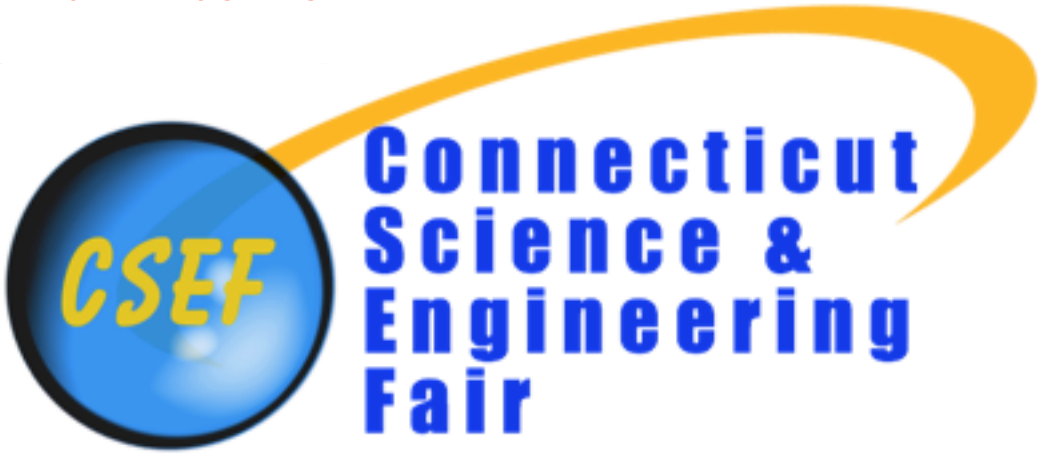
72nd Annual Fair



March 9 - 14, 2020

Student Abstracts

Fair Categories

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

Special Categories

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

Special Category Composites

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
229	PT	4001

Title: Transforming Ocean Wave Energy to Electrical Energy

Student Name(s): S. Chava, A. Konda

Abstract:

Most of the world uses water to create electricity in the form of dams. The environmental consequences of large dams are numerous and directly impacts the physical, chemical and biological or rivers and the environment around them. Oceans waves are less disruptive to the environment and are readily available.

This project created a design that allows energy to be harnessed from the motion of ocean waves through electromagnetic induction. The ocean wave generator consists of a stationary magnet that would move through a PVC pipe with coiled wires inducing or causing current as it moves with the waves. In the lab there was no direct access to ocean waves and so in this investigation, the coiled wire remained stationary and the magnet moved inside. Many variations of a design exist. This investigation tested variations in PVC pipe diameter, gauge of magnetic wire, number of turns of wire, strength of neodymium magnet and speed the magnet moved in and out of the coiled pipe. We used a metronome set to 40, 50, and 60 beats per minute to help move the magnets in and out at a constant rate. The electric current generated was measured using a micro-ammeter. Video analysis was conducted to measure speed and record the current. Most significant, the current increased as the number of turns increased. Other factors had effects but were not as significant.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
85	PT	4002

Title: On the Wings of a Drone

Student Name(s): E. Bustillo, D. Munbreo

Abstract:

The purpose of our project was to investigate if a broken drone could be re-engineered using common parts available in the classroom and at a electronic supply store. When we looked at the drone design we wanted to enhance the initial design by adding lights and more propellers to make it flyable at night and also visible. We were successful in the redesign process and added the enhancements to the original drone that we had purchased which was broken when it arrived to us.

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

Word Count	Fair Category	Project Number
181	PT	4003

Title: Low pressure conversion of Carbon dioxide to methanol

Student Name(s): J. Dobek, J. Marks

Abstract:

Our goal was to build a fully working system that converts CO2 to methanol, which can be used as an alternate solution to gasoline. We did not finish the project, and we are reporting on our progress.

Our first job was to build the electrolyzer which is a reusable source of hydrogen, and what you would use in large scale production. We tried to use different plate designs, new gaskets, O rings, different materials. We tried epoxy mold, 3D printing, and finally settled on injection molding. We put together a single cell electrolyzer. Then we ran a simple test to verify that we were making hydrogen. The electrolyzer generated 11 cc/min H2 at 5 volts. This work was all with the help of Dr. Frank Dobek, Mr. Ross Bonacci, Mr. Larry Novacco, Mr. Jeremy Kostick and Mr Johnathan Malwitz.

We also started to design the frame so we can mount parts of the system to it. Also we started to learn Arduino which is going to be the program that we use to control the entire rest of our system.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
215	PT	4004

Title: Natural Nails

Student Name(s): I. Hegarty, A. Cerbone

Abstract:

For our science fair project this year, we decided to make a natural nail polish remover. Our remover has no harsh chemicals and is 100% safe for the environment, and your skin, and nails. You can find pumice in most hand soaps and hand sanitizers. All you have to do is either use your finger or use a cotton pad, and your nail polish will come off very easily. Our remover also smells like hello beautiful from bath and body works. This lotion doesn't just make your hands softer it also makes our mixture softer on your hands and smell better. This lotion is completely safe for your skin and nails. The lotion helped our mixture because before we added the lotion it was rough and hurt your hands, and the lotion made it much softer. The ingredients we used in this mixture are water, salt, pumice of different coarseness, and lotion. We used salt and water to make our own salt water. We thought this would help our mixture because at the beach the salt water in the ocean takes off your nail polish. We also found that different types of pumice effect how well the mixture takes off the nail polish. The more coarse the pumice is, the more nail polish comes off.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
220	PT	4005

Title: Correlation Between Spice Used and Resulting pH

Student Name(s): B. Gray, E. Osei Bonsu

Abstract:

The connection between acidity in foods we eat and the onset of diseases like acid reflux, acidosis and kidney stones has long been established in the literature, but differences in pH has gotten nearly as much attention. Here we evaluate common single spices like chili powder and cinnamon all the way through more complex spices like adobo. Replicated evaluations of the role each may play in the prior connection were done here and compared against the baseline pH in water used for cooking to shed some light on what the actual differences are between these commonly used spices. When added to boiling water, it became clear that chili powder consistently produced the lowest pH (4.6), even lower than adobo and other spices. It would be interesting to advance this idea even further and see what acidities look like with these spices and salt added, as salt is known to be alkaline albeit with it's own documented health concerns for use in food. Elevating the pH of the foods you consume has also recently been linked to staving off things like various cancers as well. As we continue to build our knowledge on this, our future questions will look not just at the spices, but how the resulting pH may be affected by combinations of spices and other ingredients in food.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
208	PT	4006

Title: Portable Charger

Student Name(s): S. Shajal, M. Naeem

Abstract:

We designed this experiment for emergencies and for a more reasonable priced alternative to the power banks on the market that can range from $30 to upwards of $300 dollars. We found out a simple way to charge your phone that is a better value than the power bank competitor.

Our portable charger is about one third of the price of a traditional power bank and is also rechargeable. The materials that are needed are easily accessible at any convenience store.

In this lab my partner and I made a portable cell phone charger. We already knew it will work. We wanted to see which brand of battery would charge the phone fastest. We compared Panasonic, Duracell, and Energizer batteries. We predicted the Duracell battery would charge the phone the fastest.

With only 4 items: paper clips, charger, car charger, and a 9-volt battery, we constructed a charger. We attached paperclips to a car charger. Then attached the car charger to the positive side of a 9-volt battery, we inserted the phone cord into the car charger and lastly, completed the circuit by attaching a paper clip to the negative side of the battery.

We found that the Duracell brand of battery charged the phone faster.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
99	PT	4007

Title: A Better Way to generate energy

Student Name(s): J. Gallegos, A. Campbell

Abstract:

The purpose of this project was to create a machine to generate power, and ultimately create a better electrical power source. The hypothesis stated if different types of motors are tested, then the step motor will create the most power. When the step motor was deconstructed, Its wires were polarized which were then connected to an LED light as a test. A DC motor was also tested. Results were recorded and indicated that the step motor generated the most power. These findings supported the original hypothesis. In conclusion, the data showed that the step motor is more efficient output.

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

Word Count	Fair Category	Project Number
216	PT	4009

Title: Compatible Carrier

Student Name(s): M. Velendzas, S. Asano

Abstract:

In searching for a way to a more comfortable travel with our beloved furry quadrupeds, we have developed a safer travel system that can be reproduced and marketed for general pet owner use. We have called our invention The Compatible Carrier. Our prototype models the features that we found to be essential for pets to not only survive travel in cargo but also enjoy the flight with less stress. According to DT (Department of Transportation) statistics, in 2017, 24 dogs died during flight and from those dogs, 18 were killed while traveling with United Airlines. These fatalities are thought to have been caused by temperature control failure, rough handling and on top of that very poor ventilation.

The Compatible Carrier is adaptable to each dog individually. The inside of the carrier is lined with a thin layer of memory foam throughout the floor and walls. This will keep the dog comfortable during transit and also in the event of turbulence. We have also installed a temperature controller to help monitor extreme conditions. Attached to the wall of the carrier is a small bottle for the dogs to drink from if they ever need water. With all these added features to carriers, we hope to reach our goal of making travel easier for dogs and the owner.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	PT	4011

Title: Vibration Voltage

Student Name(s): W. Carragher, C. Sorbera, S. Dettmer

Abstract:

Our project was based around harnessing wasted energy. We started with the idea that as raindrops hit the ground, they produce energy. Through our research, we quickly realized that harnessing kinetic energy solely from falling raindrops would not generate enough energy, so we switched to vibration and solar energy. We wanted to discover a way to harness and use the energy created from footsteps or other vibrations, along with solar energy. This is another source of clean energy that would otherwise be wasted. We wanted to use this energy to generate voltage and charge a battery. We created a tile to generate these two types of energy at once, which consisted of two solar panels and a piezoelectric generator. We started to test our tile with a multimeter to see how much energy it was generating. With a slight tapping, the piezoelectric generator generated 0.25v. When we left the tile on a table, each solar panel generated 0.5v of electricity, but when left in the sun they each generated a whole volt. After leaving it for 2 weeks, each battery had charged 1.25v, for a total of 5v. If we placed our tile in other, more convenient places to generate solar energy or vibration energy, it could become a reliable and dependable source of clean energy. With this energy, we could power lights, charge phones, and provide power to a house. This could improve the quality of life drastically in some 3rd world countries, making generating energy easy and accessible.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	PT	4012

Title: Plastic vs. Plastic - Durability and Decomposition

Student Name(s): J. Scharf, E. Higgens

Abstract:

Most products are packaged using synthetic plastics that can take thousands of years to break down into tiny pieces, which then continue to have a harmful effect on living things. We researched the types of plastics that exist and what they are made of. Based on this research, we hypothesized that the regular polyethylene bag would be more durable, but we wanted to find out if there could be a safer alternative.

We compared synthetic plastics with those made from more natural materials to try to find a type of plastic that is able to decompose relatively quickly with the least amount of harmful impact to the environment. The purpose of our project is to determine if bioplastic, that is made out of non-synthetic material, will be equally as durable as polyethylene, a synthetic.

We designed tests to compare bioplastic bags with polyethylene plastic bags to find out which of these is more durable. The tests included a stretch test, a freeze test, and a permeability test.

While our tests were not as conclusive as we would have liked, the "freezer test" gave some evidence that bioplastic held up better under these conditions than the synthetic polyethylene. We would like to continue our work to try to determine whether bioplastic is equally durable. We then would intend to bring this information to the public in order to encourage businesses and consumers to replace the polyethylene plastics with alternatives that have less of a harmful long-term impact on the environment.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	PT	4013

Title: Alternative Techniques for the Chemical Purification of Water

Student Name(s): A. Patel, S. Khandelwal

Abstract:

The World Health Organization (WHO) states that 88% of diarrheal diseases and deaths are caused by a lack of clean water. Many regions suffer this due to poverty. The inability to obtain uncontaminated water accounts for the rising death toll for diarrheal diseases. However, there is an efficient and affordable solution: flocculation. While repeated research has displayed that certain chemicals combined with filtering can decontaminate water, it has been done under controlled lab conditions with measured materials. We have used some advanced equipment to test the water; however, this doesn't add to the total cost because the people who would be using the formula wouldn't test it. Research is compulsory for finding the right amounts of chemicals. The formula will be placed in a packet, which can then be opened and dissolved into the dirty water.

The project demonstrates an affordable way to purify water. While the traditional processes were not used, it was decomposed into constituent steps. We used the flocculant ferrous sulfate (FeSO4) to combine and compress sediments, and then calcium hypochlorite [Ca(ClO)2] as a bactericidal agent. We were originally going to use ferric sulfate for the flocculant [Fe2(SO4)3], but because it is toxic we switched to ferrous sulfate. Later, more experiments were conducted on how the cleanliness of the water is affected by using solutions of the chemicals. We also experimented with the amounts of each chemical to purify 200ml of water. The data collected was essential in concluding that flocculation is effective.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	PT	4014

Title: Rocket Design

Student Name(s): C. Akkili, C. Pani

Abstract:

Organizations and countries that participate in space exploration must constantly revise what they use frequently for fuel . Fuel and how it ignites plays a huge part in rocketry, so what rockets use for fuel has to be very efficient for use.

In our experiments, we created bottle rockets using rubbing alcohol to represent kerosene and liquid oxygen in a real rocket. We first wanted to use 5% alcohol for ignition, so we mixed distilled water with alcohol and achieved a 5% concentration. When we tested how flammable the mixture was by putting a burning matchstick in, it unexpectedly did not catch on fire. We tried again by putting cotton into the mixture, but the concentration did not catch on fire, but the 5% alcohol did release some steam though.

We then knew that the 5% alcohol concentration had too much water in it due to the steam. After this, we wanted to use 50% alcohol. If this didn't ignite, our mixture would be higher than 50% alcohol. If the ignition was too violent, we would know that the mixture would be 49%-6% alcohol, but the flame was just above the cup meaning it was not violent. The mixture was just right.

