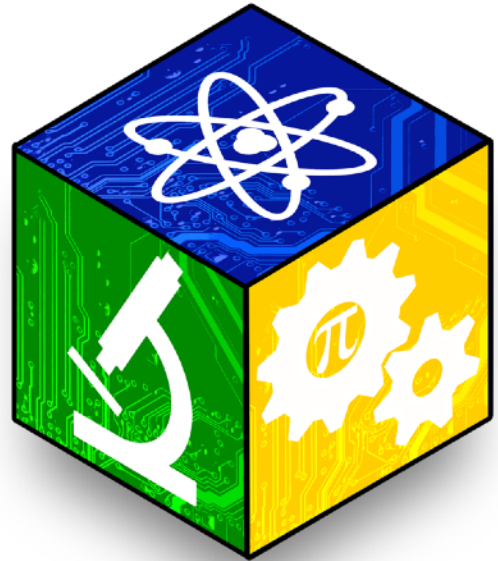# CONNECTICUT SCIENCE & ENGINEERING FAIR

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

# Student Abstracts

# Fair Categories

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

# Technical Disciplines

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

# Technical Discipline Composites

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

# CSEF Official Abstract and Certification
## 2023

**Title:** Testing the Absorbency of Different Hydrophobic Fibers on Different Oil Samples

**Student Name(s):** J. De Sousa, J. Watson, E. Moore

**Abstract:**

By testing the absorbency of hydrophobic fibers on different types of oils in water, these tests can help to find a way to clean oil spills in water safely, so oil spills no longer cause damage to the environment. The research question of this project is, "How much of different oil samples is absorbed by different hydrophobic fibers?" If hair, wool, and cotton tubes are being tested on different types of oils, then the hair tube will be the best absorbent. This is because of the porous cortex inside the human hair and the amount of oil the hair tubes have absorbed in previous oil spills around the world. The different hydrophobic fibers (hair, wool, and cotton) were put in tubes made out of mesh and were tested under simulated oil spills by using motor, corn, and vegetable oil to observe their absorbency levels of different types of oil. The absorbency between the hydrophobic fibers and the oils was measured in grams to see how many grams the hydrophobic fiber tubes had absorbed of the different types of oils, after the experiment, hair had the best absorbency out of wool and cotton because of the porous cortex which is a part of the hair that best absorbs oil. To conclude, hair is the most absorbent of oils, especially crude oils, because of the porous cortex in the hair, which supports the hypothesis, meaning that hair is a clean and safe way to efficiently clean oil spills.

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

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

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

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

☒ Yes ☐ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Solar Powered Charger

**Student Name(s):** N. DeJesus, N. DeJesus, K. Conde

**Abstract:**

For our science project we decided to build a solar powered charger that uses sunlight to charge both android and apple devices, in order to solve problems like electrical pollution, and high electricity bills. For our first design we used regular AA batteries which decreased the battery life of our devices. For example the percentage of an iPhone went from 92% to 88%. For our second updated design we re-soldered the wires, made the aluminum foil cover customizable, and switched our main power source to rechargeable batteries that increased both the battery percentage of our devices, as well as the charging rate. The percentage of the iPhone went from 24% to 26%. In conclusion we were successful in charging apple and android devices using solar energy because of the updates we made to our design.

**Technical Disciplines Selected by the Student**
**(Listed in order of relevance to the project)**    EE 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
## 2023

**Title:** What is the Effect of Grass Height on Flammability?

**Student Name(s):** A. Dickinson, E. Reda, H. Sanchez

**Abstract:**

By revealing what grass height burns the fastest, it will help city officials understand why grass can catch on fire easily, and what grass height is the best to reduce fires. The research question of this project is; How can we reduce the number of fires along the highways in our city? Our group hypothesized that a grass height of 9 centimeters will take the most time for the fire to spread to the other side because 9 centimeters of grass is the healthiest height of grass which means it will be the most unaffected by the fire. To perform this experiment, one grass patch was lit up at a time on one side of the grass patch and the stopwatch was started. After the flame reached the opposite side, the timer was stopped and water was put on the grass to put out the flame. The dried-out grass at different heights was tested on how long it takes a flame to spread across the whole patch. Of all tests, grass height at 13 cm took the longest for fire to spread, but weather conditions were introduced which can tamper the results. From these results, we learned that the best height to reduce fire spread is 13 centimeters because there isn't a lot of fuel to keep the fire active. Although our hypothesis was that 9 centimeters would have burned the fastest, we still got results from this project that revealed new information to solve this community problem.

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

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

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

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

☐ Yes   ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Robot Strength

**Student Name(s):** L. Rajesh Deepa, S. Shirzai, E. Grullon

**Abstract:**

In our project, we build a robot that can push things using an app called EV3 classroom. We use this robot to test how much weight it can move because if we find out the ratio of the weight a robot could move compared to its own weight, it could actually benefit a lot of people. For example, if people saw our project they could know the exact machine they need for the job, and this also helps engineers because they can know the maximum amount of weight their robot could move and they can save it from breaking. In our project we used three objects to see if our robot could move them, our first object was a lego cube, our second object was a juice box, and our third object was a juice box with a lot of washers. To make this project we used an EV3 kit, then we downloaded the EV3 classroom app to code the robot. After we code the robot we use different objects to see if our robot could move them. We used a lego cube ( 22.9 grams), a juice box ( 131.1 grams ), and a juice box with a lot of washers ( 307.2 ). Our hypothesis was that our robot could move objects that were almost 1.5 kilograms. Our conclusion was that our robot could only move 1/5th of its weight which is 300 grams ( the robot weighed 1.5 kg).

