

71st Annual



**Connecticut
Science &
Engineering
Fair**

March 11 - 16, 2019

Student Abstracts

CSEF Official Abstract and Certification

Word Count

202

2019

Fair Category

LT

Project
Number

1001

Title: Drought Tolerance of Herbs

Student Name(s): C. Moreen, J. Kwalwasser

Abstract:

The problem of drought and providing food to a community in times of drought is a problem that is addressed in this experiment. This experiment took rosemary (*Rosmarinus officinalis*), thyme (*Thymus vulgaris*), and mint (*Mentha Lamiaceae*) and stressed these plants by not giving them water. There was also a control group that did not have the independent variable (lack of water) to judge the effects of drought on the group with water. According to research, the rosemary should survive the longest in these drought conditions, since the thyme and mint are not as drought tolerant. The goal of this experiment was to inform people living in places with drought conditions which plant can enable them to save water and still provide a food source. They can be informed that if they want to grow a plant, rosemary is easy to grow in those conditions. Once grown, the rosemary only needs to be watered every seven to eight days and the rosemary will thrive. The thyme is not good for this experiment because it's soil needs to be wet at all times. The rosemary can help save water and be a good food source. This experiment is very beneficial and easy to conduct.

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

PS

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

LT

Project Number

1002

Title: I'm Dyeing to Find Out

Student Name(s): M. Patsalides, S. Senthil

Abstract:

We decided to test the deepness of the color of the dye made from certain fruits and vegetables. We were interested in finding out how ordinary fruits and vegetables could be used to dye cloth. The fruits we used to prepare the dye were pomegranates, blueberries, and strawberries. The vegetables we used were beets, red cabbage, and red onions. We believe that natural dyes are a sound ecological alternative to synthetic dyes because they are safer for the environment and for humans.

One set of trials in our experiments tested the vegetables. The second set was for the fruits. We chopped 3 cups of each of the fruits and vegetables and boiled them to make the dye. We placed three pieces of T-shirt material (100% cotton) in the dye and simmered it for 45 minutes. After drying, we assessed the color by giving it a color grade from 1-10.

Our final results showed that the beets were the darkest of the vegetables and blueberries were the darkest of all the fruits. Overall, the blueberries had the darkest color. They were a deep purple, almost navy blue.

Our research showed that using fruits and vegetables is a realistic alternative to using synthetic dyes. Natural dyes are an ecological solution to the problem of synthetic dyes polluting our earth. People are already trying to help produce more natural dyes. Studying this topic further will help to minimize our chemical footprint on our world.

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

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

118

2019

Fair Category

LT

Project
Number

1003

Title: Natural Sugar Banana Count

Student Name(s): A. Tack, G. Mazzarelli

Abstract:

The purpose of this research project was to test the natural sugar balance of bananas in different stages of ripeness to determine which banana had the lowest sugar content. Each banana was smashed and then the pulp was put through cheesecloth. The liquid was collected and placed on a refractometer and the sugar level was recorded. The hypothesis was the unripe banana would have the least amount sugar. However, it was not supported by the data. The results indicated the ripe banana had the least amount of sugar, 22 Bx, the unripe banana had 23 Bx, and the over-ripe had 25 Bx. Therefore, the hypothesis was disproved. Understanding how ripeness affects sugar content could benefit many.

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

ME

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

146

2019

Fair Category

LT

Project
Number

1004

Title: Biowarfare: Phages and e. Coli

Student Name(s): I. Saboor, P. Ahad

Abstract:

There are countless amounts of bacteria harmful to the human body. Some have cures like antibiotics and other medicines to help deal with them. But for others, there are currently no known cures like, for example, e. Coli. Our experiment will be tested on e. Coli not only because it's harmful to humans, but because so much contaminated food could be saved from being thrown out every year. In our experiment, we decided to see if bacteriophages, a virus to bacteria, would be effective on e. Coli bacteria. We hypothesized that the more phages added, the more e. Coli would die. We used different amounts of phages (0.1ml, 0.25ml, and 0.5ml) on agar plates exposed to the bacteria. After 24 hours, we were able to observe that our hypothesis was proven because the plate with 0.5ml of phages had the least visible signs of e. Coli.

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

MI BI ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

181

2019

Fair Category

LT

Project
Number

1005

Title: Is salt beneficial for plant growth?

Student Name(s): E. Hecht, N. Genger

Abstract:

The main purpose of this experiment was to test how much salt a bean plant could tolerate during germination and at what point it would negatively affect sprouting and growth. This was tested by watering beans and subsequent seedlings with their own specific salt solution for two weeks. From the research done prior to this experiment it was learned that salt can harm plants and stunt growth. However, the results of the experiment showed that a small amount of salt seemed to benefit the plants. The control group, beans with no salt, got moldy and didn't grow well. The groups with low levels of salt had less mold and grew better. The groups with high levels of salt dehydrated the seedlings, as the initial research suggested. It was discovered through further research that mold can indeed inhibit plant growth. It was also learned that salt can act as a preservative in many cases. It was hypothesized that low levels of salt prevented the development of mold and therefore benefited the seedlings, allowing them to grow better than those with no salt.

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CSEF Official Abstract and Certification

Word Count

187

2019

Fair Category

LT

Project
Number

1006

Title: Fire For farming

Student Name(s): J. Halas, P. Heslin, R. Devin

Abstract:

FIRE FOR FARMING

SCIENCE PROJECT

January 2019

Abstract:

Forest fires have become increasingly common and are causing massive destruction along the western side of the United States. This project looks at whether or not the ash from these fires can have a positive effect on future plant growth. To measure this, seeds were planted in three different mixtures: 100% soil, 50% ash/50% soil, and 25% ash/75% soil. Their growth was measured at 14 and 28 days. While the hypothesis was that the seed in pot that has the most ash (50% ash/50% soil) would grow the fastest and the tallest, the 25% ash/75% soil mix actually generated the most growth over the 28-day period. In addition, the two pots containing ash germinated more quickly, sprouting a week earlier than the one containing only soil. Based on these results, it's clear that even though that forest fires are destructive, they can still have a positive impact on future plant growth. Forest fires enrich the soil with the ash that they leave behind, providing beneficial nutrients that help the plants grow faster and stronger.

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

EA EV PS

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CSEF Official Abstract and Certification

Word Count

149

2019

Fair Category

LT

Project
Number

1008

Title: What's Better-Greenhouses or Hydroponics?

Student Name(s): D. Johnson, G. Panora

Abstract:

The purpose of this project was to determine which environment, hydroponic or greenhouse (system), would grow plants most effectively. Plants were grown in repurposed plastic bottles, which also had the benefit of reducing plastic environmental waste. The hypothesis was that if plants are grown in multiple environments, plants will grow best in a hydroponic system compared to a greenhouse system. In order to begin this experiment, two growing systems were made out of 2 litre plastic bottles: a hydroponic and a greenhouse system. Arugula seeds were planted in each bottle, and were grown for a period of time. Data was recorded daily. The data showed that the hydroponic system grew plants the best, as they were healthier and grew taller than the plants in the greenhouse system. The hypothesis was proven correct. The greenhouse system, did however grow the arugula plants, but not as effectively as the hydroponic system.

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

PS

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

240

2019

Fair Category

LT

Project
Number

1009

Title: The Quicker Picker Upper?

