminate pain post-treatment among survivors of breast cancer has been defined. Patients were screened using the FACT-B tool that measured how they felt as regards pain, their well-being in general, etc. The three types of exercises were compared: cardiovascular endurance, muscular strength, and balance training. The differences in pain decrease were compared by using a t-test. No statistically significant difference between the exercises was detected, and that meant no single type of exercise was more effective than the others at decreasing pain. High concern for their social and familial well-being was reported by the patients. Weaknesses of the study included reliance on self-reporting and confidentiality constraints. Subsequent research would look at the contribution of exercise to improving other aspects of recovery, such as mental health and mobility, in order to create more successful breast cancer survivor rehabilitation programs.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 258 | LS | 3109 |

**Title:** PLA as a Novel Method for Assessing Rho GTPase Activity

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

**Abstract:**

Small Rho GTPases are proteins that act as molecular switches. Extracellular signals or intrinsic cellular programs promote GTP loading of Rho GTPases, activating them. In this state, they bind to and activate downstream effector molecules. When Rho GTPases hydrolyze GTP to GDP, they become inactive and cannot transduce signals. Rho GTPases regulate essential processes like cell division, motility, shape, and phagocytosis, primarily targeting the cytoskeleton. Dysregulation of Rho GTPases is linked to diseases such as immune disorders, cardiovascular disease, neurodegeneration, and cancer. Accurate assessment of Rho GTPase activity is crucial for understanding biological processes, disease, pathophysiology, and developing therapeutics. Current methods to evaluate Rho GTPase activity include pull-down assay, bio complementation assay (BCA), and fluorescence resonance energy transfer (FRET) assay. Pull-down assays measure endogenous Rho GTPases but lack cellular resolution and are semi-quantitative. BCA and FRET measure activity in individual cells quantitatively but rely on exogenous sensor molecules. All three methods cannot monitor Rho-GTP interaction with specific effectors, despite evidence that only a fraction are activated at any time.We devised a novel method to monitor Rho GTPase activity using proximity ligation assay (PLA). PLA combines the advantages of pull-down assays (measuring endogenous molecules) with those of FRET and BCA (subcellular resolution and quantification). PLA also enables monitoring Rho-GTP interaction with specific binding partners. We optimized fixation conditions for anti-RhoA and anti-RhoC antibodies, showing specificity using shRNA. We observed a significant increase in PLA signal under conditions promoting Rho-GTP interaction with ROCK1, validating PLA's utility in monitoring Rho GTPase activity.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 252 | LS | 3110 |

**Title:** Modeling Breast Cancer Invasion Using Active Brownian Dynamics

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

**Abstract:**

Cancer cell invasion into mammary adipose tissue controls the progression and metastasis of breast cancer. However, it is difficult to obtain time-dependent, three-dimensional data on breast cancer invasion in vivo. As a result, a collaborating research group developed an experimental system where cancer cells migrate within an artificial tissue composed of hydrogel beads embedded in a collagen matrix. This project sought to develop computer simulations that could quantitatively capture the spatiotemporal dynamics of cancer cells migrating within the bead-collagen matrix. Active Brownian dynamics were first implemented to model the cancer cells' motion. Next, the beads and collision physics were added. Finally, preliminary studies indicated that the cancer cells can migrate faster and more persistently because the collagen fibers are denser and more aligned in the narrow regions between the beads. Thus, the collagen matrix was modeled by varying the migration speed and direction of the cancer cells based on the local packing fraction of the beads. The simulated migration patterns were analyzed by plotting the mean squared displacement (MSD) and comparing it to the MSD plots of the experimental data. Results indicated that the simulated trajectories had a percent error of around 10%, indicating that the simulation has potential as a breast cancer invasion model. Future studies could incorporate the exact same starting positions of the cancer cells and beads to try to generate the same trajectories as the experimental system. Should an improved simulation be developed, studying and collecting data on breast cancer invasion could be eased significantly.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** 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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2. Student independently performed all procedures as outlined in 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 256 | LS | 3112 |

**Title:** Development of nnU-Net model for pediatric brain tumor segmentation in multi-modality MRI images

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

**Abstract:**

Pediatric brain cancer can be treated with radiotherapy or surgery. Both require segmentation (drawing) of the tumor by physicians, which is based on MRIs. This process is subjective, leading to less-than-optimal treatment plans. Recently, application of machine learning has led to artificial segmentation of healthy brain tissue. While this is medically accepted, segmentation of cancerous brain tissue remains highly researched. For these studies, models were trained solely on adult data, and would not be sufficient to segment children. Pediatric and adult cancer differ drastically from their brain structures and their tumor locations and behavior. In this research, a CNN was devised to accurately segment brain tumors using MRI scans of pediatric patients. To train the model, 266 patients from the BraTS-2024 pediatric dataset were used. Each contained MRIs modalities of T1, T1c, T2, and FLAIR, along with the ground segmentation, which labelled the enhancing tumor (ET), non-enhancing tumor (NET), cystic components (CC), and edema (ED). nnU-Net, a self-configuring model based on U-Net, was employed to improve upon plain U-Net and fine-tuning deficiencies. The dataset was executed onto a remote GPU server, with a split of 188/47/25 for the training, validation, and testing data. The model segmented the overall tumor successfully, achieving a 96.348% Dice, and correctly identifying healthy areas. Compared to current standard dice coefficients, which are >90%, this model provides a great start. However, issues remain with differentiating the labels within the tumor, due to some labels (ET, CC, ED) being less common in the dataset.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** ME BC 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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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 270 | LST | 3113 |

**Title:** The Affects of Edible and Non-Edible Plants on $CO_2$ Consumption

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

**Abstract:**

Humanity produces over 35 billion tons of $CO_2$ per year, a major greenhouse gas that threatens ecosystems, endangers species, and accelerates climate change. According to recent studies, nearly 20 billion tons of $CO_2$ would need to be captured annually to reduce emissions and mitigate climate change (MIT Climate, "How much carbon dioxide would we have to remove from the air to counteract climate change?" https://climate.mit.edu/ask-mit/how-much-carbon-dioxide-would-we-have-remove-air-counteract-climate-change). However, rather than investing in artificial solutions, plants can naturally absorb $CO_2$ through photosynthesis. While $CO_2$ intake varies by species, increasing the population of high $CO_2$-absorbing plants could help reduce emissions. This study investigates the $CO_2$ consumption of six plants, divided equally into two groups: edible (red cherry tomato, eggplant, mint leaf) and non-edible (pothos, philodendron, Brazil philodendron). Each plant was placed in an airtight chamber with controlled $CO_2$ production generated by a chemical reaction between baking soda and apple cider vinegar. The primary objective is to determine which category of plants exhibits a higher $CO_2$ intake. The study consists of seven experiments, each conducted over a seven-day period, with $CO_2$ levels monitored continuously by a $CO_2$ sensor. The first experiment tested and confirmed that the chamber effectively conserved the produced $CO_2$, while the remaining six recorded the $CO_2$ consumption of each plant. Contrary to the hypothesis, the results indicate that non-edible plants exhibit a higher $CO_2$ intake than edible plants. These findings suggest that maximizing the use of non-edible plants (e.g., houseplants) could enhance carbon reduction efforts and contribute to lowering greenhouse gas emissions.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** EV EM 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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☐ vertebrate animals ☐ controlled substances

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LS | 3115 |

**Title:** Effect of dietary sweeteners on lipid accumulation in obese C. elegans to evaluate if calorie-free sweeteners promote weight reduction.

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

**Abstract:**

Obesity, a chronic and complex disease, has reached pandemic status, with current prevalence rates affecting over 42% of the U.S. population(Boutari, 2022). Dietary sweeteners(DSs) have emerged as a widely used alternative to sugar to combat obesity, yet their impact on lipid accumulation and other obesity-related metrics remain controversial. This study investigated the impact of Saccharin Sodium(SOD), Sucralose(SUC), Neotame(NEO), and Stevia on lipid accumulation in glucose-induced obese C. elegans at allowable daily intake concentrations. Following 72 hours of treatment, all DSs significantly increased locomotive behaviors ($p < 0.05$), with SUC having the highest thrashing rate. This is contrary to findings in non-obese C. elegans, where only SOD increased locomotion(Jiang, 2024). Body size remained unchanged in glucose-treated nematodes; however, NEO significantly reduced all measures of body size ($p < 0.05$), while SUC and SOD increased body width, and Stevia had no significant impact. Lipid accumulation increased significantly with SUC, Stevia, and NEO ($p < 0.05$); NEO had the highest fluorescence intensity, going against previous studies in non-obese C. elegans, where NEO reduced lipid accumulation(Jiang, 2024). These findings suggest DSs may positively influence locomotion BUT negatively influence body size and lipid accumulation in obese C. elegans. Given the growing problem of obesity, it begs the question whether dietary sweeteners should be used for weight loss as it may promote lipid storage.These results emphasize the need for further research on how obesity responds to dietary sweeteners, with potential implications for human dietary choices.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** ME 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 232 | LS | 3116 |

**Title:** Potential Impact of Acidification on Nitrate Uptake in Marine Macroalgae: Modeling Human Impact on our Coastal Marshes

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

**Abstract:**

Recently, management of our coastal wetlands has become a hot topic amongst Coastal Zone Managers. Proper and constant evaluations of marsh function are sorely needed, however, to effectively manage our impact on these ecologically critical habitats. Marine macro-algae are pivotal within these systems and their performance. As we continue to develop and industrialize coastal areas, these already sensitive ecosystems are coming under heavier stress from chemical and physical runoff changing the profile of these systems. With all of this in mind, this study was designed to evaluate whether the suspected changing acidic conditions would impact the ecosystem service provided by algae in these habitats. A replicated design was used to evaluate possible connections between increased acidity and nitrate uptake in marine phaeophyta commonly found in New Haven harbor. Results showed no measurable impact with slight acidity increases (pH 7 to 6; $p= 0.102$, $a= 0.05$), however significantly measurable drops in acidity (pH 7 to 5) resulted in significant drops in nitrate uptake, 6.4 mg/L to 1.4 mg/L ($p<0.05$). To me, this indicates a significant risk to a vital ecosystem service that these algae provide if we don't properly manage this anthropogenic pressure we've added. Literature has shown these algae to be able to utilize both photosynthetic and nutrient derived pathways, but this study provides some insight as to which would be preferred in the face of increased stress.

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 236 | LS | 3117 |

**Title:** Sleep to Success: How Sleep Impacts Student Academic Performance

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

**Abstract:**

The purpose of this experiment is to examine the correlation between sleep quality, sleep duration, and test performance. Brainwaves are used as a medium to understand this relationship. It was hypothesized that if the test subject's sleep quality and duration are high, then the brain would elicit more Beta waves and less Alpha waves, leading to better focus, and an engaged mental state. Participants would track their sleep for a night with the sleep cycle app. They would then take a portion of an ACT test with an EEG device. The participant's brain waves were registered and analyzed for correlation coefficients. The results of this experiment were that test scores, sleep quality, and sleep duration vary directly with the test subject's alpha to beta ratio. That said, the participants sleep quality and duration varied inversely with the participants test score. The results of this experiment were not significant as the R coefficient for each statistic was well below 0.05. The results indicate that getting better sleep quality can increase how effective your brain is working. The data points to the idea that if the subject has a higher alpha to beta ratio, then the subject's test performance would be better. This is due to the participant being in a more relaxed state, as shown by the alpha waves. This disproves the hypothesis, however supported the assertion that test taking is better done in a relaxed state.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** BE ME 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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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 256 | LS | 3118 |

**Title:** The Effect of Diet on Lifespan, Tumor Burden and Wnt Signaling in a Drosophila Apc1/Apc2-RasV12 Model of Colorectal Cancer

**Student Name(s):** W. Boberski

**Abstract:**

Early-onset colorectal cancer (EOCRC) in patients under 50 now accounts for 10% of new diagnoses (O'Reilly 2023). While unexplained, trends in EOCRC may be related to diet, which is associated with 29% of all colorectal cancer cases and can affect cancer signaling pathways like Wingless (Wnt) (O'Reilly 2023). This study compares the impact of high-fat and high-fiber diets on lifespan, tumor burden, and Wnt signaling in a transgenic Apc1/Apc2-RasV12 Drosophila melanogaster model of colorectal cancer (Martorell 2014) (Bangi 2016). Tumor-bearing flies were placed onto F24 standard medium supplemented with 10% coconut oil (Liao 2021) or 10% psyllium husk (Lambeau 2017). Tumor burden was measured by fluorescence microscopy of GFP-labeled tumor clone cells in dissected midgut. Wnt signaling activity was assessed by immunostaining for Armadillo (Arm), a cofactor for Wnt target gene transcription (Wang 2013) (Tian 2017). It was anticipated that flies on high-fat diets would have shorter lifespans, more tumors, and increased Wnt signaling, while flies on high-fiber diets would have the opposite results (Beyaz 2016) (von Frieling 2020) (Bishehsari 2018) (Beghelli 2024). Data suggests that both high-fat and high-fiber diets were associated with a lower survival probability over time, compared to the control ($p < 0.05$). High-fat samples appeared to have more tumors than the control, while high-fiber appeared to have less. Some colocalization between Arm immunostaining and GFP expression was observed. These results support a role for diet in rising EOCRC rates, and provide evidence to support dietary intervention in CRC patients.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 251 | LS | 3123 |

**Title:** The association between treatment choice and breast cancer survival

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

**Abstract:**

Background: Increased public awareness and scientific advances in screening and treatment helped improve breast cancer survival rates significantly. This project aimed to compare the survival time of women who underwent mastectomy to those who had breast conserving surgery (BCS), and to uncover factors associated with death from breast cancer using a publicly available dataset.