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

EE

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

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

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

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

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

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

☐ Yes   ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Horror of Waves

**Student Name(s):** K. Keddo, B. Kudaisi

**Abstract:**

The purpose of our project was to determine if we could find a way to prevent coastal flooding without harming local ecosystems. The idea for our project came from the increase in flooding in multiple areas and from the effects of climate change. The target audience for our project was residents of beaches and coastal areas. For our experiment, we built four iterations of a beach model with different flood barriers. We used materials such as seaweed, eel grass, and rocks. To test our iterations, we created a beach model and placed each flood barrier in the middle of the container. Then we filled the water on the other side of the barrier and used a smaller lid to create waves. Our observations showed most iterations letting through a small amount of water but not enough to flood the beach. Iteration B was the most successful. It not only prevents water from passing through to the beach but also will not harm the local ecosystem because it is made of plants. In conclusion, we found a possible solution to the problem of coastal flooding.

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

EN EM EE

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

☐ human subjects  ☐ potentially hazardous biological agents

☐ vertebrate animals  ☐ controlled substances

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

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

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

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

☐ Yes  ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Fueling a Stirling Engine From a Cold Energy Source

**Student Name(s):** A. Taft, J. McDermott

**Abstract:**

The purpose of this experiment is to determine if a Stirling Engine can be powered by a cold energy source, such as ice cubes. Our hypothesis is that the larger the amount of ice cubes, the less time it will take to power the Stirling Engine and the faster it will run.

This experiment was conducted by testing 4 different amounts of ice (5, 10, 15, 20 cubes) in order to determine if and how long it would take for the Stirling Engine to run. For each amount of ice cubes, we observed 5 trials and measured the time in seconds.

The overall results of the experiment showed that the average amount of time necessary to power the engine over 5 trials for each amount of ice cubes significantly decreased as the amount of ice cubes increased. Within each of the 5 trials across each group of ice cubes, there were inconsistencies in the time taken to power the engine. In conclusion, it was found that the Stirling Engine can be powered by a cold source, such as ice cubes. The more significant the temperature differential between room temperature and the cold source, the less time it took to power the engine. It was also observed that the colder the temperature, the less manual spin was needed to initiate the momentum of the engine. In the end, our hypothesis was supported. As an extension to this experiment, one can measure the actual speed of the engine with increasingly colder temperatures.

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** The Use of Boiling Point Elevation/Freezing Point Depression as Indicator of Purity in Commercially Availble "Table" Salts

**Student Name(s):** J. Ricketts, S. Coleman

**Abstract:**

The use of "salt" predates recorded history and has been used as a "spice/seasoning" in cooking and as a preservative of perishable foods in days before modern refrigeration. We were first introduced to other uses of salt when making ice cream in science class in 7th grade and came to discover that adding salt to the ice could make the temperature fall lower than the normal freezing point, speeding up the process of thermal energy transfer to ice cream cylinder from the ice bucket. With research, we learned about Freezing Point Depression/Boiling Point Elevation as a result of the colligative properties of water when adding "salt" as a solute. Learning that the type of solute is not a factor in freezing or boiling, but more the number of particles, our project explores the effects of different salts on the boiling point and freezing points of 10% solutions of "salt" solution and its comparison/purity level to lab grade NaCl. We tested the following salts: Lab Grade NaCl, Plain Salt, Iodized Salt, Sea Salt Himalayan Pink Salt, Kosher Salt, Hawaiian Red Salt and Black Lava Salt. We hypothesized that the coloring of the Black, Himalayan and Red Salts would introduce more particles to the solution, because of coloring, meaning a higher boiling point and lower freezing point. We used lab grade NaCl as a control for comparison. Our results disproved our hypothesis with non-colorful salts having boiling/freezing points further from the performance of less colorful salts to the lab grade NaCl.

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

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

☐ human subjects          ☐ potentially hazardous biological agents

☐ vertebrate animals      ☐ controlled substances

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

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

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

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

☐ Yes  ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** What water filtration method can be quickly produced, requires little process, and can provide clean water for less developed countries?

**Student Name(s):** H. Serrano, J. Donnelly

**Abstract:**

Testing simple water filtration methods for less developed countries. Many countries around the world suffer from a lack of clean water but have many natural resources that can be used to filter water. We hypothesized that the charcoal filter is the most effective at removing minerals and microorganisms, due to its effective process of adsorption. We collected 5 types of water (tap, stream, reservoir, swamp, distilled) and tested for their ppm (showing the mineral concentration is in every millionth of the water). Then we measured the clarity by putting the sample in front of a white piece of paper, and compared the difference in the color of the paper looking through, and not through the water. We used a scale of 1-10, with 1 being pitch black and 10 being perfectly clear. We used 5 water filtration methods (boiling, pine tree filter, charcoal filter, fruit peel filter, and clay pot filter). We applied these filtration methods to each water type generating 25 different results. We averaged the results for each filtration method. The clay pot and fruit peel filter were the least effective, not having much of an effect on the clarity or ppm. The pine tree filter was moderate at improving the clarity, and slightly reduced the ppm of the water. The charcoal filter was the most effective at improving clarity and was moderately effective at decreasing the ppm. Boiling was very effective at improving clarity and was the most effective at reducing the ppm.