Student Name(s): J. Lacasse, J. Wu

Abstract:

Have you ever wondered which brand of paper towel is the best? We have, and that is why we decided to do this experiment. We wanted to know which paper towel brand was best for household users and why? We used six different brands of paper towels including Bounty, Brawny, Viva, Scott, 7th generation, and Up & Up, we did two different tests for strength and absorbency, and also reviewed affordability. These evaluations were to help us find the best overall paper towel. We used quarters to test the strength by wetting a towel and seeing how many quarters each brand could hold. When the quarters eventually fell through we calculated the weight and gathered the results. In the next round we used three liquids and (separately) poured them onto a tray 5mls at a time, repeating this with each paper towel. We evaluated each brand on how much liquid the towel could absorb. Next, we calculated the price per sheet to figure out which paper towel was the cheapest. We concluded a winner for each round; Brawny won the absorbency round, Scott was strongest, and the cheapest price per sheet. Although Scott did not win all of the rounds, it still won the majority, giving it the highest overall score. In conclusion we proved our hypothesis incorrect; Bounty wasn't the best. We hope this influences others to switch to Scott because of its good absorbency, great strength and great price.

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

CH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

177

2019

Fair Category

LT

Project
Number

1010

Title: Which Soda Can Degrade Food Peelings the Fastest?

Student Name(s): W. Ong, G. Cioffi, S. Papciak

Abstract:

In this experiment, we asked ourselves which soda could dissolve a piece of squash at a faster rate than the other sodas. We decided to do this project because we were looking for other ways we could degrade food peelings. We hypothesized that Coke would dissolve the piece of squash the fastest because it has a lower pH of 2 than the other test sodas, Root Beer (4 pH) and Sprite (3 pH). To begin we tested the pH of the 3 sodas using ph strips. We then put a 2 inch by 2 inch piece of peeled squash into an airtight container and dispensed the sodas into each container every 3-4 days. During this procedure, we observed how the sodas' coloring seeped into the squash skin turning it brown and how the sodas' texture visually changed. In conclusion, we observed that Coke did indeed dissolve the squash peel faster than the other sodas, showing signs of dissolving by Day 3. The other 2 sodas showed signs of dissolving the peel on Days 4 and 6 respectively.

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

PS EV EM

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

234

2019

Fair Category

LT

Project Number

1011

Title: Egg It On

Student Name(s): A. Russell, M. Salaman

Abstract:

In this project, we tested 4 different eggs to see the effect that they would have if they were to sit in soda, so that we could make a closer prediction to what would happen if it were a tooth. This goes along with the real world, because a tooth that is not cared for and not brushed will soon turn into a cavity. This project, therefore, should be able to change the way people go about their daily lives. Alvin and Mia had two different perspectives on the outcome of project, so to put it in short, what they tried to figure out is what would happen to the egg if it sat in soda for 7 days. In order to make this project successful, we hard-boiled the eggs, sat the eggs in the sodas they were supposed to sit in, and labeled each cup. Each night we would record our data at 9:10 pm. In our results, Alvin found that 2 of the 4 eggs supported his claim, and Mia found that 3 of the 4 eggs supported her claim. In conclusion, our hypothesis's were somewhat proven by the project, but even though it did not show exactly what colors we thought the eggs would change, it still proved the point, which was to show that soda is not good for your teeth, and to make sure your teeth are clean.

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

CH ME ME

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

227

2019

Fair Category

LT

Project Number

1012

Title: Plant Tolerability to Salt

Student Name(s): T. Weiner, S. Sendersky

Abstract:

It is known that water is beneficial to plant growth, but how does salt in the water affect the growth? From the research, we learned that in a large concentration salt is very harmful to the plant and can easily kill it by dehydrating it. Our Hypothesis was that the plant receiving no salt would thrive the best and grow the tallest while the plant receiving the biggest amount of salt in its water would die quickly. To test our hypothesis we used 6 concentrations of salt. These were: no salt, 1/4 teaspoon, 1/2 teaspoon, 1 teaspoon, 2 teaspoons, and 4 teaspoons of salt per gallon. There were three cups in each group. Every day the tallest plant in each cup was measured and the average was found per group.

Over the 7 day period that we conducted this project, we found that the plant receiving 1/4 teaspoon of salt in its water was growing the best. When we conducted more research we found that at small concentrations of salt, the salt is beneficial to plant growth. We also saw that the plant receiving the 4 teaspoons of salt wasn't dying, but was growing at a much slower pace than all the other plants and was, in the end, shorter than all of them. This project shows that in moderation salt is indeed beneficial to plant growth.

Technical Disciplines Selected by the Student
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PS PS PS

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

4. Is this project a continuation? Yes No

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

177

2019

Fair Category

LT

Project
Number

1013

Title: Water filtration methods

Student Name(s): E. Lapointe, N. Islam

Abstract:

Many countries do not have access to clean drinking water, so there was a test conducted to see what materials (fabric, coffee filter, mesh fabric, paper towel) neutralizes water the best. The question is, what purification method is the most effective to send to third world countries? The hypothesis was, if multiple types of filters are used, then paper towels would neutralize the pH. For this experiment, filter materials were placed over a beaker, sample water was poured through the material, and the water that had been filtered was tested using a pH tester. These experiments were under a controlled environment. After this test was conducted, the average was found and the results were compared to the pH level of the unfiltered sample water. The hypothesis, that paper towels would be the best filter, was not proven. Paper towels had a pH of 6.4 with fabric having a 6.46 pH. This shows that the fabric filters water the best with the closest to 7 Ph level as that is closest to neutral, which is safe drinking water.

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

EV

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

LT

Project
Number

1014

Title: Harmful Bacteria in our Produce

Student Name(s): M. Khan, A. Tidjani, H. Abuteen

Abstract:

Bacteria is transmitted in different ways onto our food. This poses a threat to the food that we eat. The bacteria that is transferred onto the produce can cause harm. In our experiment we wanted to test how much bacteria there would be in bagged and unbagged produce and determine which ones had less bacterial growth and which ones had more. We purchased five different produce in total to experiment with; lettuce, tomatoes, carrots, pears and apples. We bought three bagged and two unbagged produce to compare results in bacterial growth. We swabbed the Q-tips around the produce, twisting it as we did, making sure that we captured enough bacteria on it. Then we applied the bacteria on the Q-tips in the agar, a gelatinous substance obtained from seaweed which helps bacteria grow, in a zigzag motion across to see a enough bacterial growth over time. We placed all the dishes in an incubator and checked them everyday and waited to see bacterial growth. The unbagged produce had no bacteria in the petri dishes while the bagged produce acquired a large quantity of bacteria. Before we started our experiment, we predicted that the unbagged produce would have more bacteria. After conducting our experiment, we discovered that the bagged produce had more bacterial growth because there were many people who touched this produce in the process of bagging it. After the results of our experiment we concluded that unbagged produce has less bacteria in it when shopping for food.

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

MI BI

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

4. Is this project a continuation? Yes No

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

178

2019

Fair Category

LT

Project
Number

1015

Title: The Greenhouse effect

Student Name(s): H. Ziesche, L. Dunn

Abstract:

Our experiment was recreating the greenhouse effect to answer the simple question: How does the greenhouse effect impact the temperature of our atmosphere? We simulated the earth's atmosphere with too many greenhouse gases by building a small-scale, (more or less) airtight greenhouse and measuring the temperature inside and on the outside. After nailing together four wooden boards and covering them with plastic wrap, we placed one thermometer underneath it and one beside it, and left our experiment in the backyard in the warm sunlight of Monday, January 14, 2019. For the next several days, our little greenhouse would suffer through ice, hail, mud, slush, snow, and frost. This made the thermometer inside the covered wooden frame much colder than expected, thereby skewing the results. Although the weather was unforgiving, the thermometer inside the frame had a higher temperature average than the thermometer outside. In the end, our experiment was not as successful as we had hoped. Still, we did our best to test the theory of the greenhouse effect, and we can conclude that it is real.