Overall, this procedure told us that less alcohol would not give much of a reaction. With this conclusion, we know too less kerosene is not good for a reaction either. These procedures also

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
68	PT	4016

Title: SolarOven

Student Name(s): J. Tucker, A. Kamrudien

Abstract:

Our project is about how we can make a portable and light solar oven that can reheat and boil water in situations such as if there is a natural disaster and there is no electricity you can use it to cook frozen food or boil water. Our research has concluded with the fact that it was highly effective at its main purpose to reheat food and boil water.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
244	PT	4017

Title: Factors Influencing Crystal Growth

Student Name(s): L. Chintapalli, S. Talanki

Abstract:

Crystals let us collect information on the structure of materials on both a macroscopic and nanoscopic scale. Changes in crystal structure can lead to changes in important physical and chemical properties. This investigation explores the effect of temperature and substrate material on the formation and structure of copper sulfate (CuSO4) crystals. The experiments were conducted over temperatures, ranging from 4 to 90 degrees Celsius. Three different substrates were for crystallization: aluminum, plastic, and glass. Copper sulfate crystals were put into solution with water and remained undisturbed until all the solution was evaporated. Crystals were created at 40° Celsius as the control batch. The copper sulfate was put into solution with warm water and stirred until dissolved. Additional batches were placed in the lab oven at 50°, 75°, and 90° Celsius. The final batch was set in a chemical refrigerator at 4° Celsius. The results were used to determine which temperature and material affected the CuSO4 crystals in the best way in terms of their structural integrity, size, and shape. The crystals formed at room temperature overall had the best crystal structure. At a lower temperature, the crystals formed in 2-3 days. Depending on the material they formed in different structures and at various rates. This contradicted our hypothesis as we had thought the solution would not evaporate quickly. At higher temperatures, the crystals lost their rhombus structure and the material became more chalky, white, powdery and fragile, decreasing the mechanical strength of the crystal.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	PT	4018

Title: Auto Guitar Tuner

Student Name(s): A. Ahmed, B. Aviad

Abstract:

When tuning a stringed instrument, such as a guitar, there is a margin for error since a human hand is manipulating the tuner. If a string is tuned too high, then whoever is tuning the instrument will spend more time correcting their mistakes, which leaves less time for playing the instrument. The objective of this project was to reduce the time necessary for tuning a stringed instrument. If there were a device to tune the instrument, then it would decrease the time dedicated to tuning. The auto guitar tuner was designed to clip a piezo vibration sensor to the head-stock of an electric guitar and picking the low E string on the guitar. An Arduino micro-controller was then used to receive the data from the vibration sensor and in turn, move the stepper motor. During testing, the tuner did not succeed as planned. The serial monitor used to review what the Arduino it receiving displayed "Frequency = inf." The data the Arduino is receiving is too cloudy to be processed. As a result, the auto guitar tuner is not yet fully functional. The Arduino cannot distinguish the guitar string's vibration frequency from the ambient vibrations traveling through the guitar. However, the tuner is reacting to the signals from the sensor and controlling the stepper motor accordingly. Proving that the code, Arduino, and the stepper motor are working as designed. Future iterations will include switching the sensor to a ¼ in. audio jack for direct input and an isolated guitar signal.

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

Word Count	Fair Category	Project Number
236	PT	4019

Title: Frosty Roads No More

Student Name(s): L. Miller, K. Nam

Abstract:

"Frosty Roads No More", is an experiment that determines which household liquids would melt ice the fastest. The purpose of the experiment was mainly to help people who don't have ice melting chemicals, like rock salt, at home. To conduct the experiment successfully, we followed a procedure. We kept the ice-cubes in the freezer for about 22 hours and 10-30 minutes. Due to the fact that we were doing the dish soap mixture (dish soap, rubbing alcohol, and warm water), we had to prepare the mixture before putting the ice cube in the cup. Then, we placed the ice-cubes in the same position. After that, we poured 1 1/2 tbsp of the substance on the ice. As soon as we poured the substance on the ice we started the timer. As soon as the ice melted, we stopped the timer. We had to repeat this process multiple times for each trial and substance. After conducting the experiment we found it took an average of about 155 minutes for the beet juice to melt the ice, about 142 minutes for the vinegar, about 125 minutes for the dish soap mixture, and about 79 minutes for the rubbing alcohol. At the end of the experiment, we realized that rubbing alcohol was the best option for melting ice. We learned our hypothesis was invalid after coming to the conclusion the rubbing alcohol melted the ice the fastest.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
243	PT	4020

Title: Comparison of the Effect of Thermal Conditions on the Potential of Carbonic Acid to Remove Rust

Student Name(s): T. Green, D. Nixon

Abstract:

One of the classic old wives tales for a quick fix to remove rust is to soak something in soda. The idea that carbonation, and the reduced pH in soda could do that intrigue us to the point that we also wondered what role the temperature of the soda may play. Storage and use of soda is long known to impact it's carbonation and taste, so it would serve that it may impact the ability of soda to remove rust. With that in mind, replicated studies were done here to evaluate the role of temperature in the ability of soda to remove rust. Replicated trials (n = 5 per temperature and n = 15 total) were set up with room temperature soda (25°C), elevated temperature (40°C) and chilled temperature (15°C). After 24-48 hours the rusty metals were removed and percentage rust on the metal prior was compared to percentage rust on the metal after soaking. After that comparison was complete, the metal was also passed several times over hard bristles brushes to see if the remaining rust had loosened. Through all trials, a consistent pattern emerged that temperature did not play a significant role in rust removal ($p>0.05$). In the future, trials and studies are being designed to also evaluate the role of soak time in this process. For now, it appears that although temperature may impact taste and how flat a soda is, it does not appear to impact its rust removal ability.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
129	PT	4021

Title: The Effect of Core Material on an Electromagnet

Student Name(s): M. Alcott, G. Manjoney, E. Zheng

Abstract:

The purpose of this experiment was to see if different core materials would affect the magnetic strength. The output was measured by placing the electromagnet made out of one of the core materials on the table and moving the compass until the compass is not affected by the electromagnet. The hypothesis was: if the core material was titanium, brass, stainless steel, or aluminium, then the stainless steel nail will be the strongest electromagnet. The hypothesis was supported. At the end of the tests, stainless steel had the highest output at 5.8 cm, followed by titanium at 1.8 cm, brass at 1.0 cm, and aluminum at .3 cm. At the end of this experiment, all core materials made an electromagnet, but some had a stronger magnetic field than other materials.

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

Word Count	Fair Category	Project Number
247	PT	4022

Title: Redesigning Capacitive Deionization to Desalinate Water More Efficiently

Student Name(s): D. Li, D. Wu, Z. Starr

Abstract:

Capacitive Deionization (CDI) is a more affordable and effective method of water desalination. The technology is based on the concept that porous carbon slates, when electrically charged, can absorb dissolved salt ions due to salt's natural conductivity.While Reverse Osmosis can get the job done, this method is very costly though due to the energy required to exert that amount of force. Even though CDI is a preferred method, it can still be improved upon. Most designs use two slates that are located on the top and bottom of a long tube. As brackish water flows through the dissolved salt ions are pulled towards the slates. In this design, the electrical charge must be strong enough to power the slates along the long tube. In our design, we proposed to use carbon rods placed in a container. This allowed us to increase the amount of surface area because we were able to use multiple rods. In addition, we included a tilting mechanism to the container that evenly distributes the salt ions among the water. This prevents a rod from saturating too quickly. Our project redesigns the standard CDI model by being more cost and space-efficient. After testing, we were able to lower the salinity of water from 35 grams of salt per liter of water to 26 grams per liter. While this did not quite bring down the salinity to regulation level, we believe that this is the first step towards a better method of water desalination.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
116	PT	4023

Title: Hydraulics lift

Student Name(s): C. Varas, E. Meyers

Abstract:

Can you lift a vehicle? No, our bodies are not strong enough to lift a heavy object like a vehicle. But by using the power of hydraulics, you are able to push a button and instantly have that vehicle lifted. Why is this a problem? Well, cranes that use internal combustion engines or electric motors, can be dangerous and take a long time to get a job done. It's a simple solution to a common problem in the mechanical engineering field. When using this hydraulic lift you are able to put the force of water into action and lift various objects. This project is an easy way to get an inside look at how hydraulics work.

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

Word Count	Fair Category	Project Number
242	PT	4025

Title: Saving the world, one paper brick at a time, with paper bricks as an economical source of heat

Student Name(s): A. Quinby, L. Marshaus, A. Gumkowski

Abstract:

Although many people resort to recycling as a “solve all ", our current recycling system is not recycling most of the items it receives. Instead, the recycling is being shipped around the world, only to be dumped in the ocean, raising worries about the safety of marine life. To address these problems, we propose paper bricks, made of cheap recycled paper, or biobricks, made of recycled wood chips and sawdust, are burned instead of raw wood. This substitution could reduce our dependence on fossil fuels and wood-based products not made of recycled wood. It can be hypothesized that because a paper brick is a more highly packed amount of wood than a bio-brick and the various woods used as a control, it will produce more BTU’s (British Thermal Units) than the bio-brick and the control wood.

We made our own paper bricks and then used a calorimeter to determine the amount of BTU’s per gram. We observed that while the paper brick produced less BTU’s per gram than the various wood samples and the bio-brick, it had a much slower burn rate than raw wood samples. While this may not seem helpful and does not prove our original hypothesis, recycled paper is currently selling at $-2 a ton, versus the sawdust used to make biobricks at $50 a ton. We conclude that while wood is more efficient, paper bricks are still beneficial and could have a large economical advantage.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
159	PT	4026

Title: Rethink Your Drink!

Student Name(s): J. Nelson, K. Oquendo

Abstract:

Invertase is an enzyme that breaks down the sugar in drinks, this helped us in our experiment to test sugar levels in common drinks. To complete this experiment we tested two groups, one group of drinks with invertase, and the same group of drinks without invertase. Our first group showed that the Red Bull had the most sugar and that the Sunny D had the lowest. Our second showed that the Coca-Cola had the most sugar and the Red Bull and Sunny D were the lowest and were equal as well. Our hypothesis was that Coca-Cola would have the highest glucose concentration and this experiment proved our hypothesis correct. The results of this experiment would benefit people by informing them on what drinks they should stay away from and which drinks are better for you. Drinking beverages with a lot of sugar could lead to health risks such as gaining weight, type 2 diabetes, and heart disease.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
252	PT	4027

Title: Repurposing Plastic Into A Tiny House

Student Name(s): A. Yarlagadda, N. Brown

Abstract:

Plastic has more potential than the wasteful single-use items such as plastic grocery bags, plastic straws, bottles, and single-use lids used on coffee cups. These items in their current usage cause long-term pollution to the planet.

Shelter is one of the essential needs of all people and influences lifestyle. The goal of this project is to design and construct a model of a "tiny house" that is both affordable and environmentally friendly, that has an exterior structure made entirely out of single-use plastic that otherwise would have been thrown away. We attempted to create a house design with consideration of affordability, quality of life, and impact on the planet.

We researched single-use plastics to examine what they are used for, the amount of waste they produce, along with which type of single-use plastic causes the most pollution. We also researched how much space is required, on average per person, and the different parts of a house that are absolute necessities.

After creating drawings based on our ideas for a floor plan, we worked using trial and error to improve and finalize our design. We then constructed a model for a "tiny house" that incorporated different single-use plastics, including food and drink packaging made out of polyethylene terephthalate (PET), polystyrene containers, and plastic straws.

Our design ideas offer new potential for single-use plastics to be utilized once again, by being repurposed in creative and innovative ways, thus reducing large amounts of waste to our planet.

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):

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
241	PT	4028

Title: Fueling the Future

Student Name(s): S. Sze, S. Tomita

Abstract:

Will fuel cells work more efficiently with salt water? That was the question we decided to overcome. We expected the salt to help the fuel cell and to create more volts than the normal water. First, we created the fuel cell by curling wires, which we use as anode and cathode, then attaching it to our battery clip which we would use to spark the fuel cell. We made sure the voltmeter read little to nothing for the normal water, then we conducted our experiment. We took a battery and put it to the battery clip to spark the experiment and immediately tested the water. Our first trial, the one with no salt, led to an average of 0.776 volts. Our second trial with 5 grams of salt dove to only 0.44 volts, this proved to be our outlier. In the third trial, we used water with 12.5 grams of salt which averaged to about 0.576 volts. From there it slowly went downwards to an average of 0.432 volts during the fourth and final trial of 25 grams of salt. We can conclude that using salt in fuel cells will actually decrease the efficiency at which the fuel cell works. They are used because they create little to no waste but they create energy. If we were to find a way to make these more efficient so that we can use them instead of fossil fuels we could slow global warming.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
248	PT	4030

Title: Shower Treats

Student Name(s): C. Palifka, R. Portillo

Abstract:

We wanted to measure which bath bomb would moisturize your skin the best. Some people have certain skin problems, which is why we wanted to test out this experiment. Our problem was which bath bomb would moisturize our skin the best. Our theory was, "If we use different materials and recipes, then we will be able to determine which bath bomb will be the best moisturiser for all types of skin. For our procedure we said, "First, mix the dry ingredients (Baking Soda, Epsom Salt, Corn Starch, & Citric Acid) together in a large bowl. Now mix up the wet ingredients (Coconut Oil, Water, Essential Oil, & Food Coloring) in a separate bowl. Slowly add the liquid to the dry mixture causing it to be able to form some type of shape. Stuff the dry mixture into the bath bomb molds. Let your bath bombs dry out. Finally, throw one in the bathtub each day and test it out on your hand." You will notice the difference. For our result the Mermaid Bath Bomb was picked as the best moisturizer. We asked 5 of our friends to test out our bath bombs. 4 out of 5 of our friends said that they loved the Mermaid bath bomb because it had enough oils that made their skin smooth. So our theory was correct. We were able to find out which bath bomb was the best moisturizer by asking our friends and we got the best reviews on the Mermaid Bath Bomb.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
248	PT	4031

Title: TED TALK

Student Name(s): T. Caputo, A. Srdanovic

Abstract:

People are always looking for new ways to create electricity. While doing research for our school science fair, we found out about thermoelectric generators which we can use to generate electricity. The purpose of our engineering project was to create electricity and with that electricity to charge an iphone which needs 5 volts to charge. A thermoelectric generator "is a solid state device that converts heat flux directly into electrical energy through a phenomenon called the Seebeck effect." That basically means the greater the difference between the hot and cold sides of the thermoelectric generator the more volts it will produce. To produce volts, we started by 3D printing an open box in which we laid our three generators. Next, we glued silicone sealant to the bottom of the generator and attached four metal screws it. Once we did that, we were able to fill the inside part of the box with ice water and put the contraption on top of a pan that was filled with boiling water. The boiling water touched the four metal screws and that distributed the heat across the three thermoelectric generators. Now with the ice water and the boiling water, the difference between the two created electricity. In the future we want to charge a skier's iphone while they are skiing, and charge a scientists iphone or other technology in antarctica while they are doing research. We only got 2.5 volts as our best test, we feel that this technology shows promise.

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

Word Count	Fair Category	Project Number
193	PT	4032

Title: Water Filtration Station

Student Name(s): M. Chirayil, T. Frouge

Abstract:

Clean water is an essential part of life to all humans. People use water for many things including drinking, washing, and even recreational purposes. Many people use different filters to get the fresh water that they need. In this experiment, different types of water filters were tested to see which water filter cleans dirty water collected from Tarrywile Park in Danbury, CT the best. Twelve different water filters and combinations of water filters were tested. The water filters that were tested are pebbles, sand, filter paper, polyester fiber, cotton, activated charcoal, and a Brita water filter pitcher. The things that determined which filters were the best were how fast the water went through the filters, the turbidity of the water, the pH of the water, and if there was any bacteria in the water. The conclusion of this experiment is that the polyester fiber cleaned water the most efficiently and the fastest. The pH of all the water was around 7 which indicates that the water might be safe to drink. The water for the bacteria test was purple after 48 hours so none of the water had any harmful bacteria in it.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
234	PT	4033

Title: Using Bamboo and Glass to increase the compression strength of concrete of reinforced concrete.