Hypothesis: Women undergoing mastectomy will survive longer compared to women undergoing breast conserving surgery because cancerous cells are more likely to be successfully removed, or have their growth inhibited, with complete breast removal. Methods: Kaplan-Meier survival curves were compared between various treatments and disease characteristics. The multivariable Cox regression model was used to further assess the effect of type of surgery on patient survival adjusting for the simultaneous effect of age at diagnosis, treatment patterns, and clinical descriptors. The logistic regression model was also used to compare the two treatment groups in terms of patient characteristics. Results: Women who underwent mastectomy had higher survival rates than women with BCS. They were also older at the time of diagnosis, had a higher Nottingham prognostic index, underwent chemotherapy but not radiation therapy, had positive cancer cells for estrogen receptors (ER), and when controlling for other factors, were as likely to die from breast cancer as from other causes compared to women with BCS.

Conclusion: Women undergoing mastectomy survived longer than those with BCS. When comparing survival between different treatment strategies, demographic and clinical characteristics have to be accounted for as they provide additional important information supporting statistical inferences.

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

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 209 | LS | 3124 |

**Title:** The Biodegradation of UV Treated Polypropylene and Polyethylene Terephthalate by Aspergillus Terreus

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

**Abstract:**

The world produces over 450 million tons of plastic waste annually. This plastic is in the oceans, in our food, in our ecosystems, and even in our bodies. The growing plastic crisis is due to the fact that plastic can take up to 500 years to decompose. This study involves the use of KWIK-STIK™ Aspergillus Terreus derived from ATCC® 1012™ to degrade two different types of plastic granules: polypropylene (PP) and polyethylene terephthalate (PET). The purpose of this experiment is to assess the effectiveness of A. Terreus at degrading PP and PET in a Czapek-Dox broth medium in an effort to discover methods to degrade plastic. The Czapek-Dox broth provides the vital nutrients for the fungus to survive during incubation. Along with the fungus treatment, both the PET and PP granules were placed under a UV lamp for 24 hours in order to stimulate the degradation of the plastic. It was found that there was no significant correlation between percent weight loss of the plastics and A. Terreus. Fungal degradation of plastic could be a revolutionary solution to tons of plastic waste on earth. With this technology, it is a hope that plastic waste will decrease and the health of both humans and animals will benefit.

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

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

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

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

☒ Yes ☐ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3125 |

**Title:** The Effect of Natural Root Stimulators on Plant Height and Root Growth

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

**Abstract:**

Nitrogen fertilizers and artificial hormones are commonly used to enhance plant and root growth; however, they damage water systems and local ecosystems. Honey, coconut water, cinnamon, and aloe vera have been studied as natural root stimulators. Previous experiments have found that honey has the most desirable effect on plant growth in cuttings, while others found coconut water was the most effective natural root stimulator. In this experiment, basil cuttings were prepared, dipped in a specific natural root stimulator, and planted in potting soil. The control group was planted in potting soil with nitrogen fertilizer. After being dipped into a natural root stimulator, the basil cuttings were planted and left under a grow light in a classroom for 3 weeks. A second trial of this experiment was conducted, using sand instead of soil, to see if the nutrients in potting soil would affect results. At the end of the experiment, the basil cuttings were uprooted, and the plant height and root length were measured. This experiment concluded that honey worked as the best natural root stimulator. Honey had the average highest root length (7.3 cm) and average change in plant height (2.3 cm) compared to the other natural root stimulators. The second trial of this experiment resulted in no root development or increase in plant height, showing that sand was not an ideal medium to grow basil plants. For further research, this experiment can be tested on different plant species or with different natural root stimulators not tested in this project.

**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):

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 186 | LS | 3126 |

**Title:** The Impact of Combined Bromelain and Papain Hydrogel on Wound Healing Processes Relative to Enhanced Enzyme Extraction Techniques.

**Student Name(s):** O. LaRiccia

**Abstract:**

Bromelain and papain, proteolytic enzymes derived from pineapples and papayas, are known for their therapeutic properties in enhancing wound healing through anti-inflammatory effects and collagen production. To evaluate the synergistic therapeutic potential of this project, a novel bromelain-papain infused enzymatic hydrogel was developed to determine the role in tissue regeneration. Caenorhabditis elegans were used as a model organism due to their ability to mimic cellular responses in human wound regeneration. The nematodes were cultured on Nematode Growth Medium (NGM) with Escherichia coli as a nutrient source and maintained at optimal temperatures before being introduced to enzymatic hydrogels. Enzyme extraction demonstrated peak absorbance values of 0.99 at 270 nm for bromelain and 250 nm for papain, validating their purity. Wound regeneration rates were tracked over a 48hr period, comparing enzyme-treated groups to untreated controls, with findings indicating over 50% faster tissue regeneration in the treated groups. These results suggest that the combination of bromelain and papain increases regeneration rates significantly. Future research will focus on optimizing enzyme extraction methods and integrating them into biomaterials such as nanofibers or bioengineered dressings to improve clinical applications.

**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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 161 | LS | 3127 |

**Title:** Investigating the differences in strike pattern and cadence between barefoot and traditional shoe running

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

**Abstract:**

With the modern running shoe only being created roughly 65 years ago, the interest for alternative footwear and the potential benefits they may provide has grown. In this study, I investigate how running barefoot vs. using traditional shoes affects strike pattern and cadence. A total of 13 student participants running at a speed of 6 mph have been tested barefoot and in traditional shoes. More than half have switched from a rearfoot strike to a midfoot or forefoot strike when transitioning to barefoot running: 4 switched to a forefoot strike, 3 to a midfoot strike, and 6 maintained their rearfoot strike. These findings align with previous research suggesting that barefoot running promotes a shift towards forefoot or midfoot striking, which is associated with shorter stride lengths, increased cadence, and reduced contact time. If similar results continue to be found, it provides insight into an innate human capacity that allows the body to switch to a more efficient or comfortable running form.

**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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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3128 |

**Title:** Enhancing Coral Reef Resilience Through Utilizing a Two-Part Dosing System to Increase the pH levels of $CO_2$-Acidified Ocean

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

**Abstract:**

Due to human carbon emissions, excess $CO_2$ in the atmosphere gets absorbed by the ocean, lowering pH levels, increasing acidity, which hinders coral reef growth. Scientists have spread different minerals to remove acidifying protons from the acidified ocean water to increase its pH level; however, currently it is unknown which minerals are most both efficient and cost-effective. The purpose of this project is to create a more effective and efficient way to prevent $CO_2$ pollution in coral environments. If dolomite is used as medium then the pH level will be higher, being more effective at reducing ocean acidification in comparison to calcium carbonate and olivine. Every 3 days each mixture from the system was added to their own ocean-acidified water separately along with the control group. After, water samples were taken and pH levels were measured. The coefficient of de-acidifying efficiency (termed as CDE) of each mixture in increasing the pH levels per unit was calculated; economic efficiency was also examined by dividing the change in pH by the cost of each unit (CCE). The results suggest that the addition of dolomite in comparison to other minerals was the best at strictly increasing pH levels. These results support the initial hypothesis. However, since corals weren't added and edible versions of minerals were used for safety, results may vary in a larger scale test. Future research can attempt to understand how it works on a larger scale and the effects it has with marine life in the ecosystem.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 283 | LS | 3129 |

**Title:** Lipid-based Codelivery of Doxorubicin and siRNA PD-L1, as a Multi-function Chemo-immunotherapy, Selective to PDAC via its MUC1 Overexpression

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

**Abstract:**

Pancreatic cancer is the second leading cause of death, with 90% of occurrences as Pancreatic ductal adenocarcinoma (PDAC). Doxorubicin (DOX) is the leading treatment for cancers, functioning by blocking topoisomerase II, an enzyme essential for cancer cell division. However, chemotherapy penetration in PDAC is limited due to its dense stromal barrier and destructive tumor-microenvironment (TME). Herein, a pancreas-specific chemoimmunotherapy utilizing DOX, siRNA PD-L1, and MUC1 antibodies was designed for PDAC treatment. To begin, mPEG-b-PHEP were fabricated as the nanoparticle (NP) interior, exhibiting flow-core capability. These were loaded with DOX, which were later coated with an SiO2 layer for stability. Chitosan was then added as a binder for the inclusion of siRNA-PD-L1, to inhibit the PD-L1 pathway, restoring immune activity. Finally, DOPE-Anti-MUC1 was conjugated to the NP-surface, to provide friendly delivery through the TME, with selectivity to the overexpression of PDAC cell-surface MUC1. DOX-siRNA-DOPE dissolution studies in normal extracellular fluid (pH 7.4) versus that of the PDAC-TME (pH 6.8) demonstrate 100% degradation of the DOPE outer layer within five minutes. HPLC analysis was used to subsequently demonstrate DOX-siRNA release, where 95% of a 20ug DOX-load was released within the same 5-minute period following introduction to a simulated PDAC-TME. To simulate DOX-siRNA-DOPE selectivity and function, an MUC1 ELISA-kit was modified using ATR-FTIR analysis, which highlighted adhesion of the NP's DOPE-Anti-MUC1 functionality to PDAC-MUC-1 overexpression. Finally, Giant Unilamellar Vesicles (GUVs) were created with fluorescently-labeled lipid-bilayers that mimic both normal and PDAC cells (with MUC1). DOX-siRNA-DOPE again targeted PDAC GUVs due to Anti-MUC1 selectivity.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 253 | LS | 3130 |

**Title:** Bioremediation of PFAS: Integrating Oyster Shell Waste from Connecticut's Oyster Trail and Functional Bacteria for Safe Water Purification

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

**Abstract:**

In Connecticut, 29 types of per- and polyfluoroalkyl substances (PFAS) have been detected in the state's drinking water. PFAS cause various diseases in humans and threatens the health of fish and plants. Connecticut operates "The Connecticut Oyster Trail", where up to 15,000 tons of oyster shells are sent to landfills each year. These oyster shells have excellent abilities to adsorb chemicals. This study was conducted to purify rivers in Connecticut contaminated with PFAS by using discarded oyster shells from the Oyster Trail to adsorb PFAS, and then to remove the adsorbed PFAS using functional bacteria. High concentrations of fluoride ions, indicating presence of PFAS, were detected in various household products such as cosmetics, detergents, and frying pans. While the industrial safety of PFAS is acknowledged, PFAS-contaminated water has shown toxicity in human lung cells and plant growth. After treating PFAS-contaminated water with oyster shells processed in various ways, raw oyster shells, maintaining their porous layered structure, exhibited the best effects, and the toxicity of PFAS-contaminated water to lung cells was reduced by treatment with raw oyster shells. Finally, 18 types of bacteria were isolated from soil long exposed to pesticides, and two colonies with PFAS degradation effects were selected. Based on 16S rRNA sequence analysis, one matched 98% with Bacillus megaterium, and the other matched 99% with Bacillus thuringiensis. In conclusion, this study demonstrated that with discarded oyster shells and functional soil bacteria, PFAS removed from rivers in Connecticut can be biologically safely decomposed, transforming "forever chemicals" into "degradable chemicals".