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

EV EA

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

189

2019

Fair Category

LT

Project Number

1016

Title: Which Parsley is better?

Student Name(s): G. Rodrigues, S. Pacheco

Abstract:

The purpose of our project was to see if the home-grown parsley is better than the store-bought parsley. We wanted to see how long the home-grown parsley took to grow, and if it was worth growing it or not. We think people should care about this more because usually store-bought items are never really healthy and good for your body. In this project we wanted to show people that it is better to grow your own food than to buy it even if it may take some time. We think that the home-grown parsley is going to be better than the store-bought parsley. We observed to see what happened to the parsley like the color change, size, and density told us which parsley rotted first. We saw that our hypothesis was correct! We proved that the home-grown parsley was better than the store-bought parsley. We know that our hypothesis was proven right because the store-bought parsley started to rot in about 2-3 days. The color, smell, and size changed. In conclusion home-grown parsley was better than store-bought parsley.

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

PS EA

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

104

2019

Fair Category

LT

Project
Number

1017

Title: What Makes it Grow?

Student Name(s): A. Bedir, M. Atid, N. Elsaadani

Abstract:

In this experiment, three orchids were watered with the following; tea, coffee, and water. By the end of three months, November, December, and January, the healthiest plant was determined based on the length of the plant, and its foliage quality. By the end of three months, the healthiest plant was determined, which was the plant watered with tea. The plant watered with water was also healthy. However, the plant watered with tea was healthier, maybe because tea includes plant and water in its ingredients. This experiment proves that acidic type plants such as orchids can survive with at least one of the liquids used.

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- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

LT

Project
Number

1018

Title: Factor Fiction

Student Name(s): C. Zuniga, E. Cook, C. May

Abstract:

We wanted to determine if sunscreens with higher levels of sun protection factor (SPF) provide better protection against UV rays. We tested Neutrogena® sunscreens with SPF levels of 15, 30, 55, 70, and 100. We thought that each sunscreen with an SPF of 55 and above would provide the same level of protection. To test this theory, we exposed UV sensitive beads to UV rays filtered by each sample sunscreen and then measured the amount of UV ray absorption. First, UV sensitive beads were placed in a cardboard box to block out all natural light. We then applied the sample sunscreen to a clear plastic sheet which was placed above the beads. Next, we placed a UV flashlight on top of the plastic sheet and exposed the beads to UV rays for 30 minutes. We then compared the beads to our UV exposure scale to determine the amount of UV ray absorption. We repeated these steps for each sample sunscreen. The results show that the sunscreen with SPF 15 exposed the beads to 5 UV rays; the SPF 30 exposed the beads to 4 UV rays; and the sunscreens with SPF 55, 70, and 100 each exposed the beads to 1 UV ray. In conclusion, our hypothesis was proven correct. To improve our test, we could adjust the amount of sunscreen, expose the beads to UV-light for a longer amount of time, and replace the plastic sheet for each test. These changes may help us to achieve more accurate results.

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

CB

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LT

Project Number

1019

Title: Can Plants Grow in Dry Dog Food

Student Name(s): C. Henderson, M. O'Connor, M. Sabino

Abstract:

We were prompted to do this project when we wondered if seeds could grow in anything other than soil. We discovered that a specific brand of dog food contained the same nutrients that seeds need to grow: nitrogen, phosphorous, potassium, magnesium, sulfur and calcium. We set out to record the growth of the marigold and sunflower seeds that were grown separately in potting soil and dog food.

We made a dog food-based soil that we created by pulverizing dry dog food until it was powder. We also grew the seeds in potting soil as a control and both groups were watered every 3 days. The results we obtained were that the seeds planted in the dog food did not grow while the ones in potting soil did grow.

Based on these results we set out to discover why the seeds planted in dog food did not grow. We theorize that the seeds did not grow because the seeds did not get water. We observed the dog food to be hydro-resistant. Which meant that when we watered the dog food, the water did not seep into it like it would in soil and stayed on the top.

If we were to repeat the project in the future, we have 2 ideas: The first idea would be to use a 50/50 mixture of the dog food and soil. The second idea would be to scratch the surface of the dog food and this would allow the water to reach the seeds.

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- Yes No

CSEF Official Abstract and Certification

Word Count

209

2019

Fair Category

LT

Project
Number

1020

Title: An Apple A Day Keeps The Doctor Away

Student Name(s): E. Ramirez, T. Nugent, A. Khan

Abstract:

My partners and I tested Malic acid, Starch, and PH on apples with and without iodine. We wanted to see if iodine affected the apples in any way. Our results shocked us. We used Granny Smith, Golden Delicious and Red Delicious apples to test for PH, Malic Acid, and Starch. We cut the apples into 4's and then we place the PH strip and malic acid strip on the apples without iodine. Then we poured .10 ml of iodine on the apples and tested for PH and Malic acid. Our results showed us that before the iodine all the apples were positive for malic acid and they had a pH of numbers around .55% (granny smith), .20% malic acid (red delicious) and .30% malic acid (golden delicious). The PH were 3 (granny smith), 4 (golden delicious) and 4 (red delicious). They were also all positive for starch. After iodine the malic acid levels went down to almost 0% malic acid. The PH rose by a little bit with the apples with iodine. Our hypothesis was proven because the Granny Smith apples had the highest percent of malic acid without iodine. Also my hypothesis for PH was also proven because the PH levels were all around the same numbers

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

149

2019

Fair Category

LT

Project
Number

1021

Title: Does Water Temperature Affect Plant Growth

Student Name(s): K. Guo, A. Arce

Abstract:

This research project investigated if water temperature would affect plant growth. The question asked was, will water temperature affect plant growth? The hypothesis was, if using different temperatures of water, the plant that receives the hot water will have more growth. The hypothesis was not supported. Three groups of chia seeds were grown in a controlled environment, with water temperature as the manipulated variable. Each group of seeds received a unique water temperature. Plants were watered at the same time, with the same amount of water and exposure to sunlight daily. Plant growth was recorded, hourly and at the end of each day, chia growth was compared. Three days later, data was analyzed to determine if water temperature affected plant growth. The plant that received the hot water grew the 2nd tallest. All of the plants grew, however the plant that received the room temperature water grew the tallest.

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

PS

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

226

2019

Fair Category

LT

Project
Number

1022

Title: Building a Pressurized Submersible to Create a Safe and Sustainable Environment for Marine Life Collected in the "Twilight Zone" and Brought Up to the Surface

Student Name(s): L. Lior, S. Galaburda

Abstract:

After working on this experiment for a little while, it was identified that in the Mariana Trench (about 200 to 500 below the surface of the ocean), there is almost no knowledge of marine life because many animals, including fish, would be harmed if they were brought up to the surface. The objective was to build an autonomous submersible that was airtight to make a protected habitat for life that was obtained in the "Twilight Zone" and brought up to the ocean surface. It is extremely important that people can study species from depths that weren't able to be researched until recent years. Lots of research was done, and it was very apparent that not enough renewable methods were used to gather this type of data. The methods that were used were extremely difficult to maneuver. Instead of many complicated steps, the method invented is simple and easy to use. For prototype 1 and 2, all of the materials are very simple to find and can be located at a local department store. Other methods were a lot more difficult and were not pressurized correctly. After making two different prototypes, prototype 2 was used as the final design. A lot of trial and error was used throughout the process, but the final result was a very strong and valid method compared to the ones already available.