Student Name(s): R. Ibrahim, V. Haran

Abstract:

Concrete is a common material for house foundations and road construction. Concrete is a mixture of cement, aggregate, and water. The ratio of this mixture is important to create a material with high compressive strength. In recent years, there have been many problems with crumbling foundations. While this project doesn't directly impact this problem, it does give us a better understanding of how concrete can be strengthened. This investigation looks at the effect of reinforcing materials on the maximum compressive strength of concrete. Cylindrical molds were modeled in TinkerCAD and manufactured using a 3D printer. Reinforcing materials, consisting of hollow tubes of bamboo, plastic, and two different diameters of glass tubing were added. The reinforcing material was positioned in the mold to be "vertical", "horizontal", or "diagonal". The concrete was mixed and poured into the molds and allowed to dry in air for three days. The molds were then removed and the samples were submerged in water for an additional 20 days. The samples were cut to remove excess reinforcing material and tested in compression. Results showed that for all reinforcing materials, the samples with vertical reinforcements were the strongest while those with diagonal reinforcements were the weakest. Additionally, the larger glass reinforcing materials had higher compressive strength than the smaller glass reinforcing materials. Upon examination of the fracture surface, it was noted that glass samples had some sort of adhesion to the concrete.

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

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

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

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

☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	PT	4036

Title: WAZE to Evaluate Traffic: The Drive from Guilford to JFK

Student Name(s): J. Li, E. Huang, W. Cong

Abstract:

Our project was about the traffic from Guilford to the JFK airport, including a section of I-95, which represents about 1/5 of road miles in the U.S. We evaluated the amount of traffic on highways, traffic patterns, and its economic impact. We used the app Waze to find the average speed of automobiles. First, we conducted a pilot study to ensure the data collected by each teammate was similar. Then, we collected formal data for one week from 6 A.M. to 12 A.M. The data showed that each day had 2 rush periods, in the early morning and from noon to afternoon. During these rush hours, the speed could reach as low as 26 MPH. This is like driving in a school zone. From Guilford to JFK, traffic during weekends started lighter, but during the late morning the traffic got as heavy as what is in a weekday. On the way back, the pattern in the morning was very similar. But at around noon, the traffic during weekends became lighter than the traffic on workdays. With this much traffic, excessive amounts of time and money are wasted. Assuming one hour is wasted each trip, and about 160,000 automobiles are on the highway at a time, we estimated at least 160,000 work hours are wasted each day, which is equivalent to about 624 million dollars each year.

In conclusion, the traffic on I-95 is too heavy. We believe that we must consider a new infrastructure to lessen the traffic.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
253	PT	4037

Title: Utilizing Nanotechnology to Clean up Oil Spills

Student Name(s): A. Liu, A. Gopal

Abstract:

When oil spills occur, every second is crucial to collect the oil so that it will not spread too far. Modern solutions can take days to clean up spilled oil and are unreliable in collecting oil in choppy waters.

The objective of this project was to devise a time-efficient and eco-friendly method to clean up oil spills. To fulfill this objective, a magnetic conveyor belt was constructed to remove magnified oil from a water surface and contain it. Testing has occurred to identify the best ferrofluid's composition and concentration in the spilled oil.

For creating the ferrofluid mixture with the oil, Black Iron Oxide (BIO) and Sodium C14-16 were added to mineral oil. The mineral oil is used to mimic crude oil spilled in the ocean. The BIO is combined with the mineral oil to make it magnetic, and the surfactant Sodium C14-16 is added to bind the components together. The conveyor belt is composed of a belt (with magnets), wheels to turn the belt, a motor, casing, and a wood frame.

Tests on the ferrofluid mixture were successful. The solution was attracted to the magnet with almost no oil left behind. Although the mixture was magnetic, tests on whether the conveyor belt, as-built, could pick up the ferrofluid did not yield any results. This is due to flaws in the design. The most prominent design flaw being the low magnetic pull. The magnets were too weak to pull the ferrofluid out of the water and up the conveyor belt.

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

Word Count	Fair Category	Project Number
251	PT	4038

Title: Shades N' Rays

Student Name(s): E. Brew, K. Robinson, S. Navarrete

Abstract:

The purpose of our project is to examine differently priced sunglasses and see which ones best protect your eyes. More and more people's eyes get damaged every day from not wearing sunglasses or wearing poor quality sunglasses. UV and Light rays can damage your eyes by making their way through the retina and damaging the cornea through a severe sunburn. Damage to your cornea can lead to critical eye damage or even blindness. The cornea and retina are both parts in your eye. The cornea is the clear outer part of your eye. The retina is the light-sensitive tissue lining in the back of your eye. We figured out that many pairs, if not all, declare that they are one hundred percent light and UV protective. Many pairs of expensive sunglasses block the same amount of UV and light rays as an inexpensive pair. This is the main point of our project in which we are trying to prove. We are exploring the possibilities of a cheap pair of sunglasses and testing if it's blockage is equal to an expensive pair. Maybe, you don't need to spend mounds of money on sunglasses, if their protective rate is the same. After testing our sunglasses, we learned that all of the pairs of sunglasses block 100% of UV rays. We also learned that the Jcrew pair blocked the highest percent of ambient light rays. Overall we learned that you might not need an expensive pair of sunglasses to fully protect your eyes.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
107	PT	4039

Title: Construction Catastrophe!

Student Name(s): M. Kline, J. Jones

Abstract:

The purpose of Construction Catastrophe was to test how effective different hard hat designs were at protecting a simulated head. The data was gathered by lifting barbells with increasing mass using a pulley system. Then dropping it on the Helmet cradling the simulated head (cabbage). The damage to a cabbage was then rated from 1-35 in severity. This process was repeated for each helmet and no helmet (cabbage by itself). The hypothesis was that Helmet 1 would protect the simulated head the best. The design of Helmet 1 took the most falling mass for extreme damage to show. The hypothesis was supported by the test data gathered.

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

Word Count	Fair Category	Project Number
206	PT	4040

Title: Does the Baseball Bat You Use Affect How You Hit?

Student Name(s): P. Breton, Z. Nyberg

Abstract:

Abstract

We decided to research and experiment which baseball bat hits the farthest and hardest, to see which baseball bat is the best. We compared five different baseball bats made of different materials. We used a BBCOR bat, a wood bat, a composite bat, a USA bat, and a Thermo Composite bat. We wanted to know what the best baseball bat we can possibly use is. We did this project because we both play baseball and want to know what bat is the best.

We tested five different bats at a baseball facility called D-Bat. We used a software program called HitTrax that would tell us different statistics. It told us the launch angle of the ball, the speed, and the distance traveled. We collected all the data we got and used that to see which baseball bat performed the best.

At the end of this experiment we saw that the Easton Mako 31 was the best baseball bat for the both of us that we used according to the data we collected. It resulted in the greatest distance traveled and the greatest speed for Porter but only the greatest distance traveled for Zach. The Demarini CF ZEN resulted in the greatest speed for Zach.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	P7	5001

Title: Increasing Global Temperatures in Relation to Extreme Weather

Student Name(s): O. Morrison

Abstract:

While politicians fail to address the issue, climate change is a problem that will have major effects on our future. Most people are aware of our increased carbon dioxide emissions and global warming, but only recently have real effects been seen. Extreme weather is an issue, as every year numerous major hurricanes are costing the government and people billions of dollars. In my hypothesis I propose that there will be some measurable increase in Hurricane severity in the Atlantic over the past 100 years, correlated to global warming. To test my hypothesis I collected data from the National Oceanic and Atmospheric Association (NOAA). This data included the yearly average temperature anomaly (when compared to 20th century average), carbon dioxide in our atmosphere in parts per million, the ACE (Accumulated Cyclone Energy), and the number of major hurricanes (categories 3-5). I have found that since 1880 there is an upward trend in the number of major hurricanes each year. The ACE, representing a hurricane season's total intensity, did not show a trend. Both carbon dioxide and the global temperature anomaly had a significant rise. This data supports my hypothesis, as well as my background research, therefore Hurricanes should be not increasing in frequency, but severity, as shown by the number of major hurricanes. After conducting my research I have found that there is an increase in hurricane severity that is not major but important and we should be looking out for our near future where global warming could cause massive change.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
189	P7	5002

Title: Preventing Heat Transfer

Student Name(s): E. Young

Abstract:

The purpose of this project was to compare ways of preventing heat transfer in order to keep water hot or cold. The biggest factor in this is that heat travels differently between materials of different density and quality, because energy travels between molecules.

The hypothesis being tested stated that an air vacuum between two layers of metal would be the most effective, because the absence of matter may prevent heat from transferring. The same experiment was run twice using hot and cold temperatures, with conflicting results. Both the hot and cold experiments used containers filled halfway with water, whose temperature was recorded four times over 24 hours with an infrared thermometer. The original hypothesis was correct in the hot experiment; however, the most effective material in the colder experiment was polyurethane, an extremely dense, high quality foam.

Polyurethane is actually the best insulator, but the metal layers around the air vacuum are an advantage in the heat because metal retains more heat than plastic, which allows heat to escape quickly. These two types of insulation were superior to all others, and were about twice as effective as the control.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
224	P7	5003

Title: The Surface Effect

Student Name(s): R. Jachym

Abstract:

According to the Synthetic Turf Council (STC) and FIFA, they recommend that a soccer ball bounces between 60 and 100 centimeters on a grass field. The reason I decided to do my experiment was because I play soccer and sometimes I'm asked to play on different surfaces. As a result, I have to sometimes adjust to the different surfaces I'm playing on. I was curious to see how the soccer ball bounced on each of the surfaces and how I would need to adjust while playing. My hypothesis is that the ball will bounce the highest on the gym floor. For my experiment I'll go to a grass field and drop the ball from waist height (which for me is about 3 feet). I'll use the meter stick to see how high the ball bounces. Then I'll do the same exact thing on a turf field and a gym floor. I will record the information in a notebook, and see if my hypothesis is correct. When I dropped the ball on the grass field it bounced 7 inches. When I dropped it on the turf field it bounced 5 inches. Lastly, when I dropped it on the gym floor it bounced 12 inches (1 foot). Overall, my hypothesis was correct because the soccer ball that was dropped on the gym floor bounced the highest.

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

Word Count	Fair Category	Project Number
214	P7	5005

Title: Let Them Eat Cake!

Student Name(s): H. Reed

Abstract:

My gluten sensitivity led me to want to do a project to test how different gluten-free flours would compare with a gluten flour in baking. Growing up I had many symptoms of gluten intolerance; I missed out on my many favorite foods. My allergies have inspired my science project to achieve the best Angel Food cake, made using a gluten-free flour.

I researched different types of gluten-free flours that are typically used in baking, their physical and chemical characteristics, and how they are similar to gluten flour. I hypothesized that the rice flour would work best because of its potential for elasticity.

Based on this research, I chose to test five different types of gluten-free flour and how each compared when baking an Angel Food cake that typically is made out of gluten-based cake flour. I used the exact same recipe for each cake, only changing the type of flour used.

I designed tests to compare the resulting cake qualities in terms of: surface tension, spongy texture, crumble, and airiness. I found that the Cups-4-Cups flour (a combination of white and brown rice flours) achieved the best results. From this research I hope that people with gluten sensitivity can enjoy recipes typically otherwise made with gluten flour.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
175	P7	5006

Title: PH's Color

Student Name(s): B. Maia

Abstract:

The purpose of my experimentation was to find out if the different pH's of different foods can be determined by using a natural indicator solution. To find out, I exposed red cabbage indicator to foods with different levels of pH. Then, I observed the color of the red cabbage after being mixed with the foods with different pH levels. The data showed that when the red cabbage is being exposed to different levels of pH, the red cabbage changes color. When the red cabbage indicator was put on acidic foods the color turned bright red confirming the acidity. When the indicator was added to more alkaline ingredients, the color turned green confirming the alkalinity. The data supported my hypothesis showing the pH of the different items as predicted. I think that the data showed that the red cabbage changes colors when being mixed with different pH levels, because red cabbage has something called anthocyanins in it. Anthocyanins are naturally occurring pigments of red and purple that changes colors when mixed with acid or alkaline base.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
244	P7	5007

Title: Dampening, Quantifying, and Recording Tremor

Student Name(s): A. Pourkavoos

Abstract:

The purpose of this invention is to create a device to dampen tremor, and a method to quantify it. The first prototype used elastic bands in the glove's fingers and a weight attached to the back of the glove to dampen the tremor. The elastic bands were ineffective and were eliminated. The next three prototypes used weights of various sizes and materials. The last prototype was tested on a subject with treated Parkinson's disease. In order to quantify the tremor, the subject is instructed to repeatedly draw a horizontal line on an iPad. Python numpy, bash, and ImageMagick were used to convert the jpg images of the lines into plainpbm format. First, the converted images were used to find the correlation coefficient of the data points of the line. However, the coefficients were inaccurate. Instead, the standard deviation of the y values of the lines were used. Ten images of lines drawn by a healthy subject were processed, and the average standard deviation was around 2 to 4. Then, ten images of lines drawn with simulated tremor were processed, and their standard deviations were mostly between ten and 20, which was significantly higher. In the future, I am planning to experiment with a larger variety of weights and test this method on more people with and without tremor to be able to narrow down the normal and abnormal ranges. This method may help doctors quickly and reliably quantify patients' tremor and guide medical treatment.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
252	P7	5009

Title: Sound To My Ears

Student Name(s): P. Pitsoulis

Abstract:

Would it be nice to have a speaker that uses Bluetooth, like Sound to My Ears, which saves energy, can be charged anywhere you go, and plays continuously without losing connectivity? That's really what I've tried to create! First, I designed what the speakers would look like and then I decided what materials would be used in the design (copper wires, audio amplifier, Bluetooth receivers, casing, screws, solar panel, diodes, standalone battery charger Li-Ion, Li-Ion battery holder and two speakers). I started to assemble the speakers, connecting the wires to the proper places, but there was a problem. Although the invention was initially working, suddenly the speakers blew off and I had to redesign them to find a solution. While redesigning the speakers, I realized that I could use two Bluetooth receivers which would solve the problem of playing continuously without losing the connectivity. The solar panel allows the speakers to work for six hours when fully charged in the sun and the backup Li-Ion battery helps them to function for another four hours. Finally, when I tested the Sound to My Ears speakers I realized if the connectivity is lost from one Bluetooth option, you can have another source program to connect to the second Bluetooth, so you do not lose connectivity altogether. This is useful for both businesses and homes, so they do not waste time if the radio disconnects, breaks, or one Bluetooth connectivity is lost. I have tried the final product and it works perfectly.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
89	P7	5010

Title: Are You Eating Iron for Breakfast

Student Name(s): N. Peterson

Abstract:

There are many brands of breakfast cereal on the market that contain iron. The question is though how much is too much? If a person kept eating a specific brand of cereal could that be detected in the human body. In the course of the research conducted there were ten different brands that could be found commonly in a grocery store. During the course of the experiment it proved that there were significant levels that could be found just by waving a magnet across crushed cereal in a bag.

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

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

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

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

☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
158	P7	5011

Title: Fantastic Elastic

Student Name(s): N. Roberts

Abstract:

The purpose of my experiment was to find out if air temperature effects elasticity. To do this I tested three samples of elastic fabric in different air temperatures. I measured how stretchy the elastic fabric was in inches. For this test I measured elastic fabric before and after in room temperature air, cold air, and warm air and compared how much they each stretched. After completing the experiment, the data showed that the elastic fabric in cool air stretched the most. The room temperature elastic fabric started at 4 inches and stretched to an average of 9.4 inches. The cool temperature elastic fabric started at 4 inches and stretched to an average of 9.8 inches. The warm temperature elastic fabric started at 4 inches and stretched to an average of 8.6 inches. This supported my hypothesis because I thought that the cool air fabric would stretch the most and it did. To conclude, air temperature does effect elasticity.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
228	P7	5013

Title: Exploring Magnetism

Student Name(s): D. Mitchell

Abstract:

This project explores the effect of certain variables on the strength of a magnetic field in order to test the hypothesis that non-magnetic materials cannot interfere with a magnetic field; however, certain conditions may be able to affect a magnetic field.