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 216 | LS | 3131 |

**Title:** Association Between Food Insecurity and Mortality Outcomes Among Cancer Survivors in the United States

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

**Abstract:**

Cancer diagnoses present significant challenges, including physical, emotional, and financial burdens, which are often exacerbated by food insecurity (FI). FI, defined as uncertain access to adequate nutrition due to income, employment, location, and other factors, may adversely affect cancer outcomes, particularly mortality rates. This study examines the association between FI and mortality among U.S. adults with a history of cancer, aiming to highlight disparities and inform public health strategies. Using data from the 2011-2018 National Health Interview Survey (NHIS), FI was assessed with the 10-item USDA Food Security Survey Module, and mortality outcomes were accessed through NHIS-linked death records. Hazard ratios for mortality were calculated, adjusting for sociodemographic variables, to uncover key risk factors contributing to FI-related disparities. Among cancer survivors, 11% experienced FI, with the most affected being younger, female, non-Hispanic Black or Hispanic, lower-income, and uninsured individuals. FI was associated with increased risks of all-cause and CVD-specific mortality, but not cancer-specific mortality. Comparisons with individuals without cancer showed differences in FI prevalence and mortality risks, emphasizing the vulnerability of cancer survivors with FI. The findings of this research seek to inform policy interventions and public health strategies aimed at reducing FI, ultimately improving survival rates and quality of life for cancer patients across the United States.

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

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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3132 |

**Title:** Pathonix: Enhancing Histopathological Ovarian Cancer Detection with an Explainable and Efficient Ensemble Learning Framework

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

**Abstract:**

Ovarian cancer (OC), a leading cause of female cancer deaths, necessitates accurate detection methods to improve its dismal prognosis. Tissue biopsy and subsequent histological grading is the gold-standard for diagnosis, but is often insufficient due to potential misclassifications. As AI continues to be applied to healthcare, feature-engineered OC datasets are being released to the public for the development of detection tools. However, tools driven by single-model algorithms lack both usability and the high accuracy crucial for medical applications. To address these issues, this project puts forward a novel ensemble learning methodology which integrates the diverse frameworks of ResNet50, EfficientNetB0, and MobileNetV2. Following enhancement of the STRAMPN Histopathological Dataset to 1000 cancerous and 1000 non-cancerous images via horizontal/vertical flipping, each model was trained individually. Next, unweighted averaging of the architectures was performed to better consider the variety of patterns in the data and identify cancerous tissue samples consistently. The ensemble achieved a remarkable accuracy of 100% on the testing data, which was a marked improvement on both the constituent model accuracies of 97.00% (MobileNetV2), 98.50% (ResNet50), and 99.50% (EfficientNetB0) and the highest accuracy achieved by a model on a similar dataset to date (98.8%). An interactive application titled Pathonix, which utilizes the three algorithms and further adds explainable heatmaps via Grad-CAM, was developed to aid professionals in prediction validation. This study demonstrates the promise of ensemble learning for the diagnosis of OC, an approach that can be applied seamlessly to various other realms of medicine.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 229 | LS | 3134 |

**Title:** Development and experimentation of an AI algorithm alongside a Near-Infrared LED device to assist in venipuncture.

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

**Abstract:**

Accurate vein detection and puncture are crucial in medical procedures like blood draws and intravenous (IV) insertions. However, factors such as obesity and skin color can make these procedures more challenging. By incorporating proper technique alongside an artificial intelligence model, these limitations can be significantly minimized, ensuring a safer and more comfortable experience for patients.

This algorithm would rely on two key functions: identifying veins in an image and determining the optimal vein and puncture site. The process involves using a near-infrared LED attachment with an app to scan the arm, generating a comprehensive image of the veins. The algorithm prioritizes two critical factors—location and size—to determine the most suitable vein. By analyzing vein trajectories and identifying the straightest veins through tangential lines to their average slope, the system can highlight the best options. The ideal puncture site is typically the deepest and widest section of the vein, which the algorithm will also mark.

The model primarily focuses on identifying three veins for puncture: the cubital vein, the cephalic vein, and, if necessary, the basilic vein. In the near future, data collection efforts may involve collaboration with organizations such as the American Red Cross to refine the model further. By improving accuracy in vein detection, this algorithm has the potential to enhance patient outcomes, reduce the risk of complications, and streamline clinical workflows in healthcare settings.

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 253 | LS | 3135 |

**Title:** Using Computational Simulations of Antibodies To Target the Streptococcus anginosus Surface Protein TMPC to Mitigate Gastric Cancer

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

**Abstract:**

Gastric cancer is the fourth leading cause of cancer-related mortality worldwide. Recent studies exposing gastric cancer to mice identify Streptococcus anginosus (Sa) as the pathogen that binds with surface protein TMPC. Studies show that the binding between TMPC and Sa proliferates the metastasis of gastric cancer. Historically, studies done in mice can be extrapolated to humans. As a result, this project aimed to identify the most potent antibodies targeting the Sa protein and TMPC-Gastric epithelium interaction as hindering the binding will prevent them from linking and prevent cancer metastasis. It was hypothesized that the Antibody 1A5F of the immunoglobulins group 1gG will be able to effectively bind to the TMPC Sa. Online docking servers were used to obtain the 3D structure of TMPC protein, while the antibodies were downloaded from the protein data bank. Additionally, TMPC was docked online and binding sites were predicted using machine learning softwares, with the twenty antibodies from four immunoglobulins types IgA, IgE, IgG and IgM to test for the lowest Binding Energy (k/mol) and most potent antibody to bind with TMPC. However, results from ANOVA demonstrated that while there was no statistically significant difference between the immunoglobulins, 4A6Y of IgM had the strongest binding energy of -21.3, and not IA5F, thus serving as the most promising candidate to impede the binding between TMPC and epithelial cells. Indeed, antibody 4A6Y can be used as a promising candidate that could theoretically mitigate the proliferation of gastric cancer and be potentially tested for efficacy in laboratory trials.

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 245 | LS | 3136 |

**Title:** Development of a Solar-Powered Floating Phytoremediation Device to Filter Methyl Red Dye Utilizing a Rotating Inner Disk for Enhanced Water Circulation

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

**Abstract:**

Azo dyes, such as methyl red, are widely used in the textile industry for their vibrant colors and fixation ability. However, frequent dye spillage caused by incomplete filtration contaminates aquatic ecosystems with its carcinogenic properties, prevents photosynthesis, and alters the pH levels. While physicochemical methods like coagulation have shown effectiveness in dye removal, they are costly and less scalable, making cheaper, eco-friendly filtering methods like phytoremediation promising. Despite the suggested efficacy of filtering using plants, there is an absence of commercial phytoremediation systems designed for affordability and small-scale application in wastewater treatment. Hence, the purpose of this project was to develop a solar-powered floating phytoremediation device that houses a plant (Oenanthe javanica) for filtration and uses an inner spinning disk to regulate water flow, rotating to optimize methyl red dye removal from water. The study was conducted in two phases: 1) constructing a waterproof circuit/device to optimize disk rotation, and 2) integrating the plant for filtration. The device was submerged in diluted dye water (1:1000) for a week, with dye reduction measured via spectrophotometry and qualitative color analysis using ImageJ. The device was deemed successful as it met the criteria of precise motor rotation, sustained flotation, and filtration by demonstrating 63.7% dye removal. Minor water exposure inside the circuit highlighted the need for additional waterproofing refinements in future iterations. Overall, this solar-powered phytoremediation device provides a promising, eco-friendly solution for filtering textile pollutants and advancing sustainable water treatment technologies.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3138 |

**Title:** Pulse call sequencing and structures in Offshore Killer Whales (Orcinus orca)

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

**Abstract:**

The purpose of this study is to observe how offshore Killer Whales communicate in terms of what structures their calls form and the patterns of which they communicate in. This information could lead toward a better ability to monitor them and ultimately understand their health and trends. There are three ecotypes in the killer whales species: Resident, transient, and offshore. The three ecotypes are distinguished not by the extent of their ranges, but by their feeding behaviors and genetics. Three functionally distinct vocalization types have been described for killer whales: Clicks, pulse calls, and whistles. This study will focus on offshore killer whales, as it is one of the smallest ecotype populations with little data focused on it specifically. The most common form of communication within the killer whales species is pulse calls. Pulse calls are rapidly repeating clicks resulting in tonal sounds that are used in group recognition and coordination of behavior. Pulse repetition rates are reflected in a pulse call's harmonic structure. In this study, there are 23 sound files all of which contain Offshore Killer Whale sounds recorded in their natural habitat. The sound files are put onto a spectrogram and annotated, later being analyzed for patterns. The purpose of this study is to identify specific types of pulse calls through harmonic structures and characteristics. Once this is identified, the data will be built upon to connect the patterns within harmonic structures to overall Offshore killer whale communication. Data is currently being reviewed and conclusion is pending.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 236 | LS | 3139 |

**Title:** Host Immune Response Post-QUAD Molecularly Targeted Treatment Promotes Tumor Regression in Dogs with Naturally Occurring Glioblastoma

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

**Abstract:**

Glioblastomas (GBM) are aggressive brain tumors in both humans and canines, presenting significant therapeutic challenges due to the blood-brain barrier (BBB), an immunosuppressive tumor microenvironment, and tumor cell heterogeneity. We have developed a novel QUAD therapeutic strategy that simultaneously targets four tumor-associated receptors with a single agent, showing direct tumor cytotoxicity in animal models of GBM. Additionally, QUAD treatment may initiate tumor immunogenic cell death (ICD) through the release of damage-associated molecular patterns (DAMPs) like high mobility group box 1 (HMGB1), triggering immune responses. We hypothesized that QUAD treatment would upregulate HMGB1 expression and activate ICD pathways, which would be associated with tumor reduction and improved survival in canine GBM. To test this, six dogs with naturally occurring GBM were treated with QUAD via direct intratumoral delivery. Blood samples were analyzed for HMGB1 expression using ELISA, and tumor mRNA expression was profiled with an 800-gene immuno-oncology platform. Dogs were followed for up to one year with clinical assessments and brain MRI scans.Preliminary results indicate that 66% of dogs survived at least 7 days post-treatment, while 33% passed after this period. Tumor reduction was observed, demonstrating the potential efficacy of the QUAD approach. This innovative strategy bypasses the BBB, targets multiple tumor receptors to address heterogeneity, and stimulates an adaptive immune response. Further investigation into the immune response triggered by QUAD could enhance patient outcomes, particularly when combined with other immunotherapies.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 258 | LS | 3140 |

**Title:** Caveolin-1 as a Biomarker and Potential Mediator of Melanoma Brain Metastasis

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

**Abstract:**

Brain metastases occur when melanoma, the most lethal type of skin cancer, spreads to the brain, forming additional tumors. This study investigated the role of Caviolin-1 (CAV-1), a protein expressed in melanoma cells, in melanoma progression and its prognostic value in the development of brain metastasis. A tissue microarray (TMA) containing 169 metastatic melanoma cases was previously constructed at Yale and stained for CAV-1 via immunohistochemistry. In this experiment, monochromatic, high-resolution images of each microarray tissue core were analyzed by Automated Quantitative Analysis (AQUA), a program developed at Yale University, using two algorithms: Rapid Exponential Subtraction (RESA), which identified subcellular compartments, and Pixel Locale Assignment for Compartmentalization of Expression (PLACE), which removed out-of-focus images. Binarized masks of cellular cytoplasm, nuclei, and membrane, were created using AQUA and were manually processed for accuracy. To quantify CAV-1 protein, the average signal intensity in each compartment was calculated and divided by the compartment's total size. Through JMP, a statistical analysis program, T-test (ANOVA) and Survival Kaplan-Meyers tests were used to determine the correlation between CAV-1 expression and patient clinical variables. Higher CAV-1 expression was found in brain metastases compared to lung, skin, and soft tissue metastases (p-value of 0.0155). High CAV-1 levels were also associated with shorter time intervals between initial metastasis diagnosis and brain metastasis imaging (p-value of 0.0026) and reduced survival. These results suggest that CAV-1 contributes to both susceptibility to and development of melanoma brain metastasis and could be a potential therapeutic target.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 230 | LS | 3141 |

**Title:** Developing a Dry Age-Related Macular Degeneration Model Using the Cell Line ARPE -19 to be Efficient and Accessible

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

**Abstract:**

Age-related macular degeneration (AMD) is a leading cause of blindness in the U.S., affecting nearly 20 million people without a cure. Dry AMD, accounting for 90% of cases, is characterized by drusen deposits of proteins and lipids beneath the retinal pigment epithelium (RPE) and can progress to severe stages that cause blindness. In vitro cell models are crucial for studying dry AMD's pathological processes, such as complement system dysregulation and oxidative stress. The ARPE-19 cell line is a commercially available and thus accessible RPE model; however, past studies using ARPE-19 for dry AMD research have demonstrated lower efficiency compared to models utilizing other cell types. To improve upon these models, I developed a protocol first utilizing nicotinamide to differentiate the cells to become like native RPE for 2 weeks. Then, the cells were placed on transwell inserts coated with laminin to simulate the Bruch's membrane, the layer under the RPE, for a week. Following a three-day serum starvation period, complement serum and hydrogen peroxide treatments were applied to mimic complement system dysregulation and oxidative stress. Analysis of complement activation showed increased levels of membrane attack complex (MAC), a known component of drusen, in treated groups. Notably, lubricin, when combined with hydrogen peroxide and complement serum, led to a higher increase in MAC levels than other conditions, suggesting a potential role in MAC formation for future study.