**Technical Disciplines Selected by the Student**
**(Listed in order of relevance to the project)**    EN EV 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 2023

**Word Count**
246

**Fair Category**
PT

**Project Number**
4010

**Title:** The Benefit of an Automatic Electricity Blocking Device on Preventing Waste of Electricity

**Student Name(s):** L. Sanchez-Dubois, S. Mandal, S. Alladin

**Abstract:**

The purpose of the project is to design a device that will block the electricity flow from an outlet, due to the waste and danger unattended electrical devices can pose. Such as a space heater and more. This group has studied a proposed solution to electricity waste and the risk of electrical fires from unattended heating appliances. The proposed solution to this problem is to create a system that detects the temperature of the room, then sends signals to a circuit board that will turn off the electricity. This product will turn off by coding the circuit board to turn off the electricity. The design that was created can be produced by powering the Arduino Board and plugging in the appropriate wires into the correct sections, then plugging in a LED and sensor. Once done, the code only needs to be run while the heater is powered close to the weather sensor. Once the code was run and the sensor detected 90 degrees Fahrenheit, the electricity to the light bulb would be shut off. This design was successful in being able to cut electricity to the breadboard but only to the LED. This was through many changes in wiring, coding, and components used. The group began from a singular LED annual system to a fully functioning automatic system at which all of the temperature and wiring constraints were met. Only extensions such as the if-then statement and a weather sensor affected the solution the most.

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

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

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

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

☒ Yes   ☐ No

# CSEF Official Abstract and Certification
## 2023

**Title:** How can the water filter you use affect the water you drink?

**Student Name(s):** S. Guo, J. Escalante, N. N/A

**Abstract:**

Parts of the world today do not have access to clean water, it is a crucial issue. Our experiment was created to test the effect of different water filters on water. Almost 7.2 million Americans has gotten sick from drinking contaminated water. In our project we tested 3 water filters that can be easily made at home. By the end of the experiment, we are hoping to see the results of the filtered water from each of the filters. A water filter can help purify water by preventing debris and some bacteria from getting to the water. For example, the activated charcoal filter is a filter that has sand, gravel and rock in it. This means when we pour the water into the filter, each level of the water filter would prevent debris from getting through. By the end of the experiment, we saw that the coffee filter had the best result.

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

EV

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

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

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

☐ Yes  ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Photovoltaic Window Shades

**Student Name(s):** S. Ukidwe, A. Ukidwe

**Abstract:**

Solar panels on roofs are expensive and dangerous to install, leading us to investigate economical alternatives to solar panels for households who cannot afford traditional solar panels. We investigated new ways to harvest solar energy, allowing an increase in accessibility to the general public. To carry out this investigation, we created a solar blind that can be placed inside the windows of a home. Solar panels were placed in seven different locations around our home. Data was collected at three different times of the day, in four different weather conditions. Based on results, we analyzed the best way to effectively optimize the solar input of our panels.  Results concluded that solar panels are not as effective when indoors. Solar blinds are 5x more effective when they are outside of the window, than when they are inside. Our household uses 1009 kwh/month. Even when inside the window, our blinds can still produce 57.17 W/window. In 10 hours of daylight, the shades can produce 17.7 kW/month of power, or approximately 1.7% of the total power usage of a household. This means ideally one window with PV shades can power about 10 iPhones/hr. Although the blinds are more efficient outside than inside, they can still produce 1.7% of household energy requirements. This is sufficient to power many low power appliances in an average home. Further research can be conducted to make outside solar blinds withstand weather, as that could increase our energy production dramatically.

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

ET  AT  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
## 2023

**Title:** A project to benefit all of the community, with dual-language stock market course and ML stock price predictor, focusing on the Latino and Hispanic community.

**Student Name(s):** A. Mayorga, M. Guzman

**Abstract:**

The purpose of this project was to help the Hispanic and Latino community to learn about the stock market by creating a short course explaining what the stock market is along with a machine learning app that predicts future prices so the user can make good business decisions. How do we build an app that efficiently predicts the future price of a stock along with building a course that teaches people about the stock market in both English and Spanish? Our proposed solution was to create an app that would accurately predict future prices for the user and also create a course in both Spanish and English to help the user to learn about the stock market. A prototype of the app was created by using a machine-learning package to analyze the relationship between the price in comparison to volume. The machine learning then found trends in the data to see how it could use that trend to predict future prices. We created the app and then added our course that had videos. We analyzed the predictions of our prototype and used them to adjust the machine-learning model. The entire app which had the course also was very useful and the people who used the app learned about the stock market while also making money by using the predictor. The machine learning model used computer science and mathematics to predict future prices. It was very complex so its accuracy was very high in terms of predicting future prices.

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

MA CS AT

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

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☐ vertebrate animals     ☐ controlled substances

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

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

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

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

☐ Yes   ☒ No

**Title:** Testing Window Cleaners to Eliminate Streaks

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

**Abstract:**

Window streaks can be annoying and dangerous. This project tests cleaners and cloths in an effort to prevent window streaking. This test required the creation of 21 equal-sized grids. Using water and one cup of potting soil in it, and a sponge. Each 28 x 28 cm grid was made purposefully dirty. The cleaners used included Windex, water, vinegar, lemon juice, baking soda, and a combination mixture of the last 3. Cheesecloth, paper towel, and micro-fiber cloth were used. The hypothesis was that the cleaner, not the cloth will be the cause of the window streaks.