Control experiments were performed to establish reference strength and range of a neodymium magnet. Range was determined by measuring the impact of the magnet on a compass along a preset track. Strength was determined with a paperclip count. Subsequently, temperature and material interference were introduced as variables and the control experiment methods were repeated with these variables.

The data shows that the range of a magnetic field may be extended with hot or cold temperatures; however, colder temperatures definitively yielded results in which the compass was affected at a greater distance from the magnet.

In strength testing, results were less conclusive; however, using averaged data, one can conclude that colder temperatures increase the strength of the magnetic field.

For interference testing, data showed that, for the materials chosen, the physical presence of the non-magnetic material had little to no effect on the range of the magnetic field versus the control experiment.

This project illustrates that the neodymium magnet's range is larger under cold temperatures, and potentially stronger under cold temperatures. It also concludes that the physical materials tested had minimal effect on the magnetic field.

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

Word Count	Fair Category	Project Number
184	P7	5014

Title: Slap Shot

Student Name(s): M. Schroeder

Abstract:

Professional Hockey officials keep the pucks frozen before games. Pucks are made from vulcanized rubber. Frozen rubber hardens and loses its elasticity. The expectation is the pucks will slide faster and bounce less. I decided to test this. Does the temperature of a hockey puck affects how far it will slide on the ice?

Every year, my family builds a 70' X 40' outside hockey rink. A contraption was built to push the puck with the same force and direction. The contraption was made using a mini hockey net and bungee cord stretched across the bottom of it. The puck and bungee cord were pulled together to hit a backstop (block). Then released together.

Twelve pucks were placed into four different temperature environments (Freezer, oven, refrigerator, and room temperature). The freezer puck went on the average 33.8 inches, the room temperature second at average 28.2 inches, the refrigerator a third with average 24.3 inches and the oven average 22.2 inches. My results show on average that the freezer pucks went the farthest. This supports the hypothesis that a frozen puck slides farther warmer pucks.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
121	P7	5015

Title: Chemical Energy Helicopter

Student Name(s): J. Aquino

Abstract:

In my design I was focused on making a model of a helicopter that could run on chemical energy such as battery power. The initial thought was that this could help reduce our dependence on the use of fossil fuels to power helicopters. Once the model was being built i was intrigued to see if the model was working which it did when I manipulated the connectors of copper wiring connected to a battery holder. During the building process I also searched for materials that were easily manipulated and could be easily attached this was to ensure that the model would work and after this process the model could be further investigated for more sustainable parts that would be industrially made.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
149	P7	5017

Title: Crystal Current

Student Name(s): A. Mauborgne

Abstract:

The purpose of my experiment was to find out if crystals can be used to generate electricity, and determine which crystals create the most electricity. After doing some research, I devised a way to test different crystals. I attached a magnet to a voltmeter and struck the individual crystals and recorded if any current was created. Then, I recorded the mV reading from each crystal. Out of the eleven crystals I tested, all of them produced an electrical current ranging from 36.2 mV, to 7.6 mV. Clear quartz produced the highest mV reading, and "Crazy lace agate" produced the lowest output. If I did this experiment again, I would use crystals of the same weight, and texture to eliminate factors that could influence my results. After doing this experiment, I wonder if this science could create an alternative energy source that may be utilized in future deep-space exploration.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
218	P7	5018

Title: Why is my Bedroom Cold?

Student Name(s): K. Cadmus

Abstract:

The purpose of my science fair project was to find out how to make my room warmer and why my room is currently so cold. My hypothesis was that the combination of the bedroom door being open and the baseboard heater along the wall being clear of bedroom items would be the warmest because the heat would not get trapped and there would be air flow from the open door. My procedure was to one at a time adjust different aspects of my room to see if the changes would affect the temperature of my room. The controlled variables of my project were the outside temperature and the temperature set on the thermostat inside the house. The dependent variable was the temperature of my room. The independent variables were the combinations of tests. The main result of this experiment was that all the coldest temperatures happened when the door was closed. The results show that my hypothesis was correct in the fact that it is warmer when the door is open and when the bedroom items are off the heater. Having the items off the wall did provide other circulation to occur. If I were to do this experiment again I would do the tests more times for more specific results and do more scenarios for additional results.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
129	P7	5020

Title: the relationship between tree species and BTUs

Student Name(s): R. Marquis

Abstract:

This project demonstrates the relationship between wood hardness (density), and its usefulness of a heat source measured in BTUs (British Thermal Unit). This project also explains the relationship between tree types (deciduous or evergreen) and the tree species, tree width, and tree height. Also as the tree density gets higher the wood would last longer and would burn with more BTUs. As I experimented with dry seasoned wood, maple gave the most heat, lasted the longest and and got the water to the highest temperature. The water could have been hotter but the experiment only lasted 30 min. The experiment was in a wood stove with a grate that held the wood. We ran two wires with barbeque prongs so the air and the water temperature could be measured.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
45	P7	5021

Title: Solar power

Student Name(s): S. Shaw

Abstract:

In my experiment I tested which solar car went the farthest, the homemade or the kit version. I thought that the kit will go the farthest because it had more reflectors. MY hypothesis was dis-proven because in the end the homemade went the farthest.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
151	P7	5022

Title: Voice to Text Handwriting Replicator

Student Name(s): Z. Coleman

Abstract:

Hand-written letters are one of the most personal forms of communication. There are many reasons why people may lose this functionality and although they would like to make those personal connections through their written words, because of disease, age or disability they are no longer able to do so. The objective of my work is to restore the ability of people to communicate through their written words with THEIR OWN handwriting using only their voice.

My project uses three main parts to accomplish this goal. 1) An input device 2) Multiple softwares to process the voice into text; and 3) An XY Plotter Printer that can accurately replicate handwriting using actual pens or pencils to reproduce a person's actual handwriting.

Combining several pieces of existing technology in a new way, I am working towards a system where people can use machines and technology to improve the quality of their lives.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
234	P7	5023

Title: Developing a Novel Eco-Friendly System that Recovers Wasted Thermal and Kinetic Energy From a Dryer Exhaust

Student Name(s): T. Zoghol

Abstract:

For the past couple of decades, climate change has been an extremely problematic issue. Though most of it is caused by co2 emissions, thermal and kinetic energy waste from dryer exhausts plays a significant role in the digits. This project illustrates a cost-effective, universal and eco-friendly method of extracting wasted energy from dryer exhausts. The system functions as follows. The dryer exhaust fumes are lead through a tube where they transfer heat through heatsinks to the hot side of several Peltier tiles (The cold sides of the Peltier modules are facing outward exposed to cooler air). Then the fumes leave the tube after rotating a turbine as the electric readings are recorded. During experimentation, several safety precautions are taken. First of all, the dryer is unplugged during the build to prevent the accidental inhaling of any fumes. Second of all, all bystanders stay a minimum of 20 feet away from the dryer. Finally, a fire extinguisher is kept handy at all times. Though it may seem that electricity generation is the main aim of this project, that is not the case. The main aim of this project is to minimize climate change caused by dryer exhaust fumes. By maximizing the energy extracted from dryer fumes, the climate change caused by the dryer fumes is minimized. In the long run, this system can become part of the solution to an increasing worldwide issue.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
249	P7	5025

Title: Biodegradable Trash Bag Test

Student Name(s): E. Turek

Abstract:

Plastic bags are a problem. Plastic isn't good for the environment because it does't decompose and is a non-renewable resource. CT banned plastic grocery bags but they didn't ban plastic trash bags. People use paper bags and reusable bags instead of plastic at grocery stores but you can't do the same for trash bags. Because of this, different biodegradable trash bags and paper bags were tested to see which ones worked the best. Trash bags need to not leak, and hold weight without breaking so I tested how much they leaked in three weeks, how much weight they can hold, and how much they degrade in 2 ½ months. In the weight experiment the paper bag ended up to be the most sturdy and held up to an average of 81.7 pounds. The paper bag disintegrated the best with an average of 80% remaining compared to the OKKEAI bag that left 98.7% remaining. But the part where it failed is the leaking test because the water just went through. All the biodegradable bags passed the leaking test were able to hold the water up for three weeks. This means that you wouldn't be able to use this bag for any wet trash but is the best option for any dry garbage. Even though the Think Green bag doesn't hold as much weight or disintegrate as fast it is the next best option because it doesn't leak and it holds the second average for both of the other experiments.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
148	P7	5026

Title: What is The Most Efficient Way to Remove Rust?

Student Name(s): M. McSwiggan

Abstract:

Rust is a common problem that just keeps growing and does not seem to go away. Although there are many ways to prevent and / or remove this inconvenience, which process is the most efficient? This experiment investigates which household solution is most efficient in the process of removing rust. Using water as a control, the substances used were white vinegar, lemon juice, Coca-Cola, and an OxiClean mixture. Each substance (Independent variable) was tested on a rusted metal plate. The measured effectiveness of rust removal was the dependent variable. It was predicted that white vinegar would be the most efficient of all the solutions being tested. This could be due to the high acidity contained within white vinegar. The data demonstrates that lemon juice removed the most rust. The results of conducting this experiment could assist many people with an economical and Earth-friendly option for removing rust.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
236	P7	5027

Title: Communicaider App

Student Name(s): E. Poole

Abstract:

The purpose of the Communicaider app is to help break down communication barriers for people with hearing loss by allowing them to participate in one-on-one and group discussions. Difficulty in communication can significantly impact one's education, employment, and social and emotional well-being. Currently, a low-cost, non-internet-dependent app does not exist to allow individuals with hearing deficits to participate in an active discussion in different languages. The Communicaider app is a unique solution to this problem. The app's front-end was designed using Apple's SwiftUI and the back-end was programmed in Apple's Swift. Testing of speech-to-text accuracy was performed with a variety of different types of reading recited by a variety of speakers. Testing revealed that the app had overall word recognition accuracy of over 97% across the selected recited texts. There was not a significant difference in recognition observed between speakers, though there was slightly decreased accuracy with random, less-flowing language. The Communicaider app is a reliable, affordable, and convenient way for people with hearing loss to engage in real-time two-way conversation anywhere in English, Spanish, and French. Future enhancements can seek to improve upon complex word recognition as well as the addition of more than three world language options. While the app is compatible with iPhones, iPads, and Mac computers, further developments will allow it to run on Windows computers and Android devices.

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

Word Count	Fair Category	Project Number
216	P7	5029

Title: Building With Bones

Student Name(s): A. Niass

Abstract:

This project was done to try to find a more eco-friendly way to construct buildings, in contrast to using concrete, which is bad for the earth. Concrete produces about 8% of global carbon emissions, but it is durable and can be used for bigger buildings. Other materials that are better for the environment, like recycled glass are durable but is not very strong compared to the other mass-market materials. There should be another alternative that can improve these climate-friendly buildings. One thing that can support a lot of weight is bone. A bone fragment the size of a sugar cube can support up to 1500 kg, which is more than most types of concrete. Gelatin, calcium, and phosphate bonding make bones really strong, so theoretically, if you put them on a building, it should make it much stronger. After, I put the materials in the paint and on the legos. Then I tested how strong the buildings, by hitting a pendulum one both building and letting out the air of a balloon. The building with the paint with calcium phosphate and gelatin did not fall, but the building with no paint fell. This led me to draw that buildings can become more stable if you base it off of the chemicals in bones.

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

Word Count	Fair Category	Project Number
144	P7	5030

Title: How do you create clean power...the answer is blowing in the wind

Student Name(s): A. Tuccinardi

Abstract:

For my project, I was wondering if I could make a windmill/Wind turbine to create wind energy which would convert to electricity to light up an LED light. To test my hypothesis I made the windmill and a small house containing an LED light at the window to show wind power in action. Once I built the windmill I used a hair dryer to simulate the "wind" so that the windmill blades would spin and power/energy would be generated to create electricity to light the LED light. Unfortunately, the LED light didn't light up. therefore my experiment was not a success. I determined several factors could have played a part in why i didn't get the result i wanted: I didn't generate enough "wind" to power bulb, the DC motor i used was defective(?), not connecting wires securely, or my windmill design

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
197	P7	5031

Title: Exploring the forces of friction

Student Name(s): B. Kelly

Abstract:

The purpose of doing this science fair project was to learn about the forces of friction since friction not only affects an individual's everyday life but is of great importance to numerous industries. The question for this experiment is which speed mat will produce the least amount of friction. A speed mat is a flexible flat object that was sat on while going down a playground slide. Friction is the force that holds back the movement of a sliding object. There are different kinds of friction that affect different things and three of them come into play in this experiment: Static, kinetic, and sliding friction. If a piece of cardboard, pillowcase, bath towel, and plastic trash bag are used as speed mats then it is predicted the pillowcase will cause the least amount of friction allowing the subject to travel down the slide the fastest. When performing the experiment the subject would sit down on a speed mat and go down a slide while being timed. Fifteen trials per speed mat were conducted and the speed mat with the least time, and the least amount of friction, was the pillowcase with an average speed of 2.73 seconds.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
227	P7	5034

Title: Creating A Tornado

Student Name(s): A. Rosario

Abstract:

My experiment's purpose is to test to see if the diameter of a tornado's core is affected by different water temperatures. I chose this project because as a little kid, I loved natural disasters, and as the years went by, I started to pay more attention to severe storms, more specifically, tornadoes. So now, I found this experiment online, and decided that this would be a really fun project to do. My hypothesis for this experiment is that the higher the temperature of water, the bigger the size of the diameter of the tornado's core. All I had to do, was to put some dry ice in a plastic bowl with 1 cup of hot water, turn the computer fan on, and wait for the tornado to be formed so I can make my accurate measurements. As a result, my hypothesis was proven, as hot water created the largest diameter for the tornado's core, with 5.5 cm at maximum size. This statement means that hotter water makes a bigger tornado. This might not help the people in my area, as we do not have many tornadoes. But this science project will help those living in states like Oklahoma, or Kansas, where they have more tornadoes there. In conclusion my question that I have always wanted to know, was answered: "Can water temperature really affect a tornado's size?".

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
223	P7	5035

Title: TemperBands

Student Name(s): M. Sumigar

Abstract:

I examined the effects of temperature on the elasticity of a rubber band. I chose this project because I am interested in mechanical engineering. I predicted the temperature will affect the elasticity of a rubber band. Through research, I learned that rubber bands are polymers that are made of long repeating chains of molecules; making them stretchy. A rubber band will stretch further when the temperature is hot because the atoms and molecules move faster, making a lot of space between them, allowing the object to expand.

To test this, I used a section of a rubber band, suspended in hot water and cold water. I poured hot water inside a graduated cylinder, cut a rubber band making it straight, tied one end to the middle of a skewer and the other end to 100g steel weight, then, I measured the length of the rubber band and the temperature of the water every three to five minutes until the water stabilized. I repeated the procedure for ice water.