**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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 217 | LS | 3142 |

**Title:** Effects of Penicillin, Ampicillin, Tetracycline, Temperature, and Antibiotic Concentration on Escherichia coli

**Student Name(s):** C. Junqueira de Andrade

**Abstract:**

Antibiotic resistance occurs when bacteria evolve to withstand antibiotics that are supposed to kill them. This development can cause major public health threats because bacteria become less susceptible to antibiotics, and thus making treatments less effective in treating infections. To investigate antibiotic resistance, I measured how antibiotic type, growth condition, and bacterial strain affected the growth of bacteria. Specifically, I examined E. coli B and E. coli when subjected to penicillin, tetracycline, and ampicillin. I swabbed 60 agar dishes with a given strain of E. coli and placed a given antibiotic on top of it. Half of these dishes were grown in an incubator (35°C) and the other half were grown at room temperature. I am expecting to find that tetracycline is the antibiotic that produces the largest zone of inhibition, and therefore the strongest antibiotic against E. coli. I also predict that E. coli B grown in the incubator will have more resistance than E. coli K-12 due to its chemical makeup and past resistance in similar antibiotics. Additionally, E. coli's optimal temperature is around 35°C, so I think the samples grown in the incubator will be more resistant to the antibiotics. Based on my results, I will be able to determine which antibiotics are most easily overcome by these two strains of E. coli.

**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):

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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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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 252 | LS | 3143 |

**Title:** Alkylating agents pretreatment-induced mismatch repair phenotype transformation, resistance to apoptosis, and mutation accumulation

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

**Abstract:**

Mismatch repair (MMR) genes encode for proteins that fix DNA mutations. In a mismatch repair deficient (MMRd) tumor, lack of DNA repair leads to high tumor mutational burden and microsatellite instability (MSI). While MMRd tumors benefit from immunotherapy, mismatch repair proficient (MMRp) tumors respond poorly. Since MMRd tumors only represent 4% of all cancer diagnoses, it is clinically important to identify strategies that enhance the treatment response of MMRp tumors.

Previous studies found that common alkylating agents, such as temozolomide (TMZ) and cisplatin (CDDP), may create an MMR phenotype change. In this study, I aim to further characterize this change by 1) testing the hypothesis that when pretreated with TMZ and CDDP, MMRp cells become resistant to apoptosis and hence permissive to drug-induced mutation accumulation; 2) assessing MSI in these cells using a plasmid reporter system. Therefore, I performed mutation, apoptosis, and luminescence analysis in three CT26 cell lines with different MMR statuses (parental, MSH2-knockout, TMZ and CDDP pretreated). The results show lower levels of apoptotic cells in the pretreated cell line, suggesting that the cells become resistant to apoptosis and alkylating agents after 8 weeks of pretreatment, which allows DNA errors to accumulate. High levels of luminescence in pretreated cells confirms MMR phenotype transformation and MSI by pretreatment. This study shows that alkylating agents can promote the phenotype transformation of MMRp to MMRd, allowing mutation accumulation for more effective immunotherapy. With this validated plasmid reporter system, a model can be developed to facilitate high-throughput screening of drug libraries.

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

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3. This project was conducted at a Registered Research Institution. ☒ Yes ☐ No
4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 261 | LS | 3144 |

**Title:** SiExo: Modular Bayesian-Optimized Dual-Ligand TfR/RVG Exosomes for siRNA Delivery and BBB Transcytosis in CNS Neurotherapeutics

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

**Abstract:**

Neurodegenerative diseases, including Huntington's, Alzheimer's, and Parkinson's, remain difficult to treat due to the restrictive blood-brain barrier (BBB), which blocks over 98% of therapeutics. Small interfering RNA (siRNA) offers a promising gene-silencing strategy, but clinical translation is hindered by degradation, off-target effects, and poor BBB permeability. This study presents SiExo, a modular siRNA-loaded exosome platform engineered for high-efficiency CNS delivery. Dual-ligand functionalization with transferrin (TfR) and rabies virus glycoprotein (RVG) facilitates receptor-mediated BBB transcytosis, achieving a 3.5-fold increase in BBB penetration over unmodified exosomes. Fluorescence-based tracking confirmed a 32% enhancement in exosome passage efficiency ($p < 0.01$), with SiExo exhibiting 2.8-fold greater siRNA retention and 1.9-fold higher neuron-specific uptake. Bayesian optimization refined exosome configurations by dynamically adjusting lipid composition, ligand density, and siRNA encapsulation parameters based on predicted transport efficiency and receptor-binding affinity. A Gaussian Process surrogate model guided iterative optimization, improving BBB transcytosis metrics over successive training cycles. Bayesian feature weighting and hyperparameter refinement identified key exosomal properties that maximize siRNA delivery while minimizing off-target effects, yielding a 92% predictive accuracy in selecting optimal exosome formulations. Fluorescence-based siRNA uptake assays validated SiExo's gene-silencing capability, demonstrating a 62% reduction in mutant HTT mRNA expression. The modular framework enables adaptation for other CNS disorders, including Alzheimer's (targeting BACE1), Parkinson's (targeting SNCA), and glioblastoma (delivering tumor-suppressing RNA). Future work will focus on in vivo validation and preclinical translation using patient-derived neural organoids, bridging the gap toward next-generation precision medicine for CNS disorders and clinical applications.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 237 | LS | 3145 |

**Title:** Evaluating the Effects of Gypsum on the Growth of Solanum lycopersicum in a Marine Aquaponic System

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

**Abstract:**

Gypsum (CaSO4) is a naturally occurring chemical compound commonly used in agriculture as an additive to industrial fertilizers to improve soil porosity, water infiltration rates, and provide a soluble source of nutrients to aid plant growth without interfering with other aspects of the soil profile. Recently, gypsum has been observed alleviating salinity issues in sodic-saline soils, allowing a variety of glycophytic, or salt-sensitive, crops to grow in previously inhospitable environments. In aquaponics, a growing agricultural industry, the depletion of ready-to-use freshwater has magnified interest in marine aquaponics. To determine the validity of gypsum in marine aquaponics, growth solutions with 0ppt, 10ppt, and 20ppt salinities at a ratio of 3.32g/4gal are evaluated. Plants are placed in 3 separate vats and use a Deep Water Culture (DWC) aquaponic system. Water is changed every other day and water quality assesses NH4+, NO2-, NO3-, P, DO, and pH concentrations using the LaMotte Smart 2 Colorimeter. Trace elements and supplements are assessed by X-ray fluorescence (XRF). Growth proved to have a positive trend with the rate of growth ascending from 1.667% to 5.683% on average. Water quality exhibited predictable nitrogen levels depending on the salinity with elevated levels of NO3-, signifying the presence of the nitrogen cycle. The supplementation of gypsum in aquaponics proves to be an active mitigator of salinity stress, indicating that the agriculture industry can expand on marine aquaponic use in the future.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 240 | LS | 3146 |

**Title:** Leveraging of Neural Network Design to Create High-Accuracy, Low Latency Detection of Deepfake Detection

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

**Abstract:**

Deepfakes, an advanced form of AI-driven forgery, enable instant manipulation of video and audio content, posing significant security threats. In February 2024, a multinational corporation lost $25 million after an employee unknowingly attended a virtual meeting with deepfake impersonations of colleagues, underscoring the urgent need for robust deepfake detection systems. This research develops a video and real-time deepfake detection system using CNNs optimized for high accuracy and low latency. The project began with a video-based detection model utilizing ResNet pre-trained networks, achieving ~92% accuracy after 20 epochs (~20 minutes) on DFDC and Face Forensics datasets. The confusion matrix reported 196 true positives and 168 true negatives, validating the model's effectiveness. To enhance detection across different contexts, two detection pipelines were implemented: a video-based model (92.1% accuracy) for online media and a real-time detection model (81% accuracy) for live-stream scenarios. Techniques such as Fourier Transforms and Local Binary Patterns (LBP) improved accuracy by exposing imperceptible deepfake artifacts. For efficiency, ResNet will be replaced with EfficientNet, minimizing LSTM layers to optimize performance for live-streaming applications. The model's lightweight architecture ensures low computational overhead, making it scalable for deployment on consumer devices and enterprise platforms like Zoom and Microsoft Teams. This efficiency fosters broad adoption and further research, ensuring real-time capabilities to combat digital fraud. This research provides a scalable, cost-effective solution to combat the growing threat of deepfakes across critical industries.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** 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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2. Student independently performed all procedures as outlined in 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 250 | LS | 3147 |

**Title:** Determining The Effects of Wood Density on the Survival, Growth, Development, Pupation, and Adult Emergence of Anoplophora glabripennis

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

**Abstract:**

Asian longhorned beetles (Anoplophora glabripennis; ALB) are a highly destructive invasive insect species targeting primarily hardwood trees. The species completes its development within its host tree, consequently making ALB difficult to detect, and therefore eradicate, until adult emergence. ALB develop within living and cut trees, allowing their spread to be facilitated by human activity. The purpose of this study is to determine the survival, growth, development, pupation, and adult emergence of ALB in different wood densities. The hypothesis was that later instar (stage of larval development) larvae reared on denser wood would survive longer, gain more weight, and develop at a faster rate because ALB prefer denser hardwood and are better equipped for survival at later instars. The independent variables were the initial instars (first and fifth) and the species of wood used (Acer saccharum (Sugar maple; denser hardwood) and Betula populifolia (Gray birch; less dense hardwood)); the dependent variables were the survival, growth, development, pupation, and adult emergence. Test groups included first instar larvae reared on maple, first instar larvae reared on birch, fifth instar larvae reared on maple, and fifth instar larvae reared on birch. Larvae were set up in ten bolts per treatment. Bolts were checked regularly; afterward, they were dissected to collect final data. Data was analyzed through statistical analysis software to determine treatment impacts. Cut wood density had the most pronounced effects early in development. The results could provide a heightened understanding of the impacts of hosts on the species' potential future spread and establishment.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 249 | LS | 3148 |

**Title:** Comparing the Effects of Homemade Compost to Store Bought Chemical Fertilizers on Bok Choy Plant Growth

**Student Name(s):** W. Cai

**Abstract:**

Households in the United States generate 26.5 million tons of food waste every year, partly because many people do not have convenient methods to dispose of food waste in a sustainable way. Composting is an excellent way to reduce food waste and create plant fertilizer but many people choose store bought chemical fertilizers because of the complex process of composting. In this experiment, homemade compost was compared to store-bought (plant food) fertilizer on their effects on the plant growth of Brassica rapa, also known as Bok Choy. The goal was to prove that using a home cultured fertilizer would be healthier than chemical fertilizers for plant growth.

The experiment was conducted with nine plants. After the seeds had sprouted, three were given home compost, three with chemical fertilizer, and the remaining were control values growing with unfertilized natural soil. The plants were given three weeks to grow, the diameter was measured each week.

Throughout the experiment period, the heights of the fertilized plants remained similar. However, the diameters of the compost plants were much greater than both other categories, and the compost plants displayed a healthier, darker green color too.

Based on the results of this experiment, using homemade compost as a fertilizer is both a healthier and more eco-friendly way to grow houseplants. The data from this experiment can be used to encourage more people to take the time to compost their food waste because it has great benefits for their garden and the earth's environment.