The same cleaner but a different cloth changed the number of streaks. Counted streaks show that there were 21 total streaks on the window cleaned with Windex and paper towel. On the window with Windex and cheesecloth there were less streaks (15). Pockets of streaks were also bigger. The Windex with the microfiber cloth had 7 streaks. Microfiber cloths had less streaking and less surface area of the streaks.

The test results show that the cloth changes the number and size of the streaks vs the cleaner. Windex with a microfiber cloth is the best alternative for cleaning windows. Having dirt or bird droppings on the window can affect visibility and cause accidents due to glare and streaks on your window. The cleaner and cloth used determines how the car window looks and how it is safest for drivers and passengers.

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** BlindSight

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

**Abstract:**

Purpose:
I want to help people with vision impairments navigate easier than using a cane - especially those who have recently lost sight. This project replaces a cane with wearable tech that alerts the wearer of obstacles.

Procedure:
The circuit is centered around an IR sensor. The sensor emits infrared light and sends a signal to the vibrator if it detects IR light reflected off an object. I researched the sensor, and its usage to get an understanding of it. I was then able to develop the circuit using a 9v battery, switch, and a vibrator. The chassis has spatial and stability advantages due to its shape and organization but requires everything to be exactly in place. Inside the chassis, the sensor is attached on top of the battery while the vibrator and switch are on opposite sides. The procedure used to make the device is simple enough: First, solder everything together, put it in the chassis, attach the switch, and readjust it. Once completed, the device was glued and attached to sunglasses to make it easy to use and wear.

Results:
I compared the discreteness, versatility, cost, and durability of my device to the cane. My device was better in many aspects, it is more affordable, smaller, more versatile, easier to use, less damaging, and overall more effective.

Conclusion:
I successfully made a device that senses obstacles in someone's path. It is more effective than the cane and could aid blind people to navigate the world around them.

**Technical Disciplines Selected by the Student**
**(Listed in order of relevance to the project)**    EE 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
# 2023

**Title:** Four Fab Fats

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

**Abstract:**

Has it ever happened where your cookies never really seem right when you bake them? Or one seems like it is really moist while your next batch of cookies are really dry? I decided to experiment with different types of fats. After I did research, I found that the two most used fats beside butter in baking were shortening and coconut oil. I decided to use something different so I picked avocado as the fourth fat.

If different fats are substituted for butter in a chocolate chip cookie recipe (shortening, coconut oil or avocado), then the cookies using plant fats will not spread out as much as the cookie using butter and they will not taste as good as the cookie using butter. To test my hypothesis I found a recipe for chocolate chip cookies that only uses butter and baked four batches, one for each fat in the experiment. In my results, I found that the butter cookies did spread the most and were the shortest in height while the plant fats (shortening, coconut oil and avocado) did not spread or change much when baked. Each taste tester was provided a chart to complete after they tasted all the cookies. The taste testers liked the butter cookies the best and thought the coconut oil and avocado cookies did not taste as good. After I completed my project I realized my hypothesis was proven right. I thought that the plant fats would change in width and height and they did.

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

CH

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

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

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

☒ Yes ☐ No

**Word Count**

249

# CSEF Official Abstract and Certification
## 2023

**Fair Category**

P7

**Project Number**

5004

**Title:** which sports drink contain the most electrolytes?

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

**Abstract:**

Are there different levels of electrolytes in sports drinks. Some sports drinks have higher levels of electrolytes which means a different result for helping athletes with dehydration. We are trying to find out how many electrolytes are really in various sports drinks. I researched about electrolytes and sports drinks to find out how a multimeter can be used to measure the electrolytes in sports drinks. I used a beaker, a multimeter, and sports drinks to conduct the experiment. I hypothesized that the Sparkling Ice would have the most electrolytes because the sparkling ice has a lower sodium level than the other drinks. I think that the sodium level amount will affect the measurement of electrolytes. I gathered all of the materials and started the experiment. While doing the experiment, I confirmed that some sports drinks have more electrolytes than others, and I learned some do not have many electrolytes because of the sodium level. The Powerade had the most electrolytes, and the tap water had the least electrolytes. Something I would have changed is looking at the label to find the sodium rating in each sport drink. I could have repeated the experiment to see if it is the same results as the first couple of times I did the experiment. All of the sport drinks are not all the same for athletes that are looking to hydrate quickly. Power Ade is a better choice than tap water for an athlete that is looking for electrolytes quickly and accessible.