Rubber bands stretched further when the temperature of the water was hot. My hypothesis was supported, the temperature increases the rubber bands elasticity. When matter is hot the molecules and atoms move faster causing the matter to expand.

The next thing I want to investigate is whether or not different rubber bands have different elasticity.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
217	P7	5036

Title: Which Household Product Takes The Longest To Clean A Mirror?

Student Name(s): G. Smith

Abstract:

The purpose was to find ways to clean a mirror using household products, without having to spend money on mirror cleaner at the store. I hypothesize that the vinegar will clean the best because it is in many multi-purpose cleaners and I think that they will disintegrate the hairspray speckles the best. My procedure is to put all my products in a spray bottle to have even amounts to spray on the mirror. Starting with a clean mirror, each is sprayed with 1 pump of hairspray and then left to dry. Each is then sprayed with two pumps of the product that is being tested. Next, wipe the mirror with two paper towels and after every three wipes, add another two sprays until the hairspray is no longer seen.

My controlled variables in this experiment are the amount of product and hairspray sprayed on to the mirror, as well as the cleaning method. My manipulated variable, the one that changes, is the product I will use to try to clean the hairspray speckles off the mirror.

Each product was rated from best to worst at removing the hair spray from the mirror based on the appearance of each mirror (streaks, residue, etc.).

The vinegar, found in most cleaning products, was not the best in removing hairspray.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
249	P7	5037

Title: Safety measures and precaution in the kitchen: an automatic built in stove shutoff.

Student Name(s): J. Moss

Abstract:

Jordan is trying to find a solution to prevent fires in homes. Over 1,319,500 fires happen in America every year. 374,000 of the fires involve homes that have caught on fire. The number one reason house fires start is because of cooking and specifically happen when homeowners leave their stoves on. When a stove is left on it often has something on it that catches on fire. Fires in the home are often tragic because although they often begin as a small fire they result in some very big issues. For example, house fires can lead to is homelessness because if someone's house burns down, he or she may have nowhere else to live. It can also result in poverty because objects left behind in the house during the fire would burn including all the money and valuable objects. Finally and most important, house fires can also lead to injuries and even deaths for those caught in the flames.

There should be ways to help prevent these fires from happening. Making a timer and automatic shutoff on a stove would hopefully help cut down on the number of fires. It should be a simple and not too expensive invention. Cost is important because house fires are a worldwide problem and it would be good if this could help people in all countries, not only affluent countries. Although this invention may not stop all fires in homes, any improvement in reducing this global problem would be an important step forward.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
256	P7	5038

Title: Best Baked Cookies

Student Name(s): M. Fisher

Abstract:

I decided to study and research which cookie sheet bakes cookies evenly.

Most people believe that air-bake pans are the best pan to use when baking cookies. My project showed that light non-stick aluminum pans were better than air bake pans in producing a quality appearance.

In order to see which pans baked cookies evenly, I researched which pans were currently on the market and why bakers selected pans. I also researched measurement tools used to judge cookies. I tested six pans, using the same brand of cookie dough, oven, temperature setting, and size of cookie dough scoop size for each trial. I also placed the cookie dough in the same location on the pan and placed the pan in the same location in the oven for each trial.

I conducted three tests. During the first two trials the cookies were observed and scored by three judges. The third trial was scored by ten judges. Each trial tested six pans (David Burke airbake light colored pan, airbake light dash bottom pan, airbake light dimple bottom pan, dark-colored non-stick aluminum pan, airbake dark dash bottom pan, and light colored non-stick aluminum pan). Cookies were judged on their color, crust, size, and shape.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
245	P7	5039

Title: Density and Magnets

Student Name(s): D. Hefferon

Abstract:

Grade 7 Science Fair Abstract

The purpose of my experiment is to figure out if different densities of liquids affect a magnetic field's pattern and speed. If a magnetic field is created in three different liquid densities, then the magnetic field will change. My experiment was done by pouring 100mL of rubbing alcohol, water, and mineral oil into three bottles. Then, I put 350g of iron filings into each of the bottles. Next, I created a magnetic field around each of the bottles by holding two ring magnets to the sides of the bottles. My procedure created the following results.

The results were very easy to discover and important. A key result was that the rubbing alcohol was the least dense. Its density was 786kg. The water was the second least dense with a density of 997kg. The mineral oil was the most dense. Its density was 2087kg. The iron filings in the rubbing alcohol were the fastest to collect on the magnets at 1.05 seconds. The water was the second fastest at 1.58 seconds. The mineral oil was the slowest at 40.4 seconds. In connecting my results, I gather from this experiment that the density of a liquid affects the magnetic field's speed and the time that is required for the filings to settle.

My research was found on four different sites. They explained how magnetic fields and magnetic poles can be created and changed. In conclusion, my experiment gathered the results I expected.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
215	P7	5040

Title: Low-cost golf swing analysis to minimize injury based on analyzing motion images/videos using software

Student Name(s): R. Wang

Abstract:

Golf is a well-known sport in many countries. Golf Support states that the percentage for injury annually for an amateur golfer is 40.9 percent, compared to pros at risk of injury at up to 90 percent. This project aims to reduce the risk of injury in a golf swing so that people can enjoy the sport even more. The method is to process pre-recorded videos by a real-time multi-person keypoint detection opensource software, OpenPose by CMU. There are two videos of golf swings, one that is safe and one that is prone to injury, were processed. The processed videos have an overlay of colored joints detected by OpenPose. The position data of shoulders, elbows, hips, and wrists were recorded. The dada was then exported to MS-Excel for display and analysis. Through the experiment, I concluded that OpenPose works well and can detect accurate data for both swings, good and bad. The position data can be used to tell if the swing is safe or not. In summary, the project proposed a low-cost method that can accurately detect swings of all sorts for me to analyze if the swing is safe, or prone to injury. In the near future, live videos will be analyzed with programming using the OpenPose library.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
241	P8	5501

Title: Building a Homemade Radon Detector

Student Name(s): G. Hofstatter

Abstract:

Building a Home-Made Radon Detector

BACKGROUND: Radon: a colorless, odorless gas that is the leading cause of lung cancer among non-smoking Americans. Radon is also found in dangerous levels in over 40% of all homes in the United States.

OBJECTIVE: The objective of this project was to use the engineering design process to create a working Radon detector.

METHODS: Using small electronic components including a Darlington transistor, a resistor, and multiple power supplies, as well as household items including dusting cloths and cans, the detector was constructed based on a previously published design by Charles Wenzel/Science Buddies. Along with the detector, a Radon collector was also constructed. To tell if the detector worked, readings were taken with a digital multimeter.

TESTING: Due to the known presence of low-level radon, tests were conducted at my house. Along with these tests, the detector was sent to the company Pawsey Mercer (an engineering

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

Word Count	Fair Category	Project Number
131	P8	5502

Title: Crystal Creation

Student Name(s): A. Singh

Abstract:

The purpose of this project was to see which solution will create the best crystals. I boiled water for three jars and mixed one with salt, one with sugar, and one with alum. I put a pipe cleaner hanging on a piece of string in the jar to let the crystals grow on it for 20 days. My hypothesis was that if I use alum instead of salt or sugar then, the crystals will be larger because the water in the alum solution will evaporate faster allowing the crystals to grow faster and at a greater quantity. My hypothesis was supported by the data. The results showed that the alum could grow the largest and the most crystals, the salt could grow a crystal, and the sugar could not grow anything.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
211	P8	5503

Title: The effect on the type of paint on the thermal protection of wood

Student Name(s): N. Fry

Abstract:

Abstract

Nathan Fry

The objective of this experiment was to find what paint had the best thermal protection of wood. This experiment provided some very interesting results as to the effects of paint types on insulation of wood. The original hypothesis, that oil exterior paint would provide the best insulating value, proved true. Both oil samples proved more effective than latex in insulating the wood however the oil samples also absorbed a lot more heat on their face side and the paint began to char and bubble. This was not seen in the latex samples which reflected more heat off the face. Overall there was only a small range of difference in average temperatures on the back side of the samples between different paint types. All samples provided more insulation to the wood than the bare sample. The average temperature of each sample three tests were calculated to make up for slight variations in the flame temperature and distance as well as any variation in the paint coating itself. More tests would yield a better average but would be unlikely to change the results that Oil paint provides best insulation factor but at a cost of possible ignition. Latex is almost as good and stands up to the heat much better.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	P8	5504

Title: Domino Toppling

Student Name(s): R. Benway

Abstract:

This experiment used different types of dominoes at different distances apart, in curved, sloped, and straight lines, to investigate if spacing or domino characteristics (weight, size, material) made the dominoes fall faster. The prediction that smaller domino spacing produces faster falls was supported. Slopes and curved tracks were slower and less likely to produce measurable data.

Fall time for each domino chain was measured. Phase one consisted of 70 control trials. Phase two measured additional variables including longer chains, slopes, and domino types. Phase three used electronic timing to eliminate the human reaction time variable. Speed for each domino chain and fall time per domino were calculated.

Spacing does have an impact on the time it takes for dominoes to fall. The closer the dominoes, the shorter the fall time. Curved line rates were slower than straight line rates and didn't work well above 20 mm spacing. Uphill slopes took longer than level trials and domino chains don't handle slopes well, they topple on their own when slopes exceed 30 degrees. The downhill slope trials failed at every angle because the dominoes no longer toppled, they slid downhill. Domino types matter, the heavier tile dominoes fall faster than wooden ones. The rates for plastic dominoes (smallest) fell between wooden and tile (largest) domino rates.

The domino effect, the ability to cause multiple reactions to a single event applies to information processing and amplification. An example of the domino effect is the spread of contagious disease from one carrier to many.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
144	P8	5505

Title: Whitening Egg-cellence: Which Toothpaste Whitens Teeth Best?

Student Name(s): E. Filppu

Abstract:

This purpose of this experiment was to see what toothpaste whitened teeth the best. This experiment tested three types of whitening toothpastes to see which one was more effective in whitening teeth: Tom's of Maine (an all-natural toothpaste, with no flouride and an abrasive ingredient), Sensodyne Pronamel (a toothpaste with fluoride and two different abrasive ingredients) and Colgate Optic White (a whitening toothpaste with abrasive ingredients and hydrogen peroxide). Each toothpaste was tested on three different stains: Coffee, Gatorade and Thai Tea. The hypothesis was that Colgate Optic White would remove stains the best because it has hydrogen peroxide which dissolves stains. The results demonstrate that the hypothesis was incorrect. Colgate Optic White was the least consistently effective toothpaste tested. These results might help people make better choices about which whitening toothpaste to use. Future experiments could test different toothpastes with different ingredients.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
231	P8	5507

Title: Keep Your Own Score

Student Name(s): E. Lovett

Abstract:

This project addresses the problem that score-keeping apps do not give users the ability to

save games. This project creates a new score-keeping app that is better organized and has the ability to save games for people to reference later. The first step was to find out what

the best coding language was to use. The second step was to learn the language, in this case JavaScript. The third step was to find a mentor for feedback and collaboration. The final step

was to design and code the app, finally making it functional and to the standards needed to be met. Data for the app was saved in a table, and data for the project was saved in a Log-Book.

The data saved for the app was the stats of each game. It was then coded into a user interface (UI) for future reference. The data in the Log-Book was written progressively throughout the project. The data in the Log-Book were notes on coding languages, apps, and how to code.

A better app is now functioning and can save previous games for reference, welcome users with

a home page, and record the following: 2-pointers made/missed, 3-pointers made/missed, fouls

shots made/missed, total possible points, total points scored, blocks, steals, rebounds, fouls, assists, turnovers, and even resets just in case of a mistake.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
251	P8	5508

Title: The Pathfinder: a mobile navigation system to enable people to safely and quickly evacuate large, complex buildings.

Student Name(s): j. southam

Abstract:

The purpose of my project is to create an app to help people evacuate from large, complex buildings, such as malls, airports, hospitals, office buildings, apartments and schools. It will also enable First Responders to navigate through smoke, fire, or debris filled buildings. I chose this project because fires and natural disasters can happen when people are in these buildings and it can be difficult to evacuate quickly and safely. Currently, the only navigational aid for evacuation of these buildings are 2D maps drilled onto the walls, which are neither portable nor effective.

I solved this problem by creating an app that uses an interactive map, GPS and a voiceover to help the user find the nearest exit, fire extinguisher, fire alarm, exit door, staircase or medical supplies.

To create my app, I made a plan of what commands I wanted to write and in what order I would code them. Then I used a block code to create each command. I then tested the commands, both individually and as a whole program, and modified the code as necessary. Through multiple tests and re-coding, I created a working voiceover and GPS marker. In researching my project I discovered that there are currently no truly interactive maps of the insides of buildings, which meant I could not fully connect the GPS. In the future, I would like to create digital building maps that are downloadable and would become an industry standard to ensure quick and safe evacuation of large, complex buildings.

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

Word Count	Fair Category	Project Number
239	P8	5509

Title: The Effect of Fire on Different Types of Native Northeast Tree Bark

Student Name(s): S. Williams

Abstract:

The objective of this experiment was to see which type of Connecticut native tree bark would be the most fire-resistant. The three types of tree barks that were tested were ash, oak, and maple. The tree bark that was predicted to be the most fire-resistant was the Oak tree bark, and it outperformed both of the other types of tree bark tested. The test was conducted using a safe burning location, three samples of each species of wood, a fire starter, 1 pair of fireproof gloves, 1 belt saw (to cut the saw to have a fair comparison), and a stopwatch. The pieces of tree bark were burned until they lost their integrity. The integrity was determined by periodically poking at the burning tree bark and seeing if it falls apart. It is concluded that the oak tree bark outperformed the other pieces of bark, with the time average being 24:21.13. The second-best performing tree bark was the maple tree bark, with the time average being 11:64.15. The worst performing piece of tree bark was the ash tree bark, with an average of 9:65.68. This experiment could have been made better if I had a more accurate timing method. Another thing that could've made this experiment better was using a different type of tree bark. Originally, the plan in this experiment was to acquire tree bark from California, but after numerous attempts, the plan never materialized.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
245	P8	5510

Title: A More Efficient Microbial Fuel Cell

Student Name(s): I. Yan

Abstract:

Pollution is becoming a major issue on Earth. Most of the air pollution is caused by burning fossil fuels. The microbial fuel cell (MFC), a clean energy alternative, is able to convert mud or other waste into energy. It can substantially reduce air pollution by eliminating the need for fossil fuels. However, the performance of MFC is still limited due to its efficiency.

This project aimed to make the MFC more effective. The impact of several food ingredients on the power output of the microbial population was investigated by comparing to MFC with soil only (control). First, soil was combined with water and placed inside the microbial fuel cell. Saltwater was mixed with the soil to improve soil conductivity. Agar was added into the mud to increase the amount of electrogenic bacteria. To test this project, a multimeter was used to measure the voltage from the microbial fuel cells. The impact of agar on the power output of the microbial population was investigated by comparing the MFC with soil only (control), MFC with soil + agar, MFC with soil + agar + salt, and MFC with soil + vitamin B.