**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):

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 240 | LS | 3149 |

**Title:** The effect of age on perception of personal anxiety and depression.

**Student Name(s):** P. Dwyer

**Abstract:**

This study examines the pattern of age and the awareness of anxiety and depression, as well as the actual patterns of these mental illnesses. This study was implemented to examine the extent to which different age groups overestimate or underestimate different mental health issues.

This study was examined on 30 people, 10 in the age range of 10-25, 10 in the range of 26-56, and 10 in the range of 57 and onwards. Data was collected through a paper questionnaire consisting of the combined PHQ 9(A viable and used measure of depression by Pfizer) and GAD 7(A viable and used measure of anxiety by Pfizer) and two repeat questions about how depressed and anxious the participants felt.

I expected for mental health to be overestimated in younger aged people, slightly underestimated in middle aged people, and extremely underestimated in older people. In total, the 10-25 range had the highest difference between perceived mental illness and actual mental illness. They had a difference of about +3.2 out of 10 comparatively. The 26-56 age range had a score (-1.7) very close to that of the 57+ age group(-1.8).

Overall, my results supported my hypothesis. But older people tended to have lower mental health issues in total, so how much they underestimated their issues showed a more dramatic

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 247 | LS | 3150 |

**Title:** Creating an AI to Identify Skin Conditions

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

**Abstract:**

As Artificial Intelligence is growing more and more as time goes by, it is and will expand throughout the medical field. Inspired by this, I wanted to demonstrate a type of AI that could be implemented in the dermatology field. In this project, I will be testing if AI (Artificial Intelligence) can detect common skin conditions and possibly detect early signs of life-threatening diseases. In order to execute this, I developed my own AI using the host, Teachable Machine. I registered photos of various skin conditions into the AI (around 100 -150) and then took 23 unregistered pictures for each category to evaluate whether it can be accurate or not.

My AI machine did a little poorer than expected, but it is still 58% accurate which is still close to what I had expected! I ran the test twice the blue represents the first time I ran it, and the pink represents the second time. The First time I had 16 classes, 23 tester photos, and 368 photos overall. The second time I ran it had 15 classes, 23 tester photos and 345 photos overall and it resulted in a 58% accuracy rate. The condition that it was able to detect the most were blackheads, out of 23 photos, 19 were detected resulting in an 82% accuracy. The second highest was Nodules, out of 23 photos, 17.75 photos were detected, resulting in 77% accuracy. Overall, the rest of the conditions averaged out to a 50-60% accuracy.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 231 | LS | 3151 |

**Title:** Determining the Relationship and Effects of KDM6A Isoforms of Epigenetic Contributions to Cancer in Mouse Models

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

**Abstract:**

Epigenetics is a hereditary change in gene expression, the process of genetic sequence converted into instructions/function to create molecules caused by environmental factors. It was previously discovered that by removing a specific gene in mice, it removed methyl groups from histones that can activate/inactivate certain sections of DNA. The removal of the gene which interacts with epigenetic markers in mice led to an increase of lung cancer tumors in the second generation. The purpose of this project is to identify the location and effects of KDM6A isoforms in knockout genes caused by epigenetic change leading to cancer tumors appearing in lung tissue in mouse models.The independent variables are the various mutations in the tumor's DNA sequence. The dependent variables are the location and effects of the isoforms of KDM6A located in the genome. The control of the experiment is regular lung tissue. The first step was to use three antibodies (AB300513, 33510S CST, AB36938) to a control and KDM6A knockout sample and the possible isoform were localization was determined using nuclear (Histone 3) and cytoplasmic (GAPDH) markers. Phase 2 of the project was focused on a primary band identified earlier, comparing its molecular weight to known isoforms using UniProt data. A band was detected at 60 kDa, suggesting the discovery of a potential shorthand isoform. The implications of this project are identifying factors in how cancer spreads in humans.

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LS | 3152 |

**Title:** Real-time Diagnosis and Alert of Computer Vision Syndrome, to Promote Healthy Screen-Time Habits

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

**Abstract:**

As society progresses, our reliance on technology continues to grow. This rising reliance can have various adverse effects on the human body, particularly regarding the impact of screens on our eyes. The medical term for this condition is known as Computer Vision Syndrome, which refers to the occurrence of one or more symptoms related to the eyes, musculoskeletal system, and mental health as a result of extended computer use. This research aims to develop a comprehensive real-time Computer Vision Syndrome (CVS) detection and prevention methodology, addressing the increasing prevalence of screen time in modern society. As daily screen exposure rises, CVS—characterized by ocular, visual, and non-ocular symptoms—significantly impacts individuals' well-being. The proposed model integrates three innovative detection mechanisms. First, a blink-detection model to identify and track eye movements, enabling the accurate counting of blinks. Second, a redness-detection model that assesses scleral redness through the analysis of live video streams, providing insights into ocular health. Lastly, an analysis of screen time alongside historical CVS diagnosis data creates a holistic view of usage patterns. By linking application usage with CVS symptoms, the system can predict high-risk periods for affected users with a remarkable accuracy of 96.3%. This comprehensive methodology was rigorously tested using established datasets and real-world scenarios to ensure accuracy and reliability. The culmination of these efforts is the development of a user-friendly application that detects CVS symptoms in real-time and proactively alerts users, encouraging healthier screen habits.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 159 | LS | 3153 |

**Title:** Determining the Effect of 3D Printed Staghorn, Table, and Mushroom Coral on Flood Wave Breaking And Its Potential Use Providing Coastal Relief (Connecticut)

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

**Abstract:**

Coral reefs act as natural breakwaters that absorb wave energy and break waves in coastal communities. This wave reduction occurs due to friction, as the reef's jagged and porous surfaces slow water molecules, and structural interference, as sudden changes in water depth and irregular shapes disrupt wave dynamics. With coral reef decline and advances in 3D printing technology, this study aims to determine the effectiveness of different artificial reef designs in reducing wave energy. In this study, using a computer-aid design (CAD), I recreated three coral reefs, staghorn coral (hard coral), table coral (hard coral), and mushroom coral (soft coral), and tested whether artificial reefs have similar effectiveness in reducing wave energy in a custom-built wave tank. Their effectiveness was evaluated by measuring wave height reduction, water and sand displacement under flood waves, and how much reefs were lost during testing. These experiments may benefit critical risk and environmental management, providing a potential way to mitigate flooding.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 181 | LS | 3154 |

**Title:** Developing a Hormonal Presumptive Test for Non-Dimorphic Osteichthyes

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

**Abstract:**

This study aimed to develop a rapid, presumptive test to determine gender in non-dimorphic osteichthyes species such as the Atlantic Bluefin Tuna (Thunnus thynnus). This rapid test would aid researchers in studying, maintaining, and farming critical fish species. Currently, non-dimorphic gender can only be determined in an off-site lab. The 11-Ketotestosterone (11-KT) is an androgen hormone commonly found in bony fishes. This hormone initiates secondary sexual development in males and can be up to 20x higher in males than females. This indicates that if, using a color indicative test, male samples will have far more hormone present, causing a clear difference in results and a quick identification method for male vs. female specimen. Using primary goat anti-rabbit igG antibodies and secondary anti-11-KT antibodies, a competitive, lateral flow presumptive test was constructed and used to observe the differences in results between male and female samples, establishing a new method of identifying osteichthyes gender. Using Salmon flesh samples, a dimorphic osteichthyes species with pre-known gender, baseline color differences were established between male and female.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** CB BI 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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 279 | LS | 3155 |

**Title:** NeuroStride: A Novel Multi-Modal Smart-Mat Platform for Machine Learning Driven Gait Biomarker Extraction and Early Detection of Neurodegenerative Diseases

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

**Abstract:**

200 million people worldwide are affected by Neurodegenerative diseases. Early detection is the key to slowing progression and preserving quality of life.

OBJECTIVES—Develop and validate NeuroStride, a machine learning-based gait analysis system designed for early detection of neurodegenerative diseases, including Mild Cognitive Impairment , Alzheimer's and Parkinson's Disease , using real-time spatiotemporal and kinematic gait biomarkers.

DESIGN—Cross-sectional study integrating multimodal gait assessment and cognitive evaluation, utilizing plug-and-play ML models for automated-real-time gait analysis.

SETTING—Public Gait Datasets(Physionet, MIT), Video based gait tracking (OpenPose)

PARTICIPANTS—129 datasets (MCI, AD, PD, cognitively healthy controls), 20 participants for follow-up validation phase.

MEASUREMENTS—Gait parameters were extracted using a smart-pressure mat, motion capture, and OpenPose video analysis capturing:

Gait-speed, cadence, stride-length, step-width

Turning-step-count/time, balance-recovery, center-of-mass-movement

Gait-variability, step-asymmetry.

Two models were trained on collected data to predict neurodegenerative disease risk: Random Forest Classifier, Neural-Network

RESULTS—NeuroStride identified significant gait differences between healthy controls and individuals with MCI, AD, and PD:

Reduced gait-speed and stride-length, Increased gait-variability and gait-asymmetry

Altered cadence and step-width.

Random Forest Classifier achieved high predictive accuracy:

MCI: AUC = 0.92, Accuracy = 87%

AD: AUC = 0.93, Accuracy = 91%

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

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

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☐ vertebrate animals ☐ controlled substances

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

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

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

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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 240 | LS | 3157 |

**Title:** Simulating Memory Loss:A Study of the Hippocampus

**Student Name(s):** P. Almazan

**Abstract:**

The purpose of this experiment was to investigate whether simulating memory loss can help explain the role of the hippocampus in memory formation. I conducted this study to explore how different types of memory —procedural, working, and episodic— are impacted under conditions that mimic memory impairment. To simulate memory loss, I used three experiments: tracing shapes with indirect viewing for procedural memory, studying animal facts while performing a sorting task for working memory, and reading stories while having big distractions for episodic memory. Participants were split into control and experimental groups for each experiment. My hypothesis was that simulating memory loss would provide a deeper understanding of how the hippocampus contributes to these memory processes

The experiments I conducted provided information on the hippocampus's role in memory formation by simulating scenarios that challenge its known functions. The procedural memory experiment examines how the hippocampus helps coordinate and adapt motor skills under unusual circumstances, like indirect viewing, this emphasizes its role in learning new tasks. The working memory experiment tests the hippocampus's involvement in processing and retaining information amidst distractions, this highlights its role in managing cognitive load and multitasking. Finally, the episodic memory experiment explores how interruptions affect the hippocampus's ability to consolidate narrative memories, highlighting its role in the formation of long-term memory. All together, these simulations help illustrate how disruptions to memory processes can affect everyday functioning, deepening our understanding of hippocampus's critical role in memory formation.

**Technical Disciplines Selected by the Student (Listed in order of relevance to the project)** BE 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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☐ 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: 252

# CSEF Official Abstract and Certification
2025

Fair Category: LST

Project Number: 3501

**Title:** Optimization of DNA Aptamer AS1411: An Effort to Increase Binding Efficiency to Nucleolin, an Overexpressed Protein on Cancer Cells.

**Student Name(s):** J. Cunningham, H. Mayerfield

**Abstract:**

This project aimed to manipulate DNA aptamer AS1411, a short single-stranded oligonucleotide currently being developed to improve chemotherapy's target cell specificity. As this aptamer binds explicitly to nucleolin, an overexpressed protein on the surface of cancer cells, chemotherapy damage to surrounding tissue may be lessened. This study modified the AS1411 DNA aptamer, which was named AS1411-N12, by adding 12 nucleotides to the 3' and 5' ends, forming a "flap" structure. This modification was hypothesized to further improve the DNA aptamer's binding efficiency to the nucleolin protein expressed on cancer cells. Binding reactions occurred between DNA aptamers (AS1411 and AS1411-N12) and nucleolin samples. The resulting solutions were processed using micro-centrifugal filters, which separated small unbound single-stranded DNA aptamers from bigger unbound proteins and the DNA-Nucleolin complexes. Measured absorbance of the unbound filtered DNA aptamers were analyzed to compare binding efficiencies of the modified aptamer vs. the control. The average absorbance through 3 trials of the control AS1411 DNA aptamer was 1.907 at 260nm, while the average absorbance through 3 trials was 1.364 at 260nm. Through Beer's Law, the unbound DNA control concentration was 146.6µM while the modified DNA aptamer's was 54.17µM. This modification was highly effective as it yielded a 63% change in absorbance showing a drastic decrease in the amount of DNA aptamer left in solution. The modified DNA aptamer was significantly more effective in binding to its target protein. When attached to chemotherapy, AS1411-N12 will have a higher affinity to Nucleolin, improving cancer treatment.