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

CH 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 2023

**Word Count**

241

**Fair Category**

P7

**Project Number**

5005

**Title:** Which rock is more porous?

**Student Name(s):** N. Grace, E. Oei

**Abstract:**

As an avid collector of rocks I wanted to investigate which rock is more porous. The porosity of a rock would determine how it weathers and erodes which could impact its use in building materials. For this experiment I selected four rocks from my collection including: pumice, quartz, limestone and chalk which is also a type of limestone. Pumice and quartz are igneous rocks. Limestone and chalk are sedimentary rocks. I hypothesized that pumice would be the most porous rock of these four because of its large visible pores. To begin my experiment I weighed each of the four rocks using a digital scale with a 0.01g accuracy. Each rock was placed in an individual container of 1 ⅓ cups (10.67 fl oz.) of water. The rocks sat in this water for 1 hour. After carefully removing the rocks from the cups of water they were each weighed again. I found the difference in weights and calculated the percentage of weight change. Chalk experienced an 88% increase in weight after being soaked for an hour. This experiment determined that of my samples chalk was the most porous and absorbed the most water. In the future I would like to examine other rocks from my collection to compare to this result. So far in my collection I have over 100 different minerals. Some I have collected over the years from my backyard or traveling and some I have gathered from science kits.

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

EA CH EN

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

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☐ vertebrate animals ☐ controlled substances

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

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Water Works?

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

**Abstract:**

In today's society multiple sources are used to generate power. This experiment compared the stability of four alternative non-electric power sources using two battery operated candlesticks, a solar operated tea light, a potato operated diode, and a hydroelectric water turbine diode, also powering a homemade aluminum water wheel with a diode. It was hypothesized that the water generated power would prove to be the most reliable power source while remaining the most ecologically sustainable. The amount of light produced was measured with a photographic light meter and recorded using a data table and line graph. All of the power sources diminished over time, except for the light generated by the water. This was because the pressure from the water being used for the power did not change, so the power it generated also did not change. It was found that the homemade aluminum water wheel was not receiving enough pressure from the primary water turbine to generate enough power to light the diode. Water generated power proved to be even more consistent than solar power which is why the U.S. pumped-storage hydro-power fleet provides 97% of the utility-scale storage.

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

EA PH AT

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

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☐ vertebrate animals ☐ controlled substances

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

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

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☐ Yes ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** How Does the Type of Material Affect Water Absorption?

**Student Name(s):** M. De Almeida Brito

**Abstract:**

The problem I was trying to solve was finding the amount of water that each material can absorb. I was trying to find which material absorbed the most water. I thought that the cotton would absorb more water because in my opinion, cotton is a very soft and delicate material, so you can already see that the fibers of cotton can absorb more water. I gathered my materials that are sponge, cotton, and cardboard, and put each one separately in a beaker of 200mL of water for 1 minute, and the cotton absorbed the most. I find that the cotton absorbed more water than the other materials.

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

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☐ human subjects   ☐ potentially hazardous biological agents

☐ 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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# CSEF Official Abstract and Certification
## 2023

**Title:** Experimentation of Alternatives to Leather

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

**Abstract:**

The purpose of this experiment was to test an alternative to leather which would decrease the dangerous toxic chemicals and waste from the leather industry. Examples of the chemicals used in preparing leather are formaldehyde, mineral salts, coal and tar derivatives, and other oils and dyes which may be cyanide based.

The tensile strength of dried,folded and unfolded banana leaves was tested with a spring scale attached with a clamp. The banana leaf was pulled to determine at what gram weight it would fracture.

This test determined that folding the leaf had the most impact on higher tensile strength. The direction of pulling the leaf was not as important as the number of folds of the leaf.

As far as were this could go next, testing other plant-based alternatives as well as using a tensile machine with an increased ability to calculate the fracture point would be worthwhile next steps.

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

EN

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☐ vertebrate animals      ☐ controlled substances

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

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

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

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☐ Yes  ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** The Design and Experimentation of All Purpose Cleaners

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

**Abstract:**

This experiment's purpose was to determine which cleaning products work the best with a material such as glue. This investigation examined which cleaning products and chemicals most effectively cleaned glue off of a surface area. Glue was spread across a table and several name brand cleaners and one "personal cleaner" were sprayed. After wiping the surface area with a paper towel, observations were made to compare results between all of the cleaning products. Once the experiment concluded, it was determined that Lysol, containing hydrogen peroxide, was most effective in removing the glue. Hydrogen peroxide was more effective than the products containing bleach.

Creation of cleaning products should consider using hydrogen peroxide when attempting to have the best cleaner of a surface and one that would kill virus and various forms of bacteria.

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

CH

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☐ vertebrate animals  ☐ controlled substances

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

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

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☐ Yes ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** How ice vs no ice affects a Stirling engine

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

**Abstract:**

The purpose of my experiment is to analyze how strong a Stirling engine is running with and without ice.

To conduct this project I build a Stirling engine made from parts like soda cans and metal rods. I also used machines like drills, lathe, and a grinder. After building my engine, I ran it using a torch and sterno heat oil. Using a slow motion video I recorded the RPM of the flywheel by counting in the slow motion video. I recorded different slow motion videos of the engine running with and without ice and compared the speeds.

My results determined the highest rpm being 156 with ice and the lowest rpm was 85 without ice.

The Stirling engine works depending on a difference in temperature of the hot and cold cylinders. Using ice caused a bigger difference in temperature which caused the faster speed.