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

AT 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

2019

Word Count

133

Fair Category

LT

Project
Number

1024

Title: The effects of Temperature Pollution and Chemical Pollution on Daphne's Heart Rate

Student Name(s): N. Guzman, E. Betancourt-Colon

Abstract:

This experiment is performed so that we can learn how both chemical and temperature pollution are affecting animals that live in lakes and rivers. How do chemical and temperature pollution affect the heart rate of a Daphnia? Our hypothesis was that the heart rate will increase drastically when exposed to the different water temperatures and different amounts of chemicals in the water. In this test different common pollutants were exposed to an organism called Daphnia. When Daphnia are exposed to temperature and chemical changes they have both an increase and decrease in heart rate and survival rate. Our hypothesis was proven wrong because during our testing the Daphnia's heart rate went all down for the chemical exposure and for the different water temperature the heart rate only went down for the cold water.

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

EV AS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

226

2019

Fair Category

L7

Project Number

2001

Title: What Nutrients Help Azolla Grow? How Can We Use This To Fight Climate Change?

Student Name(s): E. Goldstein

Abstract:

The reason for my experiment is to find a fertilizer that will maximize the growth of Azolla so that these aquatic ferns can be used to fight climate change. My hypothesis was that Azolla using potassium phosphate will grow the best because Anabaena, a cyanobacteria that takes nitrogen from the atmosphere and gives it to Azolla as nutrients, will give this group a good source of nitrogen while the fertilizer will give it sources of potassium and phosphate. Because Anabaena has the ability to take nitrogen from the atmosphere, we can use Azolla to fight climate change. For this experiment, three containers were put next to a window with an equal amount of Azolla in each one. Next, I scooped up a small amount of each fertilizer and put them each in two bottle caps to be measured. The fertilizer was placed in the corresponding containers so that there would be one control group, one group using potassium nitrate, and one using potassium phosphate. For the next six days, the Azolla was counted. My results were that the Azolla using potassium nitrate grew much better than the other groups with a total 300 ferns. The group using potassium phosphate had 210 ferns and the control group had 195 ferns. In conclusion, potassium nitrate is a valuable fertilizer that has been the most effective when growing Azolla.

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

PS

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

210

2019

Fair Category

L7

Project
Number

2002

Title: Garbage Gasoline

Student Name(s): S. Gomathinayagam

Abstract:

Have you ever imagined that a product that you throw away almost everyday can be made into biofuel that could solve major environmental issues? This science fair project investigated on which of the different oils produced the most energy in the form of biofuel. The experiment investigated on which one of these biofuels produced the most energy and decreased pollution and greenhouse gasses. This project used different kinds of cooking oil and conducted a combustibility test to see which one burned the longest as well as produced the most biofuel. The results proved the experiment's hypothesis was accurate, if using used cooking oil from a local restaurant, it will burn (completely combust) faster as compared to using used canola oil or the raw canola oil. The experiment also proved the simplicity of using the oil generated from used cooking oil and converting it into biofuel. Instead of wasting the oil and dumping it and letting it soak into the soil causing it to spoil, it could replace the fossil fuels that is polluting the air. This invention solves two problems in one. Overall, this experiment not only helps one understand how easily oil can be made into biofuel, but how it can promote a healthier living style for our communities.

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

EM AT 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

245

2019

Fair Category

L7

Project Number

2003

Title: THE EFFECT OF OCEAN ACIDIFICATION ON CREPIDULA FORNICATA

Student Name(s): A. Cristaudo

Abstract:

The objective of my science project was to see what the effect of ocean acidification would do on Crepidula Fornicata, which are common slipper shells. My hypothesis of this experiment was that the ocean water with the most acidification of the three would affect the slipper shells the most. I found the mass of each Crepidula Fornicata shells. I put 3 slipper shells into three different bowl with different amounts of acidification Than I left them undisturbed for 36 days. After that I weighed their mass again after the experiment to find the difference between the mass when I first started the experiment to after the experiment. It was predicted that the ocean water with the most acid will effect the Crepidula Fornicata the most. The data showed that this hypothesis was correct. The Crepidula Fornicata with the most acidity started out with an average of 4.4 grams and ended with 3.9 grams. This was proven because out of the three different types of ocean water, with different amounts of acid the one with the most (30ml) dissolved the shells the most. It beat the 15 ml of vinegar which started out with an average of 4.2 grams and ended with 4.1 grams. It also dissolved more than the neutral water that started out with an average of 4.7 grams and ended with 4.6 grams It is concluded that the water with the 30 ml of acid in it effected the Crepidula Fornicata the most

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

EA AS

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

212

2019

Fair Category

L7

Project Number

2004

Title: Cleaning Coins

Student Name(s): C. Sotelo-Rodriguez

Abstract:

The purpose of my project will be testing which liquid cleans coins the best. Why you should care about my project is because there is valuable information you can learn if you want to clean coins (if coin collector like myself). The hypothesis that I investigated was which liquid cleaned coins the best. Fill four cups each one quarter full with each of the six cleaning solutions (4 with lemon juice, 4 with orange juice, 4 with cola, 4 with water, 4 with baking soda paste and 4 with dish liquid). Label the cups.

Carefully record each coin's condition prior to placing it into its cup.

Place one of each type of coin into each solution.

Let all coins soak overnight (Not in method #2).

Using the plastic spoons and latex gloves, scoop each coin out of its cup and place it on the covered table. Take care to label and keep track of which coin came from which solution.

Examine the coins and record what you see before you start using the toothbrushes.

Use the toothbrushes to clean the coins, rinse with water, re-examine the coins, and record your observations. The answer i obtained was that my hypothesis was not proven because the liquid that was more productive was dish soap.

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

232

2019

Fair Category

L7

Project Number

2005

Title: Will a plant grow faster and stronger with fertilizer, compost, or nothing.

Student Name(s): T. Patten

Abstract:

When I started the project I put dirt into three jars then came back inside. Then I put three seeds into the the jars. After that was done then I put the compost and fertilizer in the jars. Then I watered them. A few days later I came back to check on the plants and to water them. When I finished watering them I came back to record my data. A week later I come back to water the plants and I see the fertilizer and compost plants have grown a lot more than the last time I recorded their data. The nothing plant grew a very small amount. A few days later I come back to water them and I see that the nothing plant has died. I said "How did this happen?" After that incident I went on to record my data. A week later I come home from school and water my plants and put more fertilizer and compost in my plants and record my data once again. One sunday I decide to look a my plants and I see that my fertilizer plant has died. Now I had on plant left and the one was growing pretty big. So as it turns out fertilizer is good but very hard to use and compost is very good and very easy for a person who is just starting a garden.

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

PS

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

L7

Project
Number

2006

Title: The Effects of Water Salinity on Daphnia Magna

Student Name(s): M. Hoffman

Abstract:

During winter, salt comprised mainly of sodium and magnesium chloride is applied to roads. This salt then ends up in bodies of freshwater, like ponds and rivers. During my experiment, I tested how different salinities impacted Daphnia Magna, a subset of the genus daphnia, which is commonly found in freshwater. My hypothesis was that daphnia exposed to 0 parts per thousand (ppt) salinity would do best, with the lowest daily mortality rate, as that is the closest salinity to what is found naturally in the wild, under normal conditions. The investigation was conducted by filling 6 200-milliliter containers with water of varying salinities, ranging from 0 -5 ppt. 10 daphnia were put in each container, and the mortality rates were measured over a 4 day period. A bubbler was placed in each container to oxygenate the water. During the experiment, I noticed that the bubbler jostled the daphnia constantly, which I thought might be stressing them, making them more susceptible to dying. To compensate for this variable, I conducted a second experiment where no bubblers were included. During the first experiment, The daphnia in the water with a salinity of 1 ppt lasted the longest, but during the second experiment, the daphnia in the 0 ppt water lasted the longest. In both experiments, daphnia in higher salinities had lower survival rates, and daphnia in containers with 0 and 1 ppt salinities had better survival rates, which followed my hypothesis. This shows that increased salinities in water could be harmful to wildlife.