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 257 | LST | 3502 |

**Title:** Symbiotic Synthesis: Exploring the Co-Culture of Spirulina and Bacillus subtilis for enhanced $CO_2$ Absorption and Biomass Production

**Student Name(s):** A. Settembre, J. Lin

**Abstract:**

As global carbon dioxide ($CO_2$) levels continue to rise, finding efficient and sustainable methods for carbon capture has become increasingly urgent. Algae, particularly Spirulina platensis, play a crucial role in reducing atmospheric $CO_2$ through photosynthesis, absorbing carbon and releasing oxygen as a byproduct. In this study we aim to discover an efficient, sustainable way to improve carbon absorption. By co-culturing Spirulina platensis with the bacterium Bacillus subtilis, we measured how its cultivation affects alkalinity and the production of Oxygen, and subsequently prove the algae co-culture will absorb more $CO_2$ and create a greater algae biomass.

Multiple tests were conducted to evaluate the relationship of co-culturing Spirulina platensis and Bacillus subtilis, including measuring the alkalinity of the algae on the pH scale from a water testing kit, as well as measuring the concentration of dissolved oxygen in the algae with a Dissolved Oxygen (DO) sensor after subjecting the samples to a natural 24-hour light cycle exposure.

It was found that co-culture algae can keep a stable alkalinity level, while the control culture increased in alkalinity by 2.564%. Having consistent pH levels creates a perfect environment to promote growth of biomass. In addition, the co-culture optical density changed 7% more than the control, thus showing there was a greater production of biomass. The co-culture also had consistently greater DO levels than the control, supporting the hypothesis that there was greater carbon absorption rate and oxygen output.

This proves that co-culturing Bacillus subtilis with Spirulina will improve carbon absorption and biomass production.

**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):

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 254 | LST | 3503 |

**Title:** Family Care Indicators for Current Parenting Practices in Rural China:

Evaluating Whether FCI is an Effective Assessment Tool in the Digital Age

**Student Name(s):** V. Tang, P. Meng

**Abstract:**

Early childhood development (ECD) for ages 0 -3 is crucial for predicting lifelong outcomes. Cognitively stimulating activities (reading, singing, playing) correlate with better ECD, while their absence correlates with delays. In rural China, around 45% of children under three experience developmental delay, often linked to inadequate parenting practices. The Family Care Indicator (FCI), created by UNICEF in 2002 is widely used in low- and middle-income countries including Brazil, Nepal, Bangladesh, and rural China, and may be outdated given the rise of digital technology. This study investigated FCI's effectiveness in capturing modern caregiving in rural China. We conducted qualitative interviews in three villages in Zhushan County (Hubei) and collected quantitative data from 581 households in 12 counties in Zhejiang. Results showed 40% cognitive, 42% language, and 19% motor delays among children aged 6–24 months. Notably, 431 households lacked magazines or newspapers, and the number of adult books owned did not predict child outcomes. Children spent an average of 22 minutes daily on screens—rising to 40 minutes among those 18–24 months—indicating a sharp increase in digital exposure after infancy. Meanwhile, caregivers used screens for nearly four hours daily, with 90% seeking parenting information online. However, about 39% lacked the confidence to evaluate or apply online information. These findings suggest that FCI's emphasis on physical materials no longer reflects how parenting practices influence ECD. Updating the FCI is integral to account for digital exposure and parental screen usage could help address high rates of developmental delay and improve interventions in rural China.

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

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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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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 247 | LST | 3505 |

**Title:** Early Detection of Glioblastoma Multiforme Using a Novel in Silico Random Forest Model on Blood Proteomic Signatures

**Student Name(s):** V. Kansara, N. Solomon

**Abstract:**

Glioblastoma multiforme (GBM) is the most common and aggressive malignant brain tumor in adults, characterized by rapid growth, heterogeneity, and a poor prognosis. Despite advances in treatment, including surgery and radiation, the median survival rate remains under 15 months. Current diagnostic methods, including MRWeand biopsy, are invasive, expensive, and often detect tumors at advanced stages, reducing the effectiveness of early intervention. Blood-based biomarkers offer a promising non-invasive alternative, enabling earlier detection of GBM and improving patient outcomes. This study utilizes a random forest algorithm to analyze blood proteomic profiles, aiming to identify key biomarkers for GBM detection. The dataset, obtained from the National Cancer Institute Proteomic Data Commons, was preprocessed and split into training and testing sets. A random forest classifier was applied to extract protein signatures from the mass spectrometry data, followed by feature selection using tree selection and model prediction. The model had a high accuracy of 84.4% with a receiver operating characteristic (ROC) value of 0.86135. The model's precision (0.80), recall (0.86) and F1 score (0.84) further indicated strong performance, decreasing the chance of predicting false positives. Compared to existing diagnostic models that rely on invasive tissue samples or imaging, our model offers a non-invasive, accessible diagnostic tool using blood proteomics. This approach could reduce the reliance on invasive diagnostic methods like biopsies and enable earlier treatment. The integration of machine learning and proteomics holds significant potential for advancing GBM diagnosis and treatment, potentially improving patient prognosis and quality of life.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LST | 3506 |

**Title:** Evaluating the Use of Varying Media To Determine Optimal Conditions For the Increase of pH Levels and Potential Removal of Low-Concentration Pollutants in Acidic Ocean Environments

**Student Name(s):** T. Adeniran, T. Adeniran

**Abstract:**

As the increase of carbon emissions becomes more widespread, ocean acidification has become an evident consequence. Particularly, several studies have confirmed that decreased availability of calcium carbonate has made it difficult for certain marine species to survive in such conditions, threatening the health of larger populations as a whole (Kroeker et al.). Thus, this research project aims to employ three different media — magnesium hydroxide, pulverized limestone, and titanium dioxide-induced photocatalysis — and evaluate their effects on simulated oceanic environments, ultimately to determine the association between each medium's properties and its ability to provide the most sustainable long term benefits, as well as its potential to effectively remove low-risk, low-concentration pollutants from aqueous solutions. By using 0 to 3 grams of magnesium hydroxide and pulverized limestone respectively in independent trials, pH levels of simulated oceanic environments, before and after the addition of each chemical, can be adequately controlled for. Furthermore, by utilizing 2 grams of titanium dioxide and allowing it to catalyze, pH levels can be measured at various time increments. It was hypothesized that magnesium hydroxide would provide the most substantial increase in pH levels. Additionally, an engineering objective, centered on creating a prototype of a biodegradable mechanism that dispenses and houses the most effective medium while benefiting aquatic environments, was proposed. The data found supported the hypothesis that magnesium hydroxide would facilitate the greatest benefits to aquatic environments, mitigating the impact of increasing acidity on marine species, as it created the greatest increase in pH.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 122 | LST | 3507 |

**Title:** Creation of a Long-term, Biodegradable, Alkaline cube to locally offset the effects of ocean acidification in reef ecosystems.

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

**Abstract:**

The level of CO2 in the atmosphere has caused a drop in the pH level in the ocean, and a rise in acidity levels. In the past few decades, pH levels have decreased a lot faster than they have before. This project aims to find a sustainable way to raise the pH level in the ocean using basic materials. Multiple mixtures and blocks were made and the one that stayed together and increased the pH slowly was the best mixture. Blocks were made out of sodium alginate, calcium carbonate, and magnesium hydroxide, then baked and left to harden. They were massed, placed in a oceanic replicated environment, and tested every 24 hours. Results indicated sodium alginate in small doses was most effective.

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

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

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☐ vertebrate animals ☐ controlled substances

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

☒ Yes ☐ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 209 | LST | 3509 |

**Title:** Impact of Sunscreen Contaminants on Plutes Growth and Development

**Student Name(s):** A. Hackett, K. Tortorich

**Abstract:**

Ocean pollution from sunscreen toxins has been a growing concern since scientists first identified harmful chemicals affecting marine life in 2008. Research estimates that 4,000–6,000 tons of sunscreen are washed off human bodies into the ocean annually, disrupting the growth and development of marine organisms. Despite the emergence of "reef-safe" labeling, this term lacks regulation and often serves as a marketing tactic to drive sales. This study investigates how the growth and development of sea urchin larvae are impacted by “reef-safe” vs. conventional sunscreens while providing insight into the ecological effects of the chemicals in sunscreens. Urchins were injected with 2mL of a 0.5M KCl solution, then gametes were mixed to fertilize the eggs. After 2 days, the pluteus was placed into well plates containing different concentrations of sunscreen solution. Observations were made daily for 27 days. The average day of change was 5.575. Observations showed all embryos, except the control, displayed abnormal development. Hawaii, the U.S. Virgin Islands, and Mexico have banned organic sunscreens that contain the following UV filters; oxybenzone and octinoxate. These chemicals cause issues in marine animals' reproductive systems, immune systems, and impair the growth of green algae. This project discovered sunscreens; reef-safe, organic, or traditional are toxic to marine life.

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

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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
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 245 | LST | 3512 |

**Title:** AlkaSand: A Comparative Analysis of Mineral Combinations for Enhanced Ocean Alkalinization to Mitigate Ocean Acidification

**Student Name(s):** S. Shah, R. Reed

**Abstract:**

Ocean acidification, resulting from the absorption of atmospheric carbon dioxide by the world's oceans, has led to a 0.1 pH decrease since the Industrial Revolution, posing a significant threat to marine ecosystems. This pH reduction has devastating consequences, including coral reef destruction, premature death of calcifying organisms, and disruption of maritime food chains. This study investigates AlkaSand, an alkalinization approach using synergistic minerals to enhance the ocean's carbon sink. Controlled experiments tested olivine, basalt, limestone, and carbonate, alone and in combination, in distilled water (initial pH 5.30) and lime juice solutions, measuring pH over six days. Stoppered beakers were kept in a fume hood for environmental control and safety. The optimal mineral mixture was determined based on its ability to minimize pH fluctuation and provide long-term stabilization. Initial trials excluded lime juice due to the distilled water's acidity. Stoppered beakers were kept in a fume hood for environmental control and safety. In distilled water, the 75% limestone/25% basalt mix proved most effective, raising pH from 5.30 to above 8.8 and maintaining sustained alkalinity. Limestone offered rapid initial pH increase, complemented by basalt's long-term stabilization. In lime juice solutions, similar trends were observed, with the same 75/25 mix yielding the most favorable results. These findings suggest that AlkaSand, especially this limestone/basalt combination, offers a promising strategy for controlled, effective, and adaptable ocean alkalinization. The flexible design of the study may also contribute to our understanding of ocean alkalinization strategies across varied conditions.

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

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

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☐ vertebrate animals ☐ controlled substances

2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 102 | LST | 3513 |

**Title:** Protecting Turtle Grass Ecosystems: An Investigation of the Anthropogenic Impact on Statocytes, Root Hairs, and Subsequent Anchorage

**Student Name(s):** T. Bancroft, W. Pallone

**Abstract:**

The objective of this project was to investigate the impact of sound pollution on the statocytes and root hairs of turtle grass, with a focus on the plant's capacity to maintain anchorage within the substrate. Control and testing tanks containing live rock and sand were maintained at environmental norms including pH, salinity, and temperature. Waterproof speakers were built and used to mimic the vibrations and decibel levels equivalent to boat engines. Further testing involved using a sonicator in place of the speakers. Root tips were harvested, stained, and viewed microscopically to observe statocyte condition and impact on root hair density and attachment.

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

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2. Student independently performed all procedures as outlined in this abstract. ☒ Yes ☐ No
3. This project was conducted at a Registered Research Institution. ☐ Yes ☒ No
4. Is this project a continuation? ☐ Yes ☒ No
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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 214 | LST | 3515 |

**Title:** Environmental DNA Testing

**Student Name(s):** J. Acevedo, N. Van Haitsma

**Abstract:**

Invasive species, such as Hydrilla verticillata, cause significant ecological and economic damage by disrupting native ecosystems and biodiversity. Early detection of these species is crucial for effective management and preventing further spread. This study explores the use of Environmental DNA (eDNA) as an efficient, non-invasive tool for early detection of invasive species in the environment. eDNA testing analyzes genetic material shed by organisms into their environment, allowing for the identification of species even at low concentrations. This study specifically focuses on a highly invasive species in Connecticut Hydrilla Verticillata. This species can outcompete native plants,impact biodiversity, and degrade water quality. Water samples from lakes across Connecticut were filtered, and DNA was extracted and amplified using PCR to target the rbcL plant gene. Plant DNA was successfully detected in positive hydrilla samples and other water samples, with concentrations as low as 7.1 ng/ul. The resulting DNA was sequenced and compared against known species databases to detect the presence of Hydrilla verticillata; final sanger sequencing results are pending. This approach offers advantages over traditional methods, including faster detection, the ability to survey large areas, and improved accuracy. The results from this study highlight the potential of eDNA as an early detection system for invasive species, contributing to more effective ecosystem management and conservation.