The efficiency of the microbial fuel cell was successfully increased by both agar and vitamin B. The power of the agar MFC was increased from 12.1 to 56.3 microwatts. The voltage of the vitamin B MFC increased from 12. 1 to 137.6 microwatts. This improved microbial fuel cell is more efficient and has the potential to reduce fossil fuels.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
206	P8	5512

Title: Constructing a Compound Water Turbine and Filtration Device to Autonomously Filter Water

Student Name(s): J. Zapanta

Abstract:

More than 10 percent of the world's population does not have reliable access to clean water. Additionally, 16 percent of people do not have access to electricity. This device aims to solve both of these problems by creating a device that simultaneously filters water and generates electricity when placed in a river. It is made for developing countries, and it is supposed to be something that can be left in the water and retrieved when ready. The filter is activated carbon sandwiched between one micron polyester felt. The turbine consists of four fins made of water bottles glued onto a six millimeter metal rod, which is connected to motor using a coupler. When tested, the glue connecting the filter and the turbine lost its strength, and the two pieces broke apart. The filter and the turbine were tested individually and both of them did their job. The filter part collected water, but it is buoyant, which is a major flaw considering that the device is supposed to be left unattended in the river. Looking at the turbine, it spun fairly quickly, but the LED light that was attached to the motor to signify power output did not light up, which probably meant the light wasn't working.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	P8	5513

Title: Producing Renewable Energy From Rainwater Gutter Systems Using Micro Hydro-turbines

Student Name(s): E. Okoney

Abstract:

This project demonstrates the ability to produce renewable energy using zero cost wasted rainwater from typical gutter systems found on many residential and commercial buildings.

To determine if the engineering goal was feasible, a prototype gutter transition piece and micro hydro-turbine assembly were designed and constructed to redirect water flow from a typical gutter system to the micro hydro-turbine assembly. The micro hydro-turbines were wired to a circuit including meters, battery, and charging connector to test the output while the micro hydro-turbines were rotating from the rainwater flow. Once the prototype success was confirmed, other testing was completed using variables of water flow, downspout length, and number of attached hydro-turbines. The objective was to determine which combination produced the highest and most consistent voltage output. The highest voltages were produced when the the most hydro-turbines were used with the highest water pressure and flow. The energy stored in the battery during the experiment was used to partially charge an iPad.

Practical applications include using this design on all types of rainwater removal and other waste water applications. In addition, this concept could be used in areas where electric power is not readily accessible and rainfall is abundant. To maximize the benefit of this energy, this design prototype could be installed on large scale buildings including airports, hospitals, businesses, malls, factories etc. Maximizing renewable energy helps the environment and reduces the amount of fossil fuel used, thereby having a huge positive impact on the Earth.

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

Word Count	Fair Category	Project Number
245	P8	5514

Title: THE EFFECTS OF FIRE ON PETROLEUM SOLIDS AND NATURAL SOLIDS

Student Name(s): D. Pane

Abstract:

It was predicted that petroleum-based solids will burn hotter than natural based products. The hypothesis was proven correct. It turns out that one of the natural products burned hotter at an average of 976°F than all of the other materials. Where's the Dri-Fit T-Shirt (microfiber/polyester fabric) burned at an average of 301°F the coolest out of all the materials. This project also concludes that the Dri-Fit T-Shirt (microfiber/polyester fabric) doesn't burn as hot, but melts to the surface. In the future, this could be a good thing because you will know not to wear Dri-Fit T-Shirts because they will melt onto your skin if catches on fire.

Through the experimentation increasing the time on each material could have changed the melting factors. If the experiment could have been done with a sprinkler system it would have been a better defense against the petroleum solids that were on fire. Fire sprinklers would have put the fire out while it was small so it wouldn't have the opportunity to spread so fast.

This experiment is part of the comparison of the Modern and Legacy fire. Fire itself doesn't behave any differently. Fire is extremely predictable. "The basic

mechanism in which fires spread has increased solely because of the products that are within the environment." By incorporating science into the tactical procedures and updating fire safety manuals for modern fires may lead to fewer firefighters getting hurt or killed.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
197	P8	5515

Title: Toothpaste is Cool

Student Name(s): A. Russell

Abstract:

This project is called "Toothpaste Is Cool." As humans, we use toothpaste for cleaning our teeth, and when we do so, our breath is refreshened because the build-up is being removed. Besides cleaning teeth, I believed that toothpaste has other abilities. One of those abilities was to change the temperature of other liquids. Colgate toothpaste contains a mint-like substance inside of it, which gave the ability to cool down liquid temperatures. The no-name branded toothpaste does not contain the mint-like substance, which is why I had the hypothesis that the Colgate toothpaste would have a greater effect on the temperature of the liquids(sprite, water, salt-water, sugar-mixed water) than the no-name brand. After doing this experiment, my hypothesis was proven right. For colgate toothpaste, I found that in trial 1, 75% of the liquids temperatures decreased, while 25% increased. I found that in trial 2, all of the liqud temperatures decreased. For the no-name branded toothpaste, I found that 100% of the liquids increased, and for trial 2, I found that 100% of the liquids decreased. In conclusion, toothpaste does have the ability to change the temperature of liquids.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
237	P8	5516

Title: A Solar Panel Array Over a Geodesic Structure

Student Name(s): D. Luo

Abstract:

It has been found that 78% of US global warming emissions are from fossil fuels. Landscapes have been destroyed by coal and oil mining. It is necessary to move to clean energy for the good of the environment. Solar panels are one way to do so; however, most solar panels' efficiency are only about 15-20% (this is the percentage of light reaching them that ends up converted into electricity.)

The objective of this research project was to create a more efficient, dome-shaped solar panel array in order to catch sunlight from more extreme angles, where a flat array cannot do so. To accomplish this, a geodesic dome was constructed, a fabric was cut to wrap around the dome, and solar panels were attached to it using velcro. Three solar panels were then wired, forming an array. Testing was conducted in the morning, noon, and late afternoon with both varieties of array. The dome-shaped solar panel array produced more voltage in the morning (an average of 7.72 volts compared to 7.293 volts) and afternoon (6.277 volts to 5.673 volts), but the flat solar panel array produced more voltage at noon (10.67 volts to 9.937 volts.)

The prototype was successful because it proved that the geodesic solar array produced more voltage than the flat array for the majority of the day. In the future, this more efficient solar panel array could increase the appeal of solar energy.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
245	P8	5517

Title: Drone Device for Carrying Items for Medical Purposes

Student Name(s): W. Raines

Abstract:

This project consists of a drone device designed to carry items for medical purposes from one place to another. My objective was to help design a drone that could help people lift or move objects. The drone has a claw attached to it that can pick up small objects of a certain weight and transfer it to another location.

To reach my objective, I researched how to assemble a drone. I learned how to put together the components, solder electrical wires to a power distribution board, and configure the drone using software.

Once the drone was finished, I practiced operating and controlling the drone. Tests were done to determine how the drone claw could lift objects from one point to another and to see how much weight it could carry.

The drone worked well and flew really high. Through its claw, the drone could carry an object weighing more than 500 grams (for example, a pair of shoes weighing over 700 grams). As observed, the weight that the drone could carry varies depending on the size of the drone and its claws and the power of its batteries.

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

Word Count	Fair Category	Project Number
233	P8	5518

Title: Heart Safe

Student Name(s): A. Pilla

Abstract:

Every year 1 in 4 deaths are related to heart disease in the USA. To prevent and save people going into cardiac arrest, I thought of building a wearable device, which is cost effective and practical.

I started researching the common treatments for cardiac arrest and found that defibrillation is the most commonly used procedure. For the wearable device design, I need the following components: Modules for Heartbeat tracking, Data processing, Defibrillation and Communication.

The heartbeat tracking module was built using a heartbeat simulator and an ECG shield, which are connected using the Arduino platform. Data collected from the Arduino is used to analyze patients heart rates and provide inputs to the defibrillation and communication modules. The defibrillation module is represented by an LCD screen in this experiment. The communication module is a Bluetooth device.

For the prototype, I used TechPatient Cardio as the heartbeat simulator, Arduino UNO R3 as the microprocessor, Olimex ECG shield as the heartbeat monitor, and an HM-10 Bluetooth module to communicate between the prototype and mobile device. To integrate the components, a 63-pin breadboard was used. When an irregular heartbeat is detected, the defibrillator module charges and releases an electrical shock. At the same time, the Bluetooth module contacts emergency services and family members.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
233	P8	5519

Title: Cracking a Caesar Cipher

Student Name(s): B. Green

Abstract:

The history of the Caesar Cipher (named after Julius Caesar) dates back to 100 B.C. Julius Caesar used it to protect messages of military significance. The Caesar Cipher is a type of substitution cipher in which each letter in the plaintext is shifted a certain number of places down the alphabet. The ability to crack code remains critically important today in the military for counterrorism and in public and private sectors for cybersecurity.

The objective of this project was to develop and code an algorithm to encode and decode a cipher. The steps to complete this objective involved creating the cipher, encoding a message, and then decrypting the message with the algorithm created. The materials used were Python (programming language), coding skills, and a computer. After retrieving a cipher that was made in a past project on cybersecurity, this topic was revisited on a deeper level. Before beginning the prototype, the coding program was installed to bring the code to life. Once the program was set up, the code was gathered and brought to the computer to be assembled. The design process neared completion without many difficulties, as the code was connected. A sentence was used for testing purposes. After the sentence was run through the cipher it resulted in a shifted sentence. The project was a success because it accomplished the objective of developing an algorithm to encode and decode a message.

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):

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
235	P8	5520

Title: Ultraviolet Light:

How Harmful Are You?

Student Name(s): K. Caguitla

Abstract:

This project is about the effects of ultraviolet light on rubber, ink, and paper. The purpose is to identify the effects of UV light on rubber, ink and paper. The materials in this experiment are rubber bands, newspaper, magazines, gift wrap, and A4 paper. In the first experiment keep five rubber bands as a control, expose five rubber bands to UV light for forty hours, then another five for eighty hours, then record observations. In the second experiment, expose ink by using two pieces of newspaper, magazine, and gift wrap for forty hours, then another set of papers for eighty hours, and record observations. In the third experiment, expose four strips of paper to UV light for forty hours and another four strips for eighty hours, save two strips of paper as a control. The rubber bands exposed for forty hours became less elastic compared to the control, the eighty hour batch was even less elastic, making the eighty hour batch the least elastic. The ink samples that were exposed for eighty hours showed more discoloration than the samples exposed for forty hours. The strength of the paper exposed for forty hours was weaker compared to the control, the eighty hour batch was even weaker, leaving this batch the weakest. The hypothesis is correct that when rubber, ink, and paper is exposed to UV light, it will show more signs of discoloration and physical change.

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

Word Count	Fair Category	Project Number
250	P8	5521

Title: The Power of a Wind Turbine

Student Name(s): F. Silva

Abstract:

This experiment investigated the variables that affect the amount of energy generated by a wind turbine, using a pinwheel as a model. A blow dryer was used to turn the pinwheel. The variables measured were the speed of the blow dryer, the angle of the blow dryer relative to the pinwheel, and the size of the pinwheel. It was hypothesized that the most effective angles would be 0º or 180º, the higher blow dryer speed would generate more energy, and the smaller pinwheel would have a faster winding speed.

Four different sized pinwheels were made of construction paper, two big and two small. The 9"x9" pinwheel was the control. Each pinwheel was mounted on a skewer and placed through two holes in an oatmeal canister weighted with rocks. Four different lengths of thread were tested. For each experiment, a thread was attached to the skewer with paper clips at the end and the time for the thread to wind around the skewer was measured. Measurements were recorded for multiple trials and compared to the control.

The most milliwatts were generated by the pinwheel scaled by ½. The variables that had the most impact were pinwheel size, blow dryer angle and variations in the blade structure. The 90º angle always generated the lowest power. The impact of angle was more noticeable with the largest pinwheel.

Some limitations were encountered regarding the size of the pinwheels and whether they would spin due to the height of the canister or blow dryer.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
248	P8	5522

Title: Light Up Your World with a Rainbow of Fire

Student Name(s): J. Lawson

Abstract:

Fire burns in a variety of different colors, but what causes this and how does it work? According to a study done by the National Center for Families Learning, scientists stated that people see different colored flames throughout the day. Although the basic flames are in the red to yellow family, occasionally one sees a blue or purple flame. One of the purposes of this experiment was to see what can make the fire turn to a different hue. My prediction was that the orange, purple, and blue will shine the brightest and the most visibly. In order to test this, I first chose a fireproof area to do the experiment. I then lined up ½ teaspoon of various powders in random order. I then added a similar amount of lighter fluid to each powder. I then ignited the piles using a lighter. Then, I I blew out the fire to ensure that the fire will no longer burn. Finally, I cleaned up the area and made sure there was no way the fire could reignite. Under direct flame the color changed and briefly became a red spark. All of the other colors did not show through except orange, but all of them burned orange.The materials were collected and then the chemicals and alcohol were lit on fire to see what color would show through. The experiment did not work except for the red flame. This experiment revealed which color burns the brightest in a rainbow of fire.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
254	P8	5523

Title: A Laser's Journey

Student Name(s): A. Montero

Abstract:

This project was made to show how different types of mirrors reflect light. You have 3 different types of mirrors. The normal mirror, which is completely flat, Concave mirrors, which curve inward, and Convex mirrors, which curve outward. You see all of these mirrors in your every day life.

The steps I took to follow this experiment start off as follows. 1.To start, you should brainstorm ideas of paths to make. These paths shouldn't be a straight line, and keep in mind that you will be putting mirrors on the wall of the paths you make. 2.When ready, choose one of the paths you made and build it. 3.Once you build it, place mirrors on the path's walls or floor. You can made path adjustments to the path if needed. 4. After placing the mirrors, shine the laser pointer at the first mirror!If the laser pointer got to the end, make the next path. If it didn't, move the mirrors to fix any problems, or change the type of mirror. 5. Take photos of the paths as data.

After doing all of this, my conclusion is that for the different types of mirrors, Normal mirrors are the best for being precise. Concave mirrors spreads the light out, but not to much in a way that makes it harder to be precise.Convex mirrors on the other hand have beams that spreads out to much, making the light spread out more, making it a lot less reliable on getting to precise points.

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

Word Count	Fair Category	Project Number
251	P8	5524

Title: The Hydraulic Arm

Student Name(s): V. Ortiz, F. Morra

Abstract:

The purpose of this project was to determine if it was possible to create a working hydraulic arm out of cardboard and non-standard items. The hydraulic arm would be able to maneuver from side to side, up and down, extend the arm, and finally, potentially pick up an item.

My procedures involved obtaining several pieces of corrugated cardboard, toothpicks, empty plastic syringes and tubing from a craft source, colored water, and one AAA battery. I cut out the pieces of cardboard according to a pattern and began assembly using toothpicks. It was suggested to use a bottle cap as a pivot point, but I substituted an AAA battery because I decided it would move more smoothly and allow the arm to swing without obstruction.

Filling the syringes and tubing was tricky. Getting the correct amount of fluid in the syringes, and leaving enough air in the tubing to allow for the push – pull affect to happen took some manipulations/trials. At one point I did have an adult put a hole in a syringe for me so I could fasten it better.

Finally, I completed trails using my hydraulic arm, testing to see if could maneuver in all of the directions I had hypothesized. The up and down motion was the best in movement, but the picking up the can had the highest trial success.