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

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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

**Word Count**

242

**Fair Category**

P8

**Project Number**

5503

**Title:** Do Fans Actually Cool You Off?

Battery Operated vs. Electrical

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

**Abstract:**

Many people say fans circulate hot air, so I wanted to test if fans reduce your body temperature. My project contributes to our society today by informing people of the best way to reduce their body temperature. My hypothesis is if fans reduce your body temperature then the electrical fan will be more effective. For my experiment, I measured thirty milliliters of water and poured it into two aluminum pans. I put the two pans into a small bin, with the fans attached to the containers. I turned both the electrical and battery-operated fan to medium speed and put mixing bowls on top of the bins in order to prevent air from coming out. Then, I continuously recorded the milliliters and water temperature in both pans. Finally, I repeated these steps but put the aluminum pans outside of the direct current of the fans. I found out that the temperature of the water started at 90°F (32.22°C) and ended with the temperature remaining between 64°F and 68°F (17.77°C and 20°C) for about fourteen hours. My hypothesis was proven correct. After dropping from 90°F to 69°F within twenty minutes the temperature remained constant. My project was successful although it did not go according to my plan. I decided to add the mixing bowls because the gaps from the hole in the cover of the bin were letting air out, so, therefore, adding the mixing bowls kept the water controlled in one environment.

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

EV  EA

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

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☐ vertebrate animals    ☐ controlled substances

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

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

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

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

☐ Yes  ☒ No

**Word Count**

251

# CSEF Official Abstract and Certification
## 2023

**Fair Category**

P8

**Project Number**

5504

**Title:** Quantifying the Strength of Tubing Attachment Methods for Soft Robotics

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

**Abstract:**

A soft robot is a flexible object with chambers in it. When the chambers fill with a gas or liquid–usually water or air–the chambers inflate and the soft robot actuates. Soft robots adapt and conform better than traditional robots. In my research I attempted to make soft robots by casting silicone resin into 3D printed molds. I then attached a tube into the robot to supply air or water to the inner chambers of the robot. I have found that soft robots sometimes leak, and thus fail to actuate. Because the primary point of leakage is the area of tubing attachment, my focus is finding a better tubing attachment method. Last year I developed several successful tubing attachment methods. This year I tested the strength of my best methods such as a hose barb with a base with holes in it, a gyroid base, and one with hairs. I then compared these methods to the method of tubing attachment used by organizations such as NASA, the Whitesides Research Group at Harvard, and others. This method is just pushing the tube into a hole in the robot. I have tried inflating robots with air, however I decided to use water because it's safer and shows leaks better. Last year my research was qualitative, however this year it is quantitative. Thus, I have been collecting data on how many Pascals my methods can withstand before leaking. I have designed these methods myself and am the first person to do this research

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification 2023

**Word Count**
249

**Fair Category**
P8

**Project Number**
5505

**Title:** Porosity, permeability rates, and water movement through various commercial crushed rock sizes as it relates to drainage rock in the excavation trade

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

**Abstract:**

This project explored how rock size impacts the porosity and permeability values for commercially available drainage rock. Phase 1 trials consisted of adding 750g of rock to the marked upper half of a soda bottle, pouring in 500mL of water and timing the flow to determine permeability rate. Phase 2 repeated phase 1 trials but changed several variables that were a problem in phase 1 such as pour technique, timing method and air suction prevention. Phase 3 consisted of mathematical analysis of the results including calculating porosity values, permeability rates, water retention in materials tested and then extrapolating to determine potential impact in drainage rock uses. Most permeability trials ran close to a minute except ⅜"stone which was about twice as long. Phase 2 had similar patterns but quicker times, probably a result of the procedure troubleshooting. Porosity measurements show a decreasing slope pattern from the 2" rocks to the ⅜" rocks. Rock sizes of ⅜" or smaller have slower rates and retain more water. Dry rocks have similar permeability rates to wet rocks. Dry rocks retain more water than wet rocks. Stonedust results were impractical to include on graphs since they took 120x longer than other trials. Drip rates were recorded for the stone dust with distinct differences between rates for wet vs. dry material. Results from the measured soda bottle volumes and rates were then scaled up and compared to volumes more likely to occur in triaxle dump trucks typically used to haul drainage rock materials.

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification 2023

**Word Count**
173

**Fair Category**
P8

**Project Number**
5506

**Title:** Improving a Homemade Livestock Identification System for all Farmers

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

**Abstract:**

There are a lot of different reasons why a farmer would need to identify livestock and link that animal to a database of information. Farmers need an identification system to confirm an animal's identity at a show, to provide information for a vet, or to identify a lost animal. The problem with most modern identification systems is that they are all extremely expensive. Most farmers can't afford an expensive system like most of the ones offered online. This project has upgraded an inexpensive system of my own creation to make an even better, more portable system. This project codes a livestock identification system for less than 1% of the cost of other products. Overall, the Hypothesis was correct and the system plugged into a battery, turned from an NFC tag to an RFID microchip, changed from a monitor to a touchscreen, and switched from YAML to SQL Lite Files. To prove the hypothesis correct, the system was tested on four different microchips four times. The scanning worked every single time it was tested.