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

MI AS EV

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

228

2019

Fair Category

L7

Project
Number

2007

Title: The Articulated Hand

Student Name(s): L. Vossler

Abstract:

My dad accidentally cut his ring and pinky fingers on his left hand while working with a table saw. This affected a lot of what he does, especially since he works with his hands all the time since he is a carpenter. It got me wondering if an injured finger affects how the rest of the hand functions after the injury. First, I constructed an articulated hand (right) out of string, five bendy straws, and silicone. Then, I made another articulated hand (left), but this one is missing a finger. This represents the injury, similar to my dad's injury. I then pulled the strings, or "tendons," to see what would happen. When the "tendons" on each hand are pulled, the fingers bend and move. When the tendons on the left hand are pulled, they bend and move just as well as the right hand does. I then tested the function of a real hand using my dad as the subject. I had him hold popcorn kernels, coins, and water in each of his hands. I measured how much he could hold in each hand. In conclusion, my hypothesis was wrong and right. If there is an injury such as the finger is cut off, then the rest of the fingers work fine (like in the model). However, the hand does not work the same when missing a finger.

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

209

2019

Fair Category

L7

Project Number

2008

Title: Salty Plants!

Student Name(s): J. Murphy

Abstract:

If road salt is added to model ponds at varying amounts, will the pond with the most road salt be the most negative effects? I did this project because road salt that is used to melt snow and ice in the winter, is harmful to aquatic life. The salt runs off into our ponds, rivers, and streams and harms aquatic life, including plants. For my experiment, I set up three model ponds for each of my three trials. each pond had dirt, a stone slope, and an aquatic plant. For one pond, I added no road salt. To the second pond, I added 1/4 cup of road salt. To the third pond, I added 1/2 cup of road salt. For two weeks, every other day, I sprayed the salt and allowed the water to drip and run into the pond. I chose to spray 60 times, which equals 1/2 inch of water, which equals 5 inches of snow. Results after two- week period were the same across all trials. The pond with no salt added had plants that thrived. The ponds with 1/4 cup of salt added, had plants that were brown and limp. The ponds with 1/2 cup salt added, had plants that were brown and fallen apart.

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

PS

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

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

244

2019

Fair Category

L7

Project
Number

2009

Title: Effects of different macro nutrients on the reaction time of human subjects

Student Name(s): I. Shelbaya

Abstract:

Abstract

Diets low in carbohydrates are very popular among people trying to lose weight. Some low carb diets emphasize eating large amounts of protein, and other emphasize eating large amounts of fat. People claim these diets have health, fitness, and mental benefits. But traditional health and fitness professionals say that carbohydrates are actually best for your health and performance.

One experiment that was done with 661 people showed that the people who ate a majority of fat and protein had slow brain functions. However, the people in the study who ate more carbohydrates had normal brain functions.

I wanted to see for myself what nutrients increase and decrease a person's reaction time. I decided to evaluate my subjects reaction times after eating a meal made mostly with only one of the four macronutrients: simple carbohydrates, complex carbohydrates, fat or protein. I chose to measure reaction time because reaction time has a relationship both to brain function and muscle control.

I hypothesized that simple carbohydrates would decrease a person's reaction time and that the complex carbohydrates would increase a person's reaction time the most. I used seven test subjects and gave them each a specific food with one predominate macronutrient to eat.

Beginning at thirty minutes after eating the food, I used an online (<https://www.humanbenchmark.com/tests/reactiontime>) test to determine their reaction time every thirty minutes for two hours.

My results were as I expected. Simple carbohydrates gave the fastest results after one hour.

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

BI CB

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

63

2019

Fair Category

L7

Project
Number

2010

Title: Lights, plants, action

Student Name(s): A. Muro

Abstract:

Does color effect plant growth is an experiment that tests plants under different colored lights to grow. Plants are placed in a box with a lamp with a colored light bulb in it, they are watered everyday, and the measurements are checked everyday but recorded every so often. The data that was collected was then converted into the table which disproved the hypothesis.

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

PS

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

214

2019

Fair Category

L7

Project
Number

2014

Title: Plants on the Move

Student Name(s): K. Caguitla

Abstract:

The purpose of this experiment is to find out if sunlight and artificial light will affect the plant's ability to move. The hypothesis is "If plants are exposed to both sunlight and artificial light, then the plants will only move when exposed to sunlight." To do this project, you must wait for the plants to grow into "young plants." The seeds that were used are green mung bean seeds, string bean seeds, and grass seeds. When the plants are ready, expose one to artificial light using a light bulb, in a dark room. Do a time lapse video to record the movement. Then expose the same plant to sunlight and do a time lapse video to record the plant's movement. Do the same process with the other plants. While observing the results, the bean plants moved towards both sunlight and artificial light, but the grass moved towards and away from both sunlight and artificial light. The green mung beans and the grass moved more in the sunlight while the string beans moved more in the artificial light. In conclusion, this experiment showed that not only sunlight but also artificial light can affect the ability of plants to move. Based from research there is a process called "phototropism," where most plants will move towards sunlight.

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

PS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

228

2019

Fair Category

L7

Project
Number

2015

Title: The Limits of Salmonella in Ultra-Cold Temperatures

Student Name(s): W. Broecking

Abstract:

Salmonella is a stomach bug that you can get from eating raw poultry products or ingesting feces from a salmonella-infected specimen. One way to get rid of this bacteria from your plate is pasteurization, cooking the product to a high temperature to kill it. In this experiment, I tested whether or not reverse-pasteurization would work against a common and dangerous stomach bug, salmonella. First, I created 20 plates of MacConkey Agar and some MacConkey broth. This medium grows and isolates gram-negative bacterias and viruses, which I will be testing on. I have one small cut of chicken breast to use as a source. I then left it out for about three and a half days (~84 hours) then put it in a refrigerator at my school to save it from accidentally becoming airborne in my home. The purpose of this experiment was to find out the negative limits of the Salmonella virus in deadly cold temperatures. I ended up finding out that my hypothesis was actually wrong. The bacteria on the plate ended up starting to thin at around 16 seconds, not 30-60 as I thought at first. A colony counting also proved the experiment. It showed that, in the hard data, that the longer the chicken was in contact with the dry ice, fewer colonies grew. This proves that my experiment was a success.

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

MI

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

146

2019

Fair Category

L7

Project
Number

2016

Title: Paper Towel Strength

Student Name(s): C. Meza, V. Reyes

Abstract:

The reason of this project is to see what paper towel brand is the strongest. The experiment used 4 brands of paper towel such as: Bounty, Scott, Sparkle, and Great Value, and a container. The Paper Towel was held from the 2 ends, and wet with 115 mL of water, pennies were added one at a time until the paper towel broke, the number of pennies was recorded on the data chart for each trial. Bounty held more pennies than the other paper towels. Scott held 190 coins, Bounty held 236 coins, Sparkle held 98 coins, and Great Value held 140 coins. The experiment showed that the hypothesis was proven. If the paper towel is thick, then it will be stronger than a thin paper towel, because it will hold more pennies due to the thickness. Based on the experiment Bounty is the strongest Paper Towel Brand.