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

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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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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LST | 3516 |

**Title:** Testing Therapeutic Interventions for Lung Illnesses

**Student Name(s):** N. Akberzai, J. Keelu

**Abstract:**

We investigated the different treatments for lung illness using balloon models to represent human lungs. We wanted to evaluate the effectiveness of treatments such as saline solution and an inhaler in clearing mucus obstructions as well as helping lung function. The hypothesis is that saline solution would be the most effective treatment.

A control group was created to compare a healthy lung model that contains no mucus with an obstructed lung model. The obstructed lung contained cotton balls and gel inside a straw. To test treatment efficiency, saline solution and a spray bottle (inhaler) to clear the blockage upon the two experimented balloons. A balloon pump was then used to inflate the balloons. The balloon that inflated the most with the treatment is effective in treating lung illnesses. Results showed that the control (healthy lung) inflated to 21 inches within 13 seconds. The obstructed lung treated with saline solution inflated to 15 inches, and the balloon treated with an inhaler only inflated 7-8 inches. This suggested that saline solution is more effective in clearing mucus compared to the inhaler.

Saline solution is preferred for treating mucus-related lung conditions. When nebulize, it hydrates and loosens thick mucus, making it easier to expel. This is represented in the experiment, where the mucus filled balloon model treated with saline solution showed significantly better airflow. Saline solution is more effective at clearing mucus compared to inhalers, which primarily only work on relaxing the airway muscles rather than directly breaking the blockages.

**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

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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 | CSEF Official Abstract and Certification 2025 | Fair Category | Project Number |
|---|---|---|---|
| 251 | | LST | 3517 |

**Title:** Using Machine Learning and Regression Models to Predict Atherosclerosis in Humans Considering Gene Expression, Sex, and Age as Factors

**Student Name(s):** P. Liu, L. Zhang

**Abstract:**

Atherosclerosis is a disease that clogs the wall of an artery with lipids and foam cells and was the cause of 31% of global deaths in 2015. Symptoms aren't often felt until the disease has advanced, when it frequently leads to fatal complications like stroke and heart disease. Studies have shown that treating earlier stages of atherosclerosis can return the heart to normal levels of function and slow down or reverse plaque formation in the arteries. Early screening and developing prediction models are essential to catch atherosclerosis in its more treatable stages. Currently, most atherosclerosis prediction models only evaluate clinical data, such as sex, age, race, smoking status, or cholesterol. Recently, models taking gene expression into account have shown a higher accuracy than clinical models. We want to determine if using both clinical data and gene expression would make a prediction model with comparable or better accuracy than other models. To build our model, we used dataset GSE221615, which categorizes 391 human blood samples based on an atherosclerosis disease level ranging from none to severe. The binomial logistic regression and support vector machine models produced the highest accuracy, precision-recall, and ROC score, with results comparable to several atherosclerosis risk prediction models. We also discovered overlaps between features having positive and negative correlations with atherosclerosis from our highest-performing models and genes found to be upregulated in atherosclerosis in other studies. We hope that our prediction model may provide reasoning to implement gene expression and clinical data in atherosclerosis prediction models.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 137 | LST | 3518 |

**Title:** Identification & Isolation of Ungulate Proteins Similar to Human Protein SCGB1D2 for use in Disease Inhibition

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

**Abstract:**

Our project aimed to isolate and test ungulate proteins similar to a known human Borrelia inhibitor (SCGB1D2) to assess their antimicrobial effects. Borrelia burgdorferi, the bacteria that causes Lyme disease, evades the immune system, so identifying proteins that inhibit its growth could lead to new insights into natural defenses and potential treatments. Using gel filtration chromatography combined with SDS-PAGE, proteins with similar molecular weight to SCGB1D2 were isolated from venison and beef tissue, as well as bovine blood. This was followed by antimicrobial testing against Rhodospirillum rubrum, a model organism with characteristics similar to Borrelia burgdorferi. The results were analyzed for significance and showed that protein fractions from bovine blood, steak, and venison samples, which contained primarily low molecular weight proteins (~10 kDa, similar to SCGB1D2), inhibited the growth of Rhodospirillum rubrum and potentially Lyme disease.

**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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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 254 | LST | 3519 |

**Title:** A Comprehensive Method to Combat Antibiotic Resistance in Soil Microbes: Integration of CRISPR-Cas9 Gene Editing and Nanoparticles for Enhanced Biodegradation of Pollutants

**Student Name(s):** S. Aliminate, S. Aliminate

**Abstract:**

Antibiotic resistance is a growing global threat, exacerbated by environmental pollutants that disrupt microbial ecosystems and increase selective pressure for resistant bacteria. This study explores a dual approach using CRISPR-Cas9 gene editing and silver nanoparticles (AgNPs) to enhance bacterial biodegradation of Bisphenol A (BPA) while reducing antibiotic resistance. We hypothesized that CRISPR-modified bacteria, combined with AgNPs, would exhibit improved BPA degradation, decreased resistance, and altered growth dynamics compared to unmodified strains.To test this, Escherichia coli DH5α was genetically modified using a CRISPR-Cas9 system targeting antibiotic resistance genes. Bacterial cultures, normal and CRISPR-modified strains, were exposed to BPA and AgNPs, and their growth rates, colony size, and BPA degradation were monitored over five days. ImageJ software was used to quantify bacterial colony count and measure the percentage of plate coverage, while BPA degradation was analyzed using liquid-liquid extraction and mass spectrometry.Results revealed that a combination of CRISPR-modified bacteria and AgNPs was highly efficient, yielding the lowest amount of BPA remaining (area under the peak = 264), indicating enhanced degradation efficiency compared to other conditions. Furthermore, the modified strains formed larger, more abundant colonies, demonstrating increased growth capacity. This enhanced colony formation was associated with reduced antibiotic resistance, confirming successful modulation of the bacteria's genes.This research demonstrates that CRISPR-Cas9 can be leveraged to combat antibiotic resistance and improve pollutant degradation, presenting a scalable bioremediation strategy. Future research should explore optimizing gene targets, assessing long-term ecological impacts, and integrating this approach into wastewater treatment plants, bioreactors, and environmental cleanup initiatives.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 219 | LST | 3520 |

**Title:** Picrasin B Suppressed the Progression of Alzheimer's Disease by Regulating Cystatin F-related Pathway

**Student Name(s):** T. Dong, S. Han

**Abstract:**

Current Alzheimer's disease (AD) treatments always focus on pathological symptoms improvements, with limited effectiveness in slowing disease progression. Considering the complex pathogenesis of AD, novel therapeutic targets are urgently required, which may not only provide more effective treatment options for patients, but also significantly improve disease prognosis through early intervention. The present project combines data analysis after transcriptomics sequencing and pocket binding prediction based on molecular dynamics testing, aiming to target a new AD key target gene, Cystatin F. The results clearly demonstrated that Picrasin B served as one of the key components of drug-forming drugs for Alzheimer's disease, and Picrasin B might modulate the expression level of Cystatin F protein. In this study, an AD animal model was constructed using zebrafish as the experimental subject. After the comparative experiments using Pircrasin B administration for three days, the number of nissl bodies, the number of Aβ protein complexes, the pathological staining of fish liver and kidney tissues, the level of several biochemical indicators in fish liver and kidney tissues, and the expression level of Cystatin F in fish brain tissues were detected, respectively. Results demonstrated that Pircrasin B lessened injuries in AD animals, Pircrasin B was also proved to play key roles in alleviating AD progression through regulating the expression level of Cystatin F and the related pathway.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 248 | LST | 3521 |

**Title:** Investigation On The Side Effects Of Caffeine, Microplastics and Increasing Temperatures on Danio Rerio embryonic development

**Student Name(s):** D. Clottey, P. Manikandan

**Abstract:**

Studying the effects of caffeine, microplastics, and increasing temperature on zebrafish embryos can help us to understand how these environmental stressors may similarly affect human health. This project investigates how these factors influence zebrafish embryonic development by analyzing morphological defects, heart rate, and survival rate. Breeding chambers containing two males and five females were used to maximize embryo production. The embryos were incubated at 28.6°C (their standard living temperature) and monitored from 24 hours post-fertilization to 72 hours post-fertilization using imaging techniques. Experimental conditions varied across three factors: temperature (28.6°C to 38.6°C), caffeine concentration (100 mL to 1000 mL), and microplastic concentration (50 mL to 500 mL). A control temperature of 28.6°C was used to model the natural temperature zebrafish develop, providing a baseline for all experiments. The results demonstrated that microplastics are highly toxic to zebrafish embryos, significantly reducing survival rates and increasing morphological defects. Caffeine exposure stimulates embryonic activity, increasing heart rate. Higher temperatures also elevated heart rates and caused morphological changes, with extreme temperatures leading to increased mortality. Morphological changes included defects in the otic vesicle, an enlarged heart ventricle showing signs of tachycardia, and accelerated somite production. These findings indicate that all three factors negatively affect zebrafish embryonic development and pose potential environmental risks. As the zebrafish is a model organism frequently utilized to examine human biology since we share more than 70% of our genes, these results suggest potential defects in human embryos under similar environmental conditions.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 122 | LST | 3524 |

**Title:** The Development of an Organic Powder to Rapidly Increase Nutrients in Degraded Soil

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

**Abstract:**

Soil degradation has become a growing concern due to over-farming and the use of synthetic fertilizers. Compost is a sustainable alternative but it is bulky, carries an odor, and is challenging to store. This project aims to create a compost based, dehydrated, organic powder for rapid and efficient soil reconstitution. Various combinations of leaf litter, compost tea, and raw compost were used to create powders designed to improve soil quality. Quality was tested by measuring plant growth, density, and chlorophyll concentration. Results were analyzed using average mass of grown sprouts and chlorophyll that indicate the increased nutrients in the soil as compared to the control. We concluded the powered composed of 25% leaf litter, 25% compost tea , and 50% raw compost.

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

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

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 237 | LST | 3525 |

**Title:** Potential Impact of Nutrient Loading on Nitrate Uptake of Marine Macroalgae

**Student Name(s):** S. Bianchine, N. Bergeron

**Abstract:**

In recent news, management of our coastal ocean habitats like coastal marshes has come under heavy scrutiny. The ecosystem service of pollution management is being balanced against elevated nutrient loading and is at the heart of the decisions to repurpose and improperly manage these ecologically sensitive systems. With that in mind, this study was done to evaluate the potential impact of eutrophic nutrient loading on the ability of the base of these systems —namely algae— to absorb the nutrients. Replicated trials at various nutrient levels (0-12 ppm) were used to test this theory, with eutrophic conditions theorized to show the highest uptake. Upon analyzing, no measurable difference between control through ambient levels was shown, however elevated levels showed significantly high uptake in comparison to the control (0.17 ppm v. 0.04 ppm; $p = 0.028$). The fact that eutrophic conditions also showed no measurable difference in comparison to other treatments indicates to us that there is evidence that eutrophic conditions tended to inhibit nitrate uptake. These findings imply that eutrophic conditions could compromise marshes' capacity to buffer against nutrient pollution. This is an especially important detail for coastal zone managers to consider as we see more and more enhanced loads and stress on the algae and the service they provide within these marshes. It's theorized that photosynthetic pathways become preferred in these stressful conditions, and this is thought to be the logical next step in this line of research.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 172 | LST | 3527 |