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

# CSEF Official Abstract and Certification
## 2023

**Title:** Demonstrating the Persistence of Long Island Sound Polyaromatic Hydrocarbon (PAH) Contamination via Stormwater Drainage Location

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

**Abstract:**

Polycyclic aromatic hydrocarbons (PAHs) are organic compounds that consist of two or more aromatic rings, often formed from the incomplete combustion of fossil fuels and other organic materials. PAHs are often found in urban stormwater runoff as a result of motor vehicle usage, oil spillage, vehicle tire wear, and asphalt road surface materials. As such, individuals are often exposed to PAHs ubiquitously in stormwater runoff, which has led to accumulation of these pollutants in streams, and lakes, further impacting water quality and associated pollution. This research characterized the persistence of PAHs in LI-Sound water, along the protected/inlet regions of the Greenwich, CT coastline, as a function of temperature, water movement, and location, relative to stormwater drainage. Water samples were collected along nine Tod's Point shoreline locations, which varied relative to coastline stormwater runoff (facing, away, or stationary) and currents, at 40, 55, and 70 oF. Each were examined via fluorescence spectroscopy for naphthalene and phenanthrene content, which trended with location. Stationary inlets contained as much as 0.07ug/ml-Naph and 2.06ug/ml-Phen, which are 1.3 and 1.6x higher than locations that face opposing-shoreline drainage. PAH content was lowest at locations facing drainage (0.043ug/ml- Naph and 1.62ug/ml-Phen), which coincided with direct flow/movement of sound water. Regarding temperature, PAH content was 12.2x higher at 70 oC for naphthalene, and 4x for phenanthrene, which highlights the increased PAH-release activities of warmer weather. Summarizing, LI-Sound PAH content from stormwater runoff increases with temperature, appears to move freely with currents, but collects in(inlet) areas with reduced water flow.

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

EV EM AT

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☐ vertebrate animals      ☒ controlled substances

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

# CSEF Official Abstract and Certification
## 2023

**Title:** Experiment Vital

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

**Abstract:**

This projects explores some of the basics of sound design and synthesizers such as replicating an artificial 808 bass (X8 Lite) using the virtual synthesizer, Vital. To do this, I used four different waveforms: sinewave, sawtooth wave, square wave, and triangle wave. My hypothesis was that the sawtooth wave would be the most effective due to its sharp nature. The experiment was conducted by taking each waveform and adding low filters, distortion, reverb, and then adding sustain and decay on an ASDR. After this, the waveforms were visualized by their frequencies, and put side by side to see which was the most accurate to the original. The results proved that the sawtooth wave, was indeed, the most effective waveform for replicating the X8 Lite 808 bass. This proves that my hypothesis was correct.

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

CS

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

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☐ vertebrate animals ☐ controlled substances

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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
## 2023

**Title:** Solar Storms and Magnetometers - What is a solar storm, and how do magnetometers contribute to society today?

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

**Abstract:**

Blackouts, which can be caused by solar storms, pose as a big problem to society, but with the help of magnetometers, we can be warned when there is an upcoming solar storm. Using my homemade magnetometer, I tested it seven times, collecting data after each time period. A note card, cardboard, magnet, craft mirror, water bottle, ¾ cup of sand, string, and glue were used to build the magnetometer along with the help of the laser shone into the mirror. For this experiment, certain time periods were assigned in order to check every so often to see if the laser moved. If it did move, the information was added to my data chart. But, I was also aware that the magnetometer was not able to be in a fully dark room for the time period needed, which would most likely affect some of the results. When I finished my experiment, the data I collected showed the amount of times the laser moved or did not move, and the measurements of the change in the magnetic field (if the laser moved.) And as I carried out my project, I hoped I would be able to show the importance of magnetometers and how they contribute to society today.

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

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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**

256

**Fair Category**

P8

**Project Number**

5510

**Title:** Does Our Desire for Convenient Spring Water Come at an Expense for Meaningful Microplastic Harm?

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

**Abstract:**

Microplastics(MPs), non-biodegradable pieces of plastic less than 5mm long, are a pressing issue in our world, as they are harmful to the environment and human health. Microplastics have been found in our lungs, bloodstream, as well as feces, highlighting their persistence and passage into our bodies, mainly through the mouth. Specifically, Americans eat, drink, and breathe between 74-124k MPs/year. Drinking only bottled water could add 90k MPs/year to that number. While many remain unwilling to give up the convenience and perceived quality of bottled water, identifying which water brands are most harmful would allow consumers to minimize microplastic-in-water intake. This research identified the bottled-water brands with the highest MP content through a unique, scanning electron microscopic (SEM) analysis of their products. For each brand tested, which includes Poland Spring, Fiji, LifeWtr, Voss, Kirkland's Purified water, and Aquafina, one 16oz-waterbottle was poured through a 4" diameter/5um mesh filter, to capture microplastics within the sample. A portion (1/8th) of this filter was cut, and analyzed via SEM, to measure the number of MPs captured. Energy Dispersive Spectroscopy (EDS) was used as an additional SEM spot-analysis detection method, to verify the identity of captured fragments as microplastic. With triplicate measure of each brand, results suggest that a 16oz-waterbottle of Poland Spring contains the most MPs per bottle, 128 MPs/16oz. Voss contains 64MPs/16oz, Kirkland's Purified Water has 96, Fiji was 50MPs/16oz, Aquafina was 48MPs/16oz, and finally Life Wtr was the safest choice, at 40MPs/16oz.