I was extremely happy to conclude that the hydraulic arm, made from simple materials, was successful in imitating the motions of a true hydraulic arm.

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

Word Count	Fair Category	Project Number
244	P8	5525

Title: Relationship between Viscosity and Saturated Fat in Cooking Oils

Student Name(s): S. Khan

Abstract:

The purpose of my research was to find out if there is a relationship between the viscosity and saturated fat of different cooking oils. Some cooking oils are good for our health, while others are not and could block our arteries and cause heart disease. Typically, the cooking oils with high saturated fat are considered bad for health. Perhaps the cooking oils that are more viscous than others could also be bad for our health. Viscosity is a measure of a fluid's resistance to flow and the state of being thick, sticky, and semifluid due to internal friction. I hypothesized that there will be a direct relationship between saturated fat and viscosity of each cooking oil. Five types of cooking oils were tested. A marble drop test was performed where a medium size marble was dropped into a 1,000 ml graduated cylinder filled with one cooking oil at a time. Three trials were repeated for each cooking oil and the average time was calculated and used in the equation for viscosity. The viscosity of each oil was compared against the saturated fat content of each oil. My hypothesis tested false. There was no relationship found between the viscosity and saturated fat of the different cooking oils. One oil such as Avocado oil which had a high viscosity, actually had a low saturated fat content. There was no significant difference found between the different oils with high or low viscosities against their saturated fat content.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
231	P8	5526

Title: Harvesting Energy From Rainwater With An Archimedean Screw

Student Name(s): R. Ramesh

Abstract:

Fossil fuels today generate 63.6% of our electricity. Fossil fuels cause environmentally unsafe compounds to form in the atmosphere, depleting ozone levels and thus creating a spike in skin cancer rates. The purpose of this project is to create multiple Archimedean screw designs with different parameters, including blade angle/pitch and number of blades, to see which one creates the most electricity.

Archimedean screws were designed using Autodesk Inventor and 3D printed using a Dimension Elite 3D printer. To test designs, each turbine was placed vertically in a wind tunnel. Even though air is 1000x less dense than water and air is more viscous, air and water are both fluids and both are incompressible at this speed, so they should have similar results. It was found that the turbines with 4 blades generated 71% more electricity than the turbines with 5 blades. It was also found that the turbines with blade angle 50 degrees generated 155% more electricity than the turbines with blade angle 30 degrees. In the end, it was found that the design with the biggest blade angle and the smallest number of blades generated the most electricity.

Simulations were run using Autodesk CFD (Computational Fluid Dynamics). By setting the conditions to match real life situations, it was found that the larger the pipe diameter was, the slower the Archimedean screw spun. Additional experiments using the simulation are ongoing.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
248	P8	5528

Title: Oil vs. Filters: The Surprising Truth

Student Name(s): K. Danaher

Abstract:

Right now there are 29 million gallons of oil in our oceans. While the majority comes from seeping through the ocean floor, approximately 1.3 million gallons of oil is spilled into the oceans annually. My project's purpose is to determine the best method of filtering oil out of water: sand, charcoal or cat fur. I chose these substances because sand is a natural filter, charcoal is used in fish tanks, and fur collects oil.

My hypothesis is that if I put oily water through these filters, the sand filter will work the best. For my procedure, I created 3 filters by putting sand, charcoal and cat fur in coffee filters placed over mason jars. I also used a plain coffee filter as a control. Then I made four test samples by mixing a 1/4 cup of oil with 2 cups of water each.

The variable in my experiment is how much oil is in the water. The way I measured my dependent variable was to compare how many inches of oil were in each mason jar before and after filtering. Each test sample contained 0.375" of oil before being filtered. In the end my hypothesis was proven correct because the sand filter had the least amount of oil left in the jar with 0.125" remaining. The cat fur filter was a close second with 0.1875" remaining. Although it had the most oil remaining at 0.25", the charcoal filter worked very fast while the others took hours to filter.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
147	P8	5529

Title: How Old Is The Universe?

Student Name(s): G. Beyer

Abstract:

Do you know how old the universe is? It may surprise you that no one knows the exact age. Astronomers are always working to perfect their estimates of the vast universe. In this project, you use the information you collect on dense collections of stars called globular clusters, to come up with your own estimate on the age of the universe. I used three different globular clusters given in my experiment and used Excel and specific analysis websites to determine each star's luminosity color. I found that a globular cluster's age varies on its luminosity and color. Depending on the color the older it's turnoff point is, or how long it is going to live. So collectively the three globular clusters were going to survive for over 2.3 billion years to over 49.4 billion years, meaning most will live longer then the current estimate of the universe.

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

Word Count	Fair Category	Project Number
248	P8	5530

Title: Sustainability in Skincare: Is "DIY" skincare really better quality, and more cost/time efficient, than store-bought skincare?

Student Name(s): S. Soni

Abstract:

The purpose of this experiment is to answer the question: Is "DIY" skincare really better quality, and more cost/time efficient, than store-bought skincare? For the procedure I applied the store-bought skincare in this order for a week: cleanser, serum, toner, and moisturizer. Then I tested my saliva with PH Strips to get my skin's PH level. I repeated this with DIY products. The issue with this procedure was the barriers, uncontrollable variables, and subjective observations that affected the conclusion. For example, I have resilient combination skin, which makes my skin naturally have a decent ph level (5.5). With the store-bought products my skin stayed at level 5 but with DIY products my skin's level decreased to a 6.5. For the most part, my skin felt more acne prone with DIY products. Many uncontrollable variables (like my stress levels) prevented this from being a controlled investigation. I also calculated the price of the DIY products and compared it to the store-bought products. On average each DIY product was $3.77 cheaper. But the total bill for the ingredients needed was $58.14. I spent around 3 hours picking ingredients and making the products. That gives us a total of $58.14 and 3 hours spent on DIY products compared to the $20.78 spent on the store-bought products. Considering that I will not recreate any DIY products, the $58.14 was unnecessary. DIY Skincare simply is not better quality, or more time/cost efficient than store-bought skincare.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
228	P8	5531

Title: Sustainability by the Spoonful

Student Name(s): W. Tucker

Abstract:

The environment is constantly being affected and damaged by plastic that gets thrown out. In an attempt to try to help reduce the amount of plastic going into the environment, there was an attempt at building biodgebradable spoons. The project started with a question being asked of what the purpose of the experiment was. The question “Can biodegradable spoons be made?” was asked. This was tested by making spoons out of pasta, a banana leaf, dough, a banana peel, and oatmeal. Both a ping pong ball and a golf ball were used to test the weight. The spoons were then used to eat five bites of cheerios cereal. After that the results were analyzed. The dough and pasta spoons worked, and the banana leaf, banana peel, and oatmeal spoons did not work. The rim of the oatmeal spoon was too tall and that is why it did not work.

After analyzing the results of the experiment it was determined that biodegradable spoons could be made. Both the pasta spoon and the dough spoon worked. If some changes had been made, some of the other spoons would have also worked. The oatmeal spoon would have definitley worked if the rim had been shorter and the banana peel spoon might have worked if it had not been burnt. Overall, the experiment turned out very well and the results were pleasing.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
221	P8	5533

Title: Boundary Setting Tracker

Student Name(s): S. Brauweiler

Abstract:

The American Humane Association estimates over 10 million dogs and cats are lost or stolen in the U.S. every year, and www.alz.org estimates that 6 out of 10 people with alzhiemers get lost frequently. My project was made to change that. I made an extremely accurate locating system with geofencing. What this means is that when the wearer of the device goes outside where it's set boundaries are, the device will alert you that the wearer of the device is where they shouldn't be. It can also be used to keep your dog or cat from going on the table, or other places they aren't allowed. Another useful feature is that it can tell you where they have been all day. The trackers are usually in within a foot of their actual location, which is much more accurate than GPS.

Some limitations include the fact that alerts currently only audio, and setting up zones could be easier. Future code could include alerting if a wearer has been outside a zone for a set amount of time (for example a pet has not been let outside or a patient has not been to the bathroom). Potential uses for this device could include being used in prisons, zoos, nursing homes, and in households where someone has dementia, and are prone to running away.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
233	P8	5534

Title: The Effect of Temperature and Humidity on Rubber Band Elasticity

Student Name(s): R. Benin

Abstract:

This experiment seeks to answer the question "Does the temperature and humidity at which rubber bands are stored affect their elasticity?". My hypothesis was that yes, the conditions would affect the rubber bands, and that the bands stored at a higher temperature and humidity would be the most stretchy. My procedure was to store 10 rubber bands of the same size and elasticity at various locations around the house. Then, I measured and recorded the temperature and humidity of each location daily. I also measured the elasticity of each rubber band each day with an electric hanging scale. After four days, I compared the results and came to the conclusion that humidity did not seem to have a consistent impact on the elasticity but that temperature did. My data shows that the higher the temperature, the more elastic the rubber band, which proves my hypothesis. The independent variable was the temperature and humidity of the areas around the rubber bands. The dependent variable was the elasticity of each rubber band. The controls were the length I stretched each rubber band to and the type of rubber band I used. If I were going to do this experiment again in the future I would attempt to use a more controlled environment where each location has a set temperature and humidity. This way the results would be more precise because there would be no averaging.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
142	P8	5536

Title: How do Baseball Field Dimensions Affect Hitters?

Student Name(s): A. Mangiagli

Abstract:

The purpose of this experiment is to discover if baseball field dimensions affect hitters' statistics. The experiment will also uncover whether the baseball park benefits left-handed or right-handed batters. In the experiment I counted the number of home runs in three small baseball parks and three large ones in the major leagues. Then I took those numbers, divided them into whether left-handed batters or right-handed batters hit a home run, then checked where in the field they hit a home run (left field, center field, or right field) to see if the dimensions had anything to do with benefiting certain batters. In conclusion my results were mixed. The data didn't prove my hypothesis when comparing the ballparks by themselves however, my hypothesis was correct when I grouped some of the smallest and some of the largest ballparks together.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
252	P8	5537

Title: From Waste to Paper

Student Name(s): E. Reynolds

Abstract:

The intention of this project was to create a strong, durable paper from commonly overlooked natural resources to replace more ecologically-impactful options. Trees are a common source for paper, and though a renewable resource, their harvesting contributes to widespread deforestation and habitat destruction. These concerns, as well as the observance that many items are packaged using wasteful, non-environmentally friendly materials, inspired me to use wasted plant fibres as a paper-making source. My research focused on the structure and composition of various types of paper, as well as the processes by which paper is made.

I made pulp taken from cellulose fibres of five different types of natural plant materials. Combinations of these pulps then were formed into paper and tested for tensile strength, durability, and water permeability. The test results were compared with each other and a control made from standard cardboard pulp to determine overall performance.

As expected, the paper made from cardboard pulp performed notably better than the others for strength and durability, although it was not nearly as absorbent as the other fibres tested. The papers consisting of longer, stringy fibres performed best in all tests. Some characteristics in the paper, such as the loose enmeshment of fibres, indicated potential for use as protective packing material.

The types of materials I used in the papers tested potentially could be implemented as a substitute for less sustainable packing materials, such as expanded polystyrene. If I were to continue further, I would consider testing for potential protective capabilities.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
99	P8	5538

Title: Designing an Automatic Watering Device using an Arduino

Student Name(s): S. Jonnalagadda

Abstract:

The engineering goal of this project was to create an automatic plant watering system. In order to accomplish this, An Arduino Uno, Soil Moisture Sensor, Relay and a submersible water pump were used. The Arduino Uno had an Analog pin and a digital pin, although only the digital pin was used. 5v was used for the Relay and 3.3v was used for the moisture sensor. An external 9v battery was used for the water pump. After multiple iterations of both design and code, the device successfully watered the plant when dry and also stopped watering after it was moist.

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

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
223	P8	5539

Title: Plastic Collecting Robot

Student Name(s): J. Gu

Abstract:

Plastic has affected the environment and where we live. Plastics survive in the harshest conditions, such as floating around in a marine environment under blistering, unrelenting sunshine or frozen in the Arctic ice for years before finally floating away and landing on some faraway shore. For this reason, plastics will outlast humanity itself.

The objective of this project was to design, create and program a prototype capable of collecting plastic waste in public areas such as beaches, parks, and streets. The prototype robot was designed and constructed using EV3 from LEGO MINDSTORMS. An ultrasonic sensor was added to find the waste and a small container was added to the robot as well. The container was attached to the robot to contain the collected waste.

When the robot was tested it sensed the waste, closed its claw, picked up the waste and deposited it into the container. A second claw was later added to the robot so the waste could more easily be put into the container to make it more precise. While testing, the robot did not always pick up the waste due to the size of the waste and the sensor not always locating it, but it did successfully find and collect the waste during several tests. Overall the results indicate that the robot works but there is still room for improvement.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
244	P8	5540

Title: "Can Styrofoam Be Repurposed into a Substance We Can Use?

Student Name(s): A. Campolo

Abstract:

My science fair experiment was centered around the question, Can styrofoam be repurposed into a substance we can use? My hypothesis was "Yes, I think it can. "

To support my hypothesis I placed styrofoam cups, one at a time in ½ cup of acetone. The styrofoam broke down into a guppy substance. When I took the substance out I added it 2 popsicle sticks & it made them stick together like glue. I found that it can be used as as glue after it is taken out of the acetone.

My hypothesis was supported because after the two items were combined what it created was glue. The glue that was created was strong & really sticky. When I touched the substance with protective gloves, it was so sticky & really strong so strong it stuck to my gloves, similar to the common Crazy Glue sold in the stores. When I added the gluey substance to the 2 popcicle sticks they stuck together immediately minutes later. I also applied the glue to a piece of paper that I folded to make an envelope.

In conclusion, I was able to repurpose styrofoam cups into something we can use in our everyday life. Our landfills are filled with styrofoam cups, plates & packing materials. It has been reported by scientist that they estimate it would take 500 yrs for styrofoam to be

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
185	P8	5541

Title: Solubility Differences Among a-SEET-a-MIN-oh-fen

Student Name(s): T. Joseph

Abstract:

When we have pain, we think of taking medicine. Pain relievers are medicines that are fast relieving and effective. There are several possibilities to consider when deciding on which pain relieving medication to take. Over-the-counter (OTC) medications are pain relievers that can be helpful in treating many types of pain. Acetaminophen (brand name: Tylenol) are the most commonly known pain relievers that are in drug stores and many households. It reduces pain and provides relief. However, there are generic acetaminophen that works the same way as its brand proving the same benefits. This experiment is on comparing the dissolution time of pain relieving medicine Tylenol when compared with its generic brandings from CVS and Target. It will determine which medicine that contains acetaminophen will dissolve faster when tested in a stomach temperature solution(pH of 2.8) and distilled water. When a medicine is absorbed in the stomach, it becomes active however it will take time to absorb into the blood stream and distribute throughout the body. This is called Pharmacokinetics," the ways that drugs are absorbed and eliminated by the body" (Learning, 48).

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
239	P8	5542

Title: The Brush Test

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

Abstract:

This year I wondered how different brands of toothbrushes hold up to regular brushing. I wanted to discover which toothbrush brand would display the least amount of wear after a simulated brushing period. I hypothesized that brand name toothbrushes will have less wear than a generic and that the Oral-B brand toothbrush will have the least wear overall.