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

234

2019

Fair Category

L7

Project
Number

2017

Title: Melting Ice for a Living, Killing Plants on the Side.

Student Name(s): K. Kim

Abstract:

During the winter time, many cities use CaCl₂ or more commonly known as road salt, to de-ice their roads and highways. However, how does CaCl₂ impact the surrounding environment? While CaCl₂ is very effective at melting ice and snow, it can kill plants with its high salt and chloride content, which is not a suitable condition for plants to grow in. Despite this, other studies show that CaCl₂ provides the proper nutrients that are vital for plant growth. My hypothesis was that plants that receive CaCl₂ will not grow because the high chloride and salt content would dehydrate the plants environment. My experiment was conducted by making 3 different concentration of CaCl₂ and giving those solutions to plants, three times, to test how different levels of CaCl₂ affect plant growth. The plants recieved water that had no CaCl₂ twice a day and were observed for seven days. My experiment results indicated that plant groups with 1% CaCl₂ did not grow nearly as much as the Control groups plants and the plants that were given 2.5% and 5% CaCl₂ did not grow at all. This experiment can be applied to the real world by showing how negatively CaCl₂ affects plants and many other things as well, such as metal corrosion and water pollution. Because of those, we should strive to find natural, inexpensive and effective ways to clear ice and snow in the future.

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

251

2019

Fair Category

L7

Project
Number

2018

Title: Placebo: The Power of the Mind

Student Name(s): D. Li

Abstract:

My project was to test the phenomenon known as the placebo. I was inspired to do this when my friend was over my house. I told my friend that he was playing the best character, but in reality, he was playing the worst role in the game. I expected him to play very poorly but he played exceptionally well. I decided to test this theory by having subjects play a game racing game. The first game I would record the stats. The next game I told subjects I changed the cars stats but in reality, I did not change anything. I marked the stats to see if the subjects improved. My hypothesis is that the subjects gameplay would improve with the placebo compared to the game without it. After testing, all subjects improved after the placebo. Subjects 3 and 6 showed significant growth of after the placebo with over a 5-second increase. Subjects improved because of the placebo and not practice because each subject was told to play multiple rounds before testing to make sure I addressed this variable. In addition, I questioned all subjects at the end of testing if they felt they did better because it was a placebo or because they played multiple rounds. All but one subject said that they felt that they did better after the placebo. The other subjects answer could have been because of some uncontrollable variables. For example, I need to switch rooms for convenience reasons. Therefore, my hypothesis is partially correct.

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

251

2019

Fair Category

L7

Project Number

2019

Title: Does Dog Saliva Kill Germs & What Else Might?

Student Name(s): L. Hillgen-Santa

Abstract:

To evaluate whether canine saliva kills germs, dog saliva was applied to agar plates inoculated with either bacteria or hand germs. The plates were inoculated and placed in an incubator at school. To score the effectiveness of each agar plate, every 24 hours for three days I documented and photographed the bacteria growth noting size, number of bacteria and colorization for evaluation. An alcohol based antibacterial hand sanitizer was also tested for comparison.

The experiments were repeated three times and then averaged. For controls in this experiment I monitored the growth of bacteria alone, dog saliva alone, hand bacteria, and my own human saliva. Further, I tested Staphylococcus epidermis bacteria with dog saliva; dirty hands with dog saliva; Staphylococcus epidermis bacteria with hand sanitizer; dirty hands with hand sanitizer; and Staphylococcus epidermis bacteria with human saliva. The data showed that dog saliva was on average 26% more effective than hand sanitizer with Staphylococcus epidermis bacteria and 56% more effective with dirty germy hands at containing/killing bacteria growth. Human saliva had no beneficial effect at destroying bacteria.

These results showed hand sanitizer has some effectiveness at destroying bacteria, but its strength wore out quickly and thus needed reapplication. Dog saliva does a significantly better job at the destruction of bacteria than other agents tested and over longer periods of time. Therefore, a dog licking a wound may be beneficial if not done to excess or it could cause other potential damage to fragile tissue or introduce foreign bacteria from the saliva.

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

MI AS

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

246

2019

Fair Category

L7

Project Number

2020

Title: Design, Testing, and Optimization of Kombucha SCOBY-based biofilms

Student Name(s): E. Brown

Abstract:

This project was all about manipulating Kombucha Scoby-based biofilms. I chose this project because one of my mom's students at her college made this material and was able to make a handbag with it. I thought it would be very interesting to investigate the material. The question for the first part of my experiment was- What different conditions make the biofilm grow the best? The question from the second part of the experiment was- What waterproofing material work best to keep the biofilm from melting? For part one I thought that if you added more bacteria the biofilm would grow thicker. My hypothesis for part two was that the beeswax would be the best at waterproofing, and the control would melt to a liquid. To complete the first part of my experiment I brewed tea and added different amounts of bacteria to the brews. The final product was dried, waterproofed, and set in water in order to complete part two. A brief review of the data shows that all the biofilms grew but the one with the non-used bacteria and the added sugar grew the best. The data from part two shows that the beeswax protected the most and the others didn't work nearly as well. I learned from this experiment that the more bacteria the thicker the biofilm grows. From part two I learned that even though water may loosen up the dried biofilms and make it sticky again, it won't melt to nothing.

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

233

2019

Fair Category

L7

Project
Number

2021

Title: A Plant's Favourite Nutrient
What Helps Plants Grow Best: Distilled Water, Miracle Gro, or Bio-Tone Starter Plus

Student Name(s): C. MacKinnon

Abstract:

The reason I did my project was to find out what nutrient helps plants grow best: distilled water, miracle gro, or bio-tone starter plus. I decided that I could use this project to help my mom's plants grow more. My hypothesis was that miracle gro would be the best nutrient due to its chemical formula, then distilled water, and then Bio-tone Starter Plus. To begin my experiment, I first planted seeds in seed starter in a pot. Next I used nutrients on plants. Plant A had distilled water, plant B had Miracle Gro, and plant C had Bio-tone Starter Plus. After using the nutrients, I measured daily results for two weeks in inches. Finally, I collected data by finding the average amount of inches grown. In the end, Miracle Gro had the worst growth compared to distilled water and Bio-tone Starter Plus. I realized the pot with Miracle Gro grew better in trial two. I believe this is because it was in a warmer location than trial one. My hypothesis was that Miracle Gro would be the best nutrient. The data and results from my experiment proved my hypothesis wrong. In both trials, the plant with distilled water grew the best, then Bio-tone Starter Plus and Miracle Gro. One experiment to look into in the future is what type of water is the best help in growing plants.

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

PS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

96

2019

Fair Category

L7

Project
Number

2022

Title: Which foods shall create more energy?

Student Name(s): J. Valentin

Abstract:

A question this experiment answers is: which of the tested foods gives the most electricity? The hypothesis was that the lemon would generate more electricity than the lime or the potato. Copper pennies and zinc coated screws were put into the food and then it was connected to a voltmeter to measure output. Copper and zinc are electrically conductive and are used in batteries. It was discovered that the lemon generated more electricity. The results for the lemon was above one volt on average, while the lime and the potato were below one volt when tested.