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

EV EM ME

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

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

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

☐ Yes ☒ No

# CSEF Official Abstract and Certification
## 2023

**Word Count**

**251**

**Fair Category**

**P8**

**Project Number**

**5511**

**Title:** Mitigating the Threat of Microplastics in Drinking Water: The Potential of Coconut Fiber and

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

**Abstract:**

Microplastic pollution is a growing problem in our environment, air, and water. The increasing use of plastics in consumer products significantly contributes to pollution in our environment, which can cause health problems for all living beings. My research focused on finding a sustainable and cost-effective solution to this problem by using coconut fibers as a filter for microplastics. The project was done by testing the microplastic levels in tap water before the experiment was done. For the experiment, I put a layer of either coconut fibers or activated charcoal and fibers in a glass beaker and poured different-sized microplastics mixed with water through them. After the data was collected, I got my samples tested and compared them to the data before, demonstrating how coconut fibers and activated charcoal made from coconut shells are successful filtration materials. The results of my project consisted of an overall 43.38% decrease in particle count. For 200-100 micron size there was a 90% decrease, for 80-200, an 81.25% decrease, for 16-60, a 58.14% decrease, 4-16 had a 61.14% decrease, and 4-0 had a 20.74% decrease. My research and experiments concluded that coconut fibers and charcoal are sustainable sources that can be successfully used for the filtration of microplastics. This solution can help reverse the damage plastic has done to the planet. The data that I collected was done with only one layer of each material, but in the future, I hope to continue researching how additional combinations and layers can increase the success rate.

**Technical Disciplines Selected by the Student**
**(Listed in order of relevance to the project)**  EN EV 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
## 2023

**Title:** Does Air Pressure Affect How Far A Soccer Ball Travels In The Air When Kicked?

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

**Abstract:**

This project investigated how the inflation in Pounds Per Square Inch (PSI) of a soccer ball affects the distance it travels in the air when kicked. The relationship between multiple variables (launch angle, velocity, distance, time in air) and path of the ball were also evaluated using collected and theoretical data. Exploring these variables introduced new math concepts (trigonometry, parabola).The experiment used a modified catapult as a control to make the force of kicking more consistent than a person. The catapult was converted by adding supports to allow rotation, increasing height and adding a platform for a soccer sneaker with shoe tree. The sneaker was attached with different methods (duct tape, masking tape, string). An adult helped with modifications. Thirteen different PSI were tested (130 trials, Phase_1, 65 trials, Phase_2). Phase_1 and Phase_2 used different measurement methods and settings. Phase_1 data was collected outdoors. Phase_2 data was collected indoors to eliminate weather and terrain variables. A measurement grid was created on the floor to improve accuracy of measured distances. Distance and time traveled in air were documented using a video recording of every trial (Phase_2). Results showed Phase_1 data had more variability than phase two by comparing mean, median and range. In Phase_1, the average distance traveled in the air was the longest for 10 PSI. In Phase_2 it was 8 PSI. The machine kicker wasn't as consistent as expected. A difficult variable to control was the launch angle because the tape would tear or the string would stretch.

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

MA EE 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 2023

**Word Count** 150

**Fair Category** P8

**Project Number** 5513

**Title:** The Design and Experimentation of Creating a Cold Pack Out of Household Items

**Student Name(s):** B. Dauber-Katz

**Abstract:**

The problem that is being investigating is, how to deal with an injury when a icepack is not at hand. After the problem was investigated and the substances found that kept cool for the longest and are in the average household they were added together in a mixing bowl and placed inside of a freezer for 1 hour. The results showed that the cooling mixture out of at home substances stayed cool for as long as the reusable ice pack but was even better than the instant ice pack in the long run. This means that it is as effective to a extent. This also shows that it is indeed possible for a cooling pack to be created out of household items to help if an injury occurs. So if these ingredients are added and the directions are followed it is possible to create a safe and effective cooling pack.

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

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

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

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

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

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

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

☐ Yes   ☒ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Humans Living on Mars by 2030

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

**Abstract:**

Will scientists move humans to Mars by 2030? Or will we be somewhere else?My hypothesis is that humans will not be on Mars by 2030 because it all seems to soon.Scientists are still trying to figure out how we are going to breath without an astronaut suit.l'm using content analysis to compare and contrast information about if humans will be leaving earth to go to Mars. I plan to use articles, books, and websites.

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

PH

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

☐ human subjects      ☐ potentially hazardous biological agents

☐ vertebrate animals      ☐ controlled substances

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

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

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

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

☒ Yes   ☐ No

# CSEF Official Abstract and Certification
## 2023

**Title:** Identifying Skin Lesions with Artificial Intelligence

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

**Abstract:**

The purpose of this project was to develop an artificial intelligence system to identify skin lesions with images. Using 10016 images, the system was trained and achieved an accuracy of 82%. The procedure used included collecting and labeling images, creating a deep learning model, and training the model. The results of the project showed a high accuracy of 82%, demonstrating the potential of the developed AI system for skin lesion identification. The dataset was split into 2 sections. Around 80% was set aside for training, and 20% was set aside for validation. Training consisted of feeding the images through the AI and lowering the effect of some neurons that led to incorrect outputs. Validation served to test the accuracy of the AI. The validation set had never been shown in training, that way the AI had no way to just memorize the images. The goal of this was to prevent those suffering from lesions not have to travel far to identify the lesion. Some may be deterred by the possible long drive and high expense of going to a dermatologist. If someone has a malignant skin lesion, their chance of survival is significantly higher if it is caught and treated early and before it develops more. My project allows those who are concerned about a lesion on their skin to simply take a picture and receive a result, so they know whether it is urgent to treat it.

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

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