My procedure included researching, selecting my toothbrushes, measuring base data, designing and running my mechanism for simulating brushing, and recording data. To measure the dependent variable in my experiment, the amount of wear on the toothbrushes, I measured how much the toothbrush bristles spread out after brushing. I took an initial measure for comparison using a Vernier caliper measuring length, width and height. I used robotics to ensure the simulated brushing was applied consistently. I used the Lego Technic and Ev3 systems for my mechanism. The Ev3 is a programmable autonomous robot. I ran my mechanism with the toothbrushes attached for 54,000 rotations to simulate the total amount of brushes every three months.

The length and height had such small changes that it was not enough to accurately measure. There were significant variations in the width, displaying the bristles spreading out. The data disproves both of my hypotheses because the generic brand showed the least wear and the Oral-B showed the most wear. These findings provide evidence that the generic toothbrush wears better than the more expensive name brands.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
204	P8	5543

Title: Natural UV Protective Sunscreen

Student Name(s): E. Baitch

Abstract:

Many sunscreens have chemicals called oxybenzone and avobenzone which adversely affect coral reefs. The chemicals damage their DNA making them susceptible to bleaching. These sunscreens damage reefs by washing off of people's skin and polluting the water. These chemicals also pose many health risks to humans.

The goal of this project was to research and identify which natural sunscreens are most effective. Some common ingredients found in natural sunscreens are different types of oils, but do they really block the sun? To explore that question, several different types of sunscreens with a SPF of 50/55 were experimented with. Some of the sunscreens contained oxybenzone. Others were homemade, chemical-free sunscreens made out of oils, such as almond oil, coconut oil, and red raspberry oil. The different types of sunscreens were put on UV activated beads and put under a UV light to see how long it takes for them to light up.

The goal of finding which sunscreens are the most effective was met. The homemade sunscreen did not block the UV rays. After less than twenty minutes, the bead was lit up by the UV light. The beads with the store bought sunscreen were protected against the light and did not change color.

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

Word Count	Fair Category	Project Number
103	P8	5544

Title: How Different Types Of Water Affect Hydrogen Prodution

Student Name(s): R. Lincoln

Abstract:

This project was done to optimize the production clean electricity. This was done to find the most efficient way to create hydrogen. In this project, battery energy was converted to hydrogen using a fuel cell. Different types of water (seawater, swamp water, lake water, tap water) were used to generate energy up to 1 volt. The results were that tap water was most effective, swamp water the failed 2 of the 5 trials, and ocean and lake water did not produce electricity. The hypothesis was wrong, because the silt and muck in the water, made the hydrogen produce slower than the other types.

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

Word Count	Fair Category	Project Number
225	P8	5545

Title: PH Water Testing of Bottle, tap, well and river water

Student Name(s): J. Deus

Abstract:

I tested different types of water because it was something you use in everyday life. Since water is something you put in your body, I wanted to test the quality of different types of water that went in my body. The experiment was performed by testing various types of water such as bottled (up to four brand names), town (from the tap), and well water from various towns to identify which type of water was the best quality of water through PH testing. The procedures are very simple. Gather eleven water samples. Put them in eleven different types of plastic cups to eliminate cross contamination. Add the PH regiment liquid to the water and wait for the water changes color. Write your data down in a separate piece of paper in a very organized manner. Then type the data collected in an excel spreadsheet to find the average of each water type. Use charts to visualize your information.

In conclusion when I was doing the project, I found that my hypothesis of well water being the best quality of water was confirmed, however, Nestle was the best quality of water out of all the bottled water. Especially because Nestle's bottle of water is called Nestle Pure Life. Some of the waters weren't bad they just aren't the best to drink and put in your body.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	P8	5546

Title: How To Compute Carbon Emission

Student Name(s): J. Colangelo

Abstract:

The purpose of my project was to understand how carbon emission can be found from simple variables, and my algorithm can be used for both residential and business purposes. My project focused had two key elements: ease and simplicity for the user and an algorithm that could calculate carbon emissions. The program asks questions that take numerical values found on a bill, such as an electrical or gas bill. It then calculates the needed ratios, saves its own variables, and delivers accurate readouts of the carbon emission. My project found that carbon emissions could be calculated through two factors: the amount of time energy is being expended and the amount of energy released. The algorithm then determines what creates the most carbon emissions, which allow a homeowner/business to reduce their carbon production. To calculate carbon emissions, I developed a mathematical formula based on time and energy. The theory was that for every hour energy was used, there was a time:energy ratio. This ratio would carry with it a certain amount of carbon. So every time the "time" parameter was fulfilled, a certain amount of energy had been expended and the corresponding carbon was produced. If the time:energy ratio increased, the carbon produced would increase in a proportionate ratio. I produced a mathematical sequence to calculate the necessary ratio from user input and found the unit rate carbon emission. This unit rate had to be set to increase proportionally with the ratio, so the two variables were linked.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
131	P8	5548

Title: Microplastic Mania

Student Name(s): A. Hamilton

Abstract:

Microplastics are a big problem in our oceans and bodies of water, but they are overlooked because they are so small. In my project, I collected nine 3-centimeter total core samples of sediments from Cemetery Creek behind our school. I was searching for microplastics that were in the sediments in the banks of the water. I found almost the exact same amounts of plastics in the 3 sites that I chose to take sediments from. The average amounts of plastic per site was 7, 7 again and 7 1/3 in the three sites. In my hypothesis, I thought I would find more plastics in still water, but I was incorrect. This means that the flow rate of water does not affect accumulation of microplastics based on my findings and experiment.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
127	P8	5549

Title: Making an Affordable Ozone Sensor and Proofing its Accuracy

Student Name(s): R. Parker

Abstract:

The purpose of this project is to design, develop, and test an inexpensive and accurate ozone sensor for the health and safety departments. I designed, coded, and tested an ozone sensor to its fullest ability, and perfected its original capabilities through modifications in the code that would send small changes to the sensors output. Using the preplaced tuner on the module, adjustments were made by increasing or decreasing the sensors resistance to different variables that posed a risk to the readings being incorrect. In demonstrating the sensor's capabilities, it was compared to a standardized chemical test that produced precise and accurate results. The chemical test data was analyzed using the Ideal Gas Law. The testing demonstrated the sensor's accuracy compared to the chemical test was 2.2% difference.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
246	P8	5550

Title: NO3 Nitrates in the Housatonic?

Student Name(s): M. Cono

Abstract:

The purpose of my experiment is to show how the amount of nitrates varies from place to place on the Housatonic River. To do this, I went to Pittsfield, Massachusetts to collect water samples before and after the town. I took similar samples from three other riverside towns in Massachusetts and five in Connecticut. I tested the samples using a nitrate test. I put in ten drops of one solution and another, shook it up, and compared the resulting color to a color chart.

At the beginning of the river, there were little to no nitrates. As we continued, the level increased because the water picked up nitrates from fertilizer or waste as it flowed down the river. Towards the end, there were no nitrates again because the ocean water mixed with the river water and washed the nitrates out into the ocean. There was also a dam in the river, which decreased the nitrates in the middle.

The level of nitrates does vary as you go down the Housatonic River. Levels increase as water flows through towns, farms, and cities. However, nitrates can also be decreased by the presence of dams and ocean currents. Excessive nitrates in the river can harm plants and fish populations. Further analysis of nitrate levels could help identify actions to avoid these harmful effects. If I were to do this experiment again, I would test for water salinity to show how much ocean water is circulating with the river water.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
199	P8	5551

Title: Miniature Horse Prosthetic

Student Name(s): M. Santulli

Abstract:

There are few options for miniature horses who break their lower legs, most of the time it involves being euthanized. Since horses are so heavy, you can not just amputate their leg like a dog. Miniature horses weigh on average 100 - 250 pounds. There are not many prosthetics available for miniature horses because they are very expensive, and not always successful.

The objective of this project was to make a prosthetic for miniature horses. This prosthetic was accustomed to the hind leg because with a back prosthetic miniature horses have a higher survival rate than with the front. To accomplish this, first, a ball and socket joint was designed, created and tested. Then casting tape mold was used and tested for the base of the prosthetic. Finally, a hoof mold made of plaster was designed, created, and tested.

The goal to make a model miniature horse prosthetic for a lower back hind leg was achieved. The prosthetic design was close to the bone structure of a miniature horse's lower hind leg. Moreover, the prototype prosthetic was able to support and balance the stuffed miniature horse. With more sophisticated materials this prosthetic has the potential to save miniature horses' lives.

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

Word Count	Fair Category	Project Number
248	P8	5552

Title: Effect of Salt Concentration on the Rate of Electrolysis of Water

Student Name(s): E. Pelletier

Abstract:

Electrolysis of water is the decomposition of water into hydrogen and oxygen gases due to the passage of an electric current. The hydrogen and oxygen produced may be used for a number of important reasons including fuel refining, electricity production, fuel for space craft, and patients with breathing problems that need purified oxygen. In water electrolysis, an electrolyte must be added to the water to allow electric current to flow through the water. Often the electrolyte is a salt. With this knowledge, I wondered if there was a concentration of electrolyte that would optimize the rate of hydrogen and oxygen production to make the process more efficient. My hypothesis was that as electrolyte concentration was increased then the rate of the process would increase and an optimal concentration could be found.

Using a simple electrolysis set up with current provided by a battery, I tested increasing concentrations of sodium bicarbonate (baking soda) over a set time interval and measured the hydrogen and oxygen gas produced. The results showed that low concentrations of sodium bicarbonate did not produce electrolysis, but with increasing concentrations the rate of electrolysis increased. A comparator electrolyte (sodium chloride) at a concentration matching the highest sodium bicarbonate concentration demonstrated a significantly higher rate, suggesting the possibility of further optimizing the process through choice of electrolyte.

This work demonstrated that salt concentration affects the rate of water electrolysis . Optimization of this process would positively impact many processes that use the gasses produced from industry to health

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
174	P8	5553

Title: How is Capillary Action important in your life?

Student Name(s): M. Marquez

Abstract:

The focus of this project and it's experiment is the phenomenon known as Capillary Action. The purpose of this experiment is to demonstrate capillary action and to see if regular household materials can be used to simulate the effect. To conduct this experiment, measure out a cup of distilled water into seven separate beakers. Put a different colored food coloring in each separate beaker. Once each beaker is a different color, fold an individual paper towel half lengthwise, and fold it in the middle so each end is in a separate glass respectively. Allow the water and paper towels to sit without disturbance for at least twenty four hours and observe the results. The results of this experiment showed that is was in fact possible to simulate capillary action in a household setting as the paper towels showed clear visual absorption of the water and were able to demonstrate capillary action The hypothesis is "If the paper towels don't soak up the water, is it possible to simulate capillary action in the household environment?".

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

Word Count	Fair Category	Project Number
250	P8	5554

Title: How Does Moisture Affect the Performance of a Woden Bridge?

Student Name(s): L. Benedict

Abstract:

This experiment tested how moisture content and wood type affect the performance of wooden bridges. The prediction was, more moisture in the bridge makes the structure more flexible and it will hold more load; this was not supported. The more moisture in a bridge, the smaller load it holds. A second prediction was the bridge performance would depend on wood species and cedar would perform best because it is a hardwood.

Altogether, 40 wooden bridges were cut from four different wood species (cedar, mahogany, pressure treated, clear pine). Each bridge was put into one of five different environments for one week (control, soaked in well water, frozen, soaked half ways in salt water [to model the ocean], and outside). Moisture content was tested using a moisture meter before and after being exposed to the variable. All bridges were book matched, in order to eliminate the variables of different grain, moisture, and adhesive. A bag was hung from each bridge and filled with books, adding one at a time in the same order, until the bridge broke. The weight of the books supported by the bridge was recorded as data.

Experimental results suggest that bridges with more moisture broke easiest, while bridges with less moisture were most resistant. The type of wood made a difference in performance. This information is applicable to any wooden structure built near a body of water, or exposed to the elements over time and should be taken into consideration by engineers, architects, carpenters, and construction workers.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
250	P8	5555

Title: Capillary Action in Action

Student Name(s): L. Reilly

Abstract:

Capillary action occurs in small pipes made of materials that are hydrophilic. Depending on how small the tube is and how hydrophilic it is, water in the tube will rise above the water below the tube. I instantly thought, well why doesn't it just make a loop? It was a lot more complicated than I originally thought and I was disappointed to find out it wasn't the key to a working perpetual motion machine. After researching capillary action more, I began thinking about ways that I could alter the tube to change how water flows from it. I decided to test if cutting the tube would alter it because of how important the tube was to capillary action. I hypothesized that one cut at the steepest angle would pull out the most water because it pulled the water out farther after the closed tube ended.

My hypothesis was not supported by the data. The data showed that the tube that displaced the most was the opposite of what I predicted. Looking back it is easy to see why. Because the tube was not completely closed, capillary action was not occurring in the slanted end of the tube. This meant the water was being pulled out slower than in the complete tube.

If I were to do this experiment again I would use smaller tubes and more precise measurements. If I were to change what I was testing, I would test how the material affected how high the water rose vertically.

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
101	P8	5556

Title: Breaking in Wind Turbines

Student Name(s): A. Jarrett

Abstract:

My project was to reduce the use of fossil fuels by bringing more wind turbine plants to the state of Connecticut. If the state were to build more wind turbine plants then we could reduce our use on fossil fuels to provide electricity this in turn would help reduce fossil fuel emissions. There are added benefits by investing in this form of energy such as creating a skilled work force within the state of Connecticut which can help drive the economy. In addition it would create a need to specialized training which can in turn keep more revenue in the state.

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

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

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

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

☒ Yes ☐ No

CSEF Official Abstract and Certification

Word Count	Fair Category	Project Number
254	P8	5557

Title: Heatstroke Monitor

Student Name(s): M. Sheehe

Abstract:

Heatstroke is deadly, but it can be prevented while allowing people to maximize their time outside in warmer months. Heatstroke occurs when the core body temperature exceeds 40°C. The objective of this project was to design a device that will prevent heatstroke by alerting users of a rising body temperature.

A prototype was built using: LM35 thermistor sensor, Arduino board, jumper wires, breadboard, small LED light, potentiometer, resistor, and balsa wood. The LM35 temperature sensor detects the user's temperature and sends the data to the Arduino board to be displayed on a screen. The LED was programmed to light at or above a threshold temperature of 40°C as a "warning" light.

To test the prototype, the student's finger was heated using friction four times, measured with a Laser Grip 774 Infrared Thermometer, then placed on the sensor for test readings. For convenience, the threshold value for the LED was reduced to 30°C. The four readings on the infrared thermometer were 25.3°C, 27.6°C, 30.4°C, and 31.1°C. The prototype displayed 25.2°C, 27.4°C, 30.2°C, 30.8°C, respectively. These small fluctuations are likely due to the student's hand quickly cooling in the 23°C room. The 25.3°C and 27.6°C tests didn't light the LED, while the 30.4°C and 31.1°C tests did.

The prototype functioned successfully in the tests. The final version would be in a wearable form, with the temperature information transmitted to a smart phone or watch with warning capability (visual and audio).

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

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

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

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

☐ Yes ☒ No