**Title:** Greener Alternatives:

Assessing Bioplastics Environmental Impact and Practical Use

**Student Name(s):** L. Lin, M. Ahmed-Islam

**Abstract:**

The ever-growing accumulation of harmful synthesized plastics has posed a significant threat to the environment due to the increasing demand for plastic-based products in human life. Therefore, the researchers in Miss Porter's School aimed to study the greener alternatives of commercial plastics — biodegradable plastics made from renewable biomass sources. In this experiment, the researchers compared two common recipes of bioplastics, cornstarch-based and algae-based, by producing them in the lab, and testing their functionality and environmental impact. The tensile strength, elongation, durability, supported weight, electrical conductivity, and waterproofing of plastic pieces are examined and compared to those of conventional plastics. At the same time, several pieces of bioplastics are planted into pots of radish seeds, and their growth is tracked and compared in one month. Moreover, by modifying the proportions and types of plasticizers, we attempted to optimize the bioplastics for improved balance in textures and functionality. The results provide insights into the potential of cornstarch-based and algae-based bioplastics as an eco-friendly alternative to conventional plastics.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 121 | LST | 3528 |

**Title:** Isolation of Regenerative Proteins in Echinoderms: An investigation of Asterina gibbosa

**Student Name(s):** T. Carney, P. Crosby

**Abstract:**

This project investigates regenerative proteins in echinoderms, focusing on Asterina gibbosa. The study aims to determine whether Asterina shares regenerative proteins with other echinoderms, namely Patiria Miniata. Nodal, a protein identified in P. miniata, has a weight of ~53kDa. Three different protein gels attempted to expose proteins in the Asterina and possibly locate the Nodal protein. Techniques such as centrifugation, mortar and pestle homogenization, and column chromatography were employed to improve sample quality by increasing protein concentration. However, the gel results were largely inconclusive. Despite attempts to increase protein concentration, the samples only produced faint bands across the gel. One of these bands was around 50 kDa, but its faint appearance made it impossible to conclude that this protein was Nodal.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 249 | LST | 3529 |

**Title:** H2Oh NO what's in your water?

**Student Name(s):** H. Khaliq, Z. Khawaja, R. Bennet

**Abstract:**

Purpose of this project is to analyze and compare the quality of different water sources to determine which is the safest for consumption. We will focus on five water types: tap water (sink), school water (fountains), river water (Connecticut River), filtered water (refrigerator filter), and distilled water (Costco). To compare the quality of various water samples, we will test for key water quality parameters, this project aims to identify the cleanest and safest water source for drinking.

Methods: Ten water samples (two from each source) will be collected in clean, labeled containers to prevent contamination. The samples will be tested for pH, dissolved oxygen, nitrate, phosphate, bacteria, iron, and hardness levels using test kits, strips, and meters. For example, pH with pH strips, bacteria with coliform kits, and dissolved oxygen with a meter. All the results will be recorded and organized to compare.

Expected Outcomes: We hypothesize that filtered water will be the safest to consume due to its lower levels of contaminants, including bacteria, phosphates, nitrates, and hardness. We expect filtered water to exhibit the lowest bacterial count and most balanced chemical composition, making it the most suitable for consumption. We also expect filtered water to have low pH levels, dissolved oxygen, & iron.

Conclusion: This project will provide a comprehensive comparison of water quality across different sources, offering valuable insights into water safety. The findings will help identify the cleanest and safest water source for consumption and highlight the importance of water quality testing in ensuring public health.

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

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4. Is this project a continuation? ☐ Yes ☒ No
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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 232 | LST | 3530 |

**Title:** ProPreserve

**Student Name(s):** S. Ali, P. Srivastava

**Abstract:**

Project ProPreserve aims to address the significant issue of food waste in schools by developing natural, sustainable solutions to extend the shelf life of fresh produce. Partnering with Blue Earth and Curbside Compost, we conducted research showing that schools are responsible for nearly 800 tons of total food waste annually, primarily due to the rapid spoilage of produce. To tackle this issue, we tested several methods to preserve the freshness of apples, a commonly wasted fruit in schools, using natural ingredients. Our experiment involved four different treatments - untreated apples, apples wrapped in cling flip and stored in an airtight container, apples wrapped in paper towels and apples soaked in a lemon juice and ice water solution.

The result revealed that citrus infused treatments, such as lemon juice and airtight sealing, extended the apples shelf life by up to 21 days, compared to the 2-5 days for untreated apples. Building on this data, we developed three inventions, the Fresh Guard Wraps, Produce freshness pouches and citrus infused spray, all utilizing citrus antioxidants and acids to slow down spoilage and microbial growth. These solutions offer an eco-friendly alternative to chemical preservatives. Moving forward, we aim to refine our prototypes with the support of our non profit partner ad test their real world application in schools. By reducing food waste, we aim to foster a more sustainable and cost effective food system in school.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 230 | LST | 3531 |

**Title:** Applying Higuchi's Fractal Dimension and Kernel-Based Learning to Monitor Tremor Severity and Gait Dynamics in Parkinson's Disease

**Student Name(s):** H. Chaine, L. Chen, L. Jiang

**Abstract:**

In response to the rise in Parkinson's disease (PD) and its unpredictability, this study investigates the potential of machine learning to predict symptoms in PD patients. Affecting 10 million people worldwide and nearly 1 million Americans [1] [2], Parkinson's has become the second most common movement disorder in the world—a number that has increased by 50% since previous years [3], [4]. Tremors and gait impairments are among PD's most challenging motor symptoms since they do not respond effectively to conventional medicines and are often unpredictable, placing hardship on both caretakers, doctors, and patients. In response to this challenge, scientists have been prompted to explore different methods to predict PD, including a rapid rise in using machine learning in predicting PD patterns [6]. Inspired by these studies, such as the one made by Li and Li [2] and Farashi et al. [5], we aim to use a different approach to monitor tremor severity and gait dynamics. Thus, this study proposes the application of Higuchi's fractal dimension and kernel-based learning to monitor tremor severity and gait dynamics in Parkinson's disease. The data set, sourced from physionet.org, was analyzed by graphing and comparing the data collected from force sensors attached to patients. By leveraging fractal analysis and nonlinear classification, this research seeks to uncover previously unrecognized patterns in PD motor symptoms, offering a novel framework for improved diagnosis and symptom tracking.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 207 | LST | 3532 |

**Title:** Discovery of an Inhibitor for

PR-10 Food Allergen Reactions

**Student Name(s):** P. Saunders, J. Wendell

**Abstract:**

Pathogenesis-related 10 (PR-10) proteins have the risk to trigger allergic reactions in humans. These allergens due to their similar structure are able to cross-react with others, meaning those who are allergic to one PR-10 protein can be susceptible to being allergic to another. PR-10 proteins are widely known for both their structure and function, but less is known on inhibitors to change the structure to prevent human IgE binding. In this experiment, we provide insight to an possible inhibitor to PR-10 proteins through the use of the flavonoid catechin. We observed the change in molecular weight in both the native and denatured proteins, measured via SDS-PAGE. The differences in molecular weight between different samples in polyacrylamide gels were recorded to confirm the binding of catechin. We found that binding occurred slightly in the denatured samples and fully in the native samples, more in peanuts and less in strawberries. Moreover, the results show that catechins have the ability to mask these proteins, further suggesting that it can prevent IgE binding and an immune response. Overall, this study suggests the use of catechins and other flavonoids in the process of assisting immune defense to those who are allergic to PR-10 proteins.

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

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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: 253

# CSEF Official Abstract and Certification
2025

Fair Category: LST

Project Number: 3533

**Title:** A Comparative Study Investigating the Role of Tryptophan on Memory in a Growing Brain through Supplementation

**Student Name(s):** S. Girard, A. Czajkowski, L. Carillo

**Abstract:**

Tryptophan, a substance for the large neutral amino-acid transporter system, competes for transport with several other amino acids essential for brain function. Clinical studies show that "acute tryptophan supplementation improved serial reaction times, attention scores and abstract visual memory, while chronic supplementation increased positive facial recognition memory and decreased baseline static responsibility." (National Library of Medicine). In this study, aiming to conclude the effects tryptophan on the developing brain and particularly memory, participants ranging from fifteen to twenty five years of age (n=10) were administered the Short Blessed Test, Mini Mental State Examination (MMSE), Edinburgh Cognitive and Behavioral ALS Screen, St. Louis University Mental Status Exam, and CAM-ICU test before ingesting a dosage of tryptophan based on weight. Five hours after consumption, the participants were asked to complete a second variation of these tests, where the results were analyzed to determine the effects tryptophan has on the developing brain. This procedure was repeated for three consecutive days to collect measurable data. The Paired-T test was performed on the baseline and final test scores to determine whether or not tryptophan supplementation impacted memory across days. It was concluded that there was no significant statistical difference in the data, suggesting that the null hypothesis can be accepted. By accepting the null hypothesis, it can be determined that there were other influential variables (test difficulty, test length, average daily tryptophan intake per person) that played a role in an individual's memory over the course of the experiment, more so than tryptophan itself.

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

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- ☐ potentially hazardous biological agents
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- ☒ 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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☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 257 | LST | 3535 |

**Title:** Investigating Novel Antibiotic Adjuvant Therapy Using Tetracycline and a Terpene-based Plant-derived Efflux Pump Inhibitor

**Student Name(s):** J. Subbu, A. Lehnhoff

**Abstract:**

Antibiotic resistance mediated by active efflux of antibiotics poses an immediate and growing threat to public health, and has thus been the cause for extensive research into inhibitors of these proteins –adjuvant therapies. While β-lactamase inhibitors present the most well-characterized class of antibiotic adjuvant therapies within the literature, investigation towards interactions between adjuvants and tetracyclines remain unclear, especially in E. coli and gram-negative bacteria. Here, we investigate the effect of terpenes as a therapy, using three compounds –parthenolide, artemisinin, and carvacrol– to better illustrate interactions with tetracycline-resistant gram-negative bacteria. In order to discover the potential of these compounds, the primary step was to confirm their antibiotic effect on their own through Kirby-Bauer disk diffusion assays in resistant bacterial cultures. Using a mutant strain of E. coli (DH5-alpha) with a plasmid vector encoding the TetC pump, disk diffusion analysis with serial dilutions of the compounds revealed that carvacrol was the only of the three compounds to exhibit possible antibiotic effectiveness with a minimum inhibitory concentration (MIC) of (1360 µg/mL). Therefore, a Fractional Inhibitory Concentration (FIC) test was performed with a checkerboard assay. This secondary screen revealed possible synergistic and additive effects with the addition of tetracycline and carvacrol together at specific concentrations in the presence of the DH5-alpha cells, exhibiting a calculated FICI of 0.3 at 272µg/ml of carvacrol and 10µg/ml of tetracycline. These results help to understand the path towards reversing adaptations of bacteria towards existing antibiotic classes, allowing for immediate delivery of treatment to patients.

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

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# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 114 | LST | 3536 |

**Title:** The effect of invasive English Ivy on native Wild Ginger plants

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

**Abstract:**

English Ivy (Hedera helix) is an invasive species that threatens native plants like Wild Ginger (Asarum canadense). This study examines how English Ivy affects Wild Ginger's growth and survival. English Ivy spreads quickly, forming dense mats that block sunlight and compete for nutrients. As a result, Wild Ginger struggles to establish, leading to reduced biodiversity. To analyze this impact, we observed Wild Ginger in areas with and without English Ivy. Findings suggest that Wild Ginger populations are significantly smaller in ivy-dominated areas. This highlights the need for invasive species management to protect native plants. Future research could explore effective removal methods. Protecting native plants like Wild Ginger is crucial for maintaining healthy ecosystems.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
2025

| Word Count | Fair Category | Project Number |
|---|---|---|
| 160 | LST | 3537 |

**Title:** The Effect of UV Repellents and Absorbents on Growth and Survival Rates of Phytoplankton

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

**Abstract:**

While much research has focused on the impact of sunscreen on macrofauna, such as stony corals and fish species (NOAA, 2024), there is a notable lack of studies examining their effects on prokaryotes and microscopic eukaryotes, including dinoflagellates and diatoms. This study aims to investigate the impact of UV repellents and absorbents on the growth of microalgae and cyanobacteria found in and around coral reef ecosystems. Various algae species were cultured in a seawater medium and baseline absorption and transmittance were collected. Cultures were divided and microdosed with solutions matching the levels of oxybenzone, avobenzone, and zinc oxide currently found in waters adjacent to resorts and subsequent human traffic. Absorbance and transmittance data were recorded over 36 hours. Results were analyzed for statistical relevance and indicate that the absorbance of each Phytoplankton was heavily altered by both UV Repellents and Absorbents. Going to portray the detrimental effects of such chemicals on the micro-algae and CyanoBacteria occurring in ocean ecosystems.

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

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

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

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

☐ Yes ☒ No