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

BI

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

L7

Project
Number

2023

Title: The Effect of Collector Quantity on Solar Heating

Student Name(s): D. Mitchell

Abstract:

The purpose of this experiment is to test the ability to collect solar energy using solar collectors. It was predicted that the solar collector mechanism with 8 collector tubes would collect more heat than the collector with 4 collector tubes. I built four collector boxes, two containing 4 collector tubes, and two containing 8 tubes. It consisted of a small fan, insulated tubing covers, wood frame, and acrylic sheets, with most things being attached firmly by hot glue. I let them all sit out for a week, and collected data every day. The data, collected by an infrared temperature reader, showed that the average temperature of the solar collector with 8 tubes, 3.7°C, was warmer than the average temperature of the solar collector with 4 tubes, 2.7°C. It is concluded that tube quantity does collect more, which proves the hypothesis to be correct. One thing that was noticed was that Collector 2, even being a collector with 4 tubes, turned out to be the highest collecting mechanism, although not in the highest temperature average. This may be due to the sun being most exposed on this mechanism, as it was in the closest area to the middle. Also, the mechanism may have had smaller air intake holes, allowing for more hot air to be produced in the top. One way in which the experiment could have been improved was by taking more accurate temperatures. Another way would be by adding more, or better and more precise pictures to the experiment.

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

2019

Word Count

161

Fair Category

L7

Project
Number

2024

Title: Molecular Health Indices of the Kalmia Latifolia

Student Name(s): M. Sousa

Abstract:

My project is very important to nature and us. Testing for how much starch in a plant is important because this is how they store their energy. If plant do not have any energy stored they will not survive. In the process of testing my experiment the three major procedures that I used in this project was paper pigment chromatography, testing for starch with iodine, and measuring how much light is absorb with my substances. When doing the chromatography portion I saw that in almost all of the leaves, that the pigments that mostly showed was chlorophyll (green) and Carotenoid (yellow). When I was testing the starch I found out that the healthy leaves contain more starch because when the iodine was on them they turned darker. The last part was me testing how much light was absorbed by my substance. Some of the healthy leaf trials had higher absorbance results than the other healthy trials, same thing with the diseased.

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

PS

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

L8

Project Number

2501

Title: Does Color Affect Memory Retention?

Student Name(s): Z. Curtin, n. na, n. na

Abstract:

My topic was, "Does color affect memory retention?" I chose my topic because I am not the best test-taker and wanted to know if the color of the text I study with would make studying easier. We also use a lot of online textbooks and I wanted to find out if students had a choice of the color of the material, would it affect how much they remember. Based on my preliminary research, my hypothesis was that warmer tone colors (red and orange) would allow for better retention of information than text in cooler tone's (blue or purple). To test my hypothesis I created different colored cards using number stencils and asked participants to play the memory game. I measured the time it took for volunteers to match all the cards. My results ended up differently than expected showing that purple cards produced the fastest reaction time indicating better memory retention. Orange came in second. After completing the project, I wondered: why would purple and orange result in the best reaction times? I realized that people probably don't see purple and orange as often as people see the other colors of blue, black and red. Conclusion: people should be given an option to use colors that work best for their individual learning preference. It will help you study and give you a better grade on your tests. Further studies would be needed to determine the level of positive effect that the differences in colors can make to individual learners.

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

BE

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

L8

Project Number

2502

Title: The Effect of Fertilizer on Algae Growth

Student Name(s): S. Toprani

Abstract:

February 28, 2019

Abstract

The Effect of Fertilizer on Algae Growth

The purpose of this experiment was to determine if fertilizer effects algae growth. It was predicted that All Purpose Miracle Grow Liquid Fertilizer® will cause the greatest growth because it is an organic and commonly used fertilizer. The project started by putting a spirulina tablet in each 60 milliliter bottle. 45 milliliters of water was added in to dissolve the tablet. The fertilizer solution contained 2 milliliters of fertilizer, dissolved into 500 milliliters of water. 15 milliliters of each fertilizer was emptied into each of the three bottles. Fertilizer wasn't added to three bottles of solution. All the mediums were placed on a sunny windowsill, mixing them every five days. Four and a half weeks later, the bottles were tested at a lab. The results of each bottle was recorded. It was concluded that All Purpose Nature Cares Water Soluble Fertilizer® resulted in a higher growth of algae, at an average of 0.715. The All Purpose Miracle Grow Liquid Fertilizer® diminished the algae growth, at an average 0.161. This was known because the Algae Without Fertilizer had an average growth of 0.647. The All Purpose Dr. Earth Root Zone Starter Fertilizer® came in second to last, at an average of 0.690. It is concluded that the hypothesis was wrong because the All Purpose Miracle Grow Liquid Fertilizer® diminished the algae growth. This experiment has proven that All Purpose Nature Cares Water Soluble Fertilizer® results in the highest algae growth.

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

PS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

L8

Project Number

2503

Title: The Effects of Oil on the Removal of Microplastics from Water

Student Name(s): A. Doolabh

Abstract:

The presence of microplastics (pieces of plastic 5mm or smaller) in wastewater systems is an increasing problem as consumers use, but do not properly dispose of plastic. These microplastics cause harmful, lasting effects to both marine and human life. The purpose of this experiment is to demonstrate one way of effectively removing microplastics from water. Specifically, does the addition of cooking oil to microplastic infected water bind to and separate the microplastics from the water better when the oil is mixed with the water as compared to not mixed. In the experiment, a control of “No Plastic” was used, along with four types of plastics: High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Polypropylene (PP), and Polystyrene (PS). There were two different conditions for each plastic sample; the “Controls” group, where the oil and water were left separate, and the “Mixing” group, where the oil and water were vigorously mixed and then left to sit and separate. The data showed that the oil was most successful at binding to LDPE and PP plastics in both the “Control” and “Mixing” conditions as evidenced by the increase in weight after oil and water filtration. The hypothesis was disproven, as the oil was more effective at binding to the LDPE and PP plastics in the “Control” as compared to the “Mixing” condition. Further research should be done to determine whether mediums other than oil would be more successful at removing microplastics, and also to look at extraction of additional types of plastic.

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

EM EV EA

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

216

2019

Fair Category

L8

Project Number

2504

Title: "Music Memory"

Student Name(s): T. Snow

Abstract:

My project is "Music Memory". My hypothesis is that music will help your performance on a memory test because the beats you are listening to will trigger your memory. My independent variable is the music while studying for the test, my dependent variable is the test score you get on the memory test. What drew me to this experiment is that it was "relatable". I listen to music while studying for a big math test and other tests too. I want to know how much of a difference does listen to music affect your

The memory is a very delicate thing. Memory loss is a common disease throughout the world. Sleep deprivation is one of the factors leading to memory loss. The amount of sleep you get and the quality of sleep are important to memory. Not getting enough sleep can cause exhaustion. Depression and stress can also lead to memory loss.

If music does improve your memory and test scores teachers will be able to play music during test and quizzes. Also it may help doctors find cures to Alzheimer's with music. If we allow music to play for tests like the SAT. This would improve the test scores in the U.S. In conclusion music will help improve many things including memory and test scores.

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

217

2019

Fair Category

L8

Project Number

2505

Title: Clones... double trouble

Student Name(s): A. shaw

Abstract:

The science project was to help find a way to better clone plants. It is important because it shows how effective the alternative are to the original process. The question was "Which liquid had a greater effect on the production of the root in cloning the English ivy plant?" I selected a healthy host plant. Then cut a stem that is between four to six inches long. Then cut the English ivy stem at a 45-degree angle, directly below a node. I cut four stems off. Then dip each stem in a different liquid and then planted them. Cover the plant with a Ziploc bag to give a greenhouse effect. My hypothesis was the rooting hormone would have the greatest impact of the root growth. The experimental results supported my hypothesis, the rooting hormone that was use had the greatest root production at 2.54 cm. The next liquid that had the second greatest root production was the plain water with the length of 2 cm. The third liquid that had the next greatest production was the distilled water with the length of 1.27 cm. The liquid with the least root production was the grey water with the length of 0.05 cm. This science fair project informs us what liquid is best to use to clone a plant.

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

PS CB

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

L8

Project Number

2506

Title: Going Bananas!

Student Name(s): S. Johansen

Abstract:

My experiment was how do bananas ripen and what causes them to ripen fastest? I did this because one day my sister came home from school and complained her pretzels tasted like banana with a banana in her lunchbox. I was curious to find out why that happened. I started my experiment. My hypothesis was the banana in the plastic bag would ripen fastest. I thought the banana next to 10 blueberries would ripen slowest. To conduct this experiment I had to create a procedure, my procedure was I took 10 bananas and placed them in different spots. I had a banana away from others, next to 10 blueberries, in a brown bag, in a plastic bag, next to another banana, in the sunlight, in a lunchbox, and in the dark. Everyday I observed the bananas and noted there differences. After the first banana was ripe I stopped the experiment and tested it again. When the second group finished I compared the results. My results of my experiment was the brown bag did the best and the banana in the plastic bag did the worst. In order from most to least ripe went the brown bag, away from others, next to another banana, in a lunchbox, in the dark, in the sunlight, next to 10 blueberries, and in a plastic bag. My hypothesis was wrong. If I were to do this project again I would use different things to ripen the banana. This is useful information I will use.

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

PS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

217

2019

Fair Category

L8

Project Number

2507

Title: If people can handle salt, can plants?

Student Name(s): F. Nadeem

Abstract:

In this project, I researched if salt affects the germination rate of a seed. This is helpful for when you put fertilizer on your plants to help them grow because fertilizer has salt in it. If you put too much fertilizer, then the plants will die because too much salt will kill the plants. I tested the salt tolerance of bean seeds. I watered each plant with different amounts of salt solution. When watering the plants with the different solutions my results were varied. I got some interesting results of some plants growing very tall, growing a little bit, or not growing at all. After my experiment, I saw that the plants watered with 35ppt salt in the water didn't grow at all. This shows that my hypothesis was correct. Then the plant watered with 4ppt and 2ppt salt in the water gave some strange results. Some of plants grew very tall, while others, didn't grow at all. The data showed that water should have less than 2ppt of salt in water to ensure the growth of the plants. This information is helpful for people who live in coastal regions. When living near salt water plants may struggle to survive if they can not tolerate salt. This experiment can help farmers understand the tolerance of key crops.

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

PS 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

196

2019

Fair Category

L8

Project
Number

2508

Title: Do Leaves from Different Species of Trees Decompose at Various Rates When Placed in Different Climates? - A Microscopic and Lignin to Nitrogen Level Analysis.

Student Name(s): N. Tracy

Abstract:

Leaves from five species of New England deciduous hardwood trees (Red Maple, Red Oak, White Oak, Black Birch, and American Beech) were subjected to variable temperature and humidity to determine variation in decomposition rates with respect to these variables. Leaves from each species were placed in separate paper bags in each of four environments: warm & humid, warm & dry, cold & humid, or cold & dry. Decay rates were determined after air-drying samples by using an electronic scale. Microscopic analysis of decay damage was conducted and photographed for each species.

Leaves placed in warm, humid conditions were predicted to decompose most rapidly from fungal and bacterial action. Similarly, leaves placed in cold, dry conditions were predicted to decompose at the slowest rates. Oak and Beech leaves were predicted to decompose more slowly than other species due to their relatively high lignin content and low nitrogen content. Results gathered supported these predictions. Results from these decay experiments also were compared to known lignin and nitrogen contents for leaves from these species to correlate with differences in decomposition rates.

Future studies could target exotic, invasive plant species to compare to native species and to address their effects on nutrient cycling.

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

PS 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

250

2019

Fair Category

L8

Project
Number

2509

Title: Deep Freeze Cell-e-bration (Cell cryopreservation in salt and sugar)

Student Name(s): E. Long

Abstract:

My science experiment was about preserving cells. In my experiment, I wanted to explore cryopreservation and test preservation techniques on a variety of cells. My hypothesis was that if I froze four different kinds of cells with different levels of salt and sugar inside, then I would find that around 30% salt worked the best to maintain the life of the cell. For my science experiment, I started out with gathering twelve containers and putting a thin piece of the vegetable in each one. Next, I put 0%-50% of salt into 6 of the containers. I repeated the same step, this time using sugar. Then, I filled each container with water and gently stirred them with the teaspoon. Finally, I put all of the containers into the freezer and let them sit for a week. I did two experiments a week to save time and compare the cells. I wrote down my results and took pictures of each day so I could observe my progress. In conclusion, my hypothesis was incorrect. The cells that had been preserved in sugar ended up lasting longer than the ones preserved in salt. The salt caused the cells to shrivel and die faster than the cells preserved in sugar did. If I could add to this experiment, I would test a larger variety of plant and animal cells using more advanced preservation solutions such as freezing media and liquid nitrogen. I would recommend this experiment to anyone who is interested in cell cryopreservation.

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

CB BI

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

239

2019

Fair Category

L8

Project Number

2510

Title: How Do Height and Weight Affect A swimming Race Times?

Student Name(s): M. Revzon

Abstract:

For this project, I investigated how height and weight affect the race time of swimmers. I am on a competitive swim team in my town and the height and weights vary amongst the swimmers. I am one of the slower, heavier, and slightly taller swimmers on the team. I chose this project to see if a swimmer with a certain height or weight has an advantage. I got swimmers in my age group from my town swim team and swim teams in neighboring towns to participate. These swimmers all have similar training, are mixed gender, are over 13, and are on the same level. Once I got started collecting the heights and weights of the swimmers, I created a spreadsheet and entered their race times for the 50 free as well as the 100's and 200's of each stroke. After collecting this data I was able to create graphs to analyze the data and find patterns. From the data that was collected, I could find a pattern that as weight increases, times become faster. There was at least a slight correlation of weight to speed in every race I investigated. For height I found from the data collected that as height increases, times will become faster, this pattern was found in every race. However, the tallest person was not always the fastest. In general, my findings were that greater heights and weights correlate to faster race times.

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

BE

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

224

2019

Fair Category

L8

Project Number

2511

Title: Searching for SNP's (pronounced snips)

Student Name(s): A. Bhattacharya

Abstract:

Alzheimer's is a widespread brain disease in the U.S. known and feared by many. Currently 5.7 million people in the U.S. have the disease, a number that is projected to increase 2.5 times by 2050. Alzheimer's is also the sixth leading cause of death in the U.S. Early-Onset Alzheimer's Disease (EOAD) is when Alzheimer's starts before the age of 65. Genetic mutations are a significant factor in EOAD, as these could start the disease at an earlier age. This project studies how a genetic mutation relates to protein function in the brain, which could lead to EOAD. I examined specific target genes in the OMIM (Online Mendelian Inheritance in Man) database to see the functions of the proteins they make. Next, I selected a gene based on how critical their function was in the brain, and viewed SNP's of the selected gene. SNP's are single nucleotide polymorphisms, when just one base pair in the DNA is different from normal. I found SNPs that had a profound effect on protein function, and researched each one in the SNP database by NCBI (National Center for Biotechnology Information). Eventually, I found a SNP that was directly correlated to EOAD. A literature review on this SNP revealed two experiments which supported this conclusion. This shows that a single SNP can have a profound effect leading to EOAD.

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

CB 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

163

2019

Fair Category

L8

Project
Number

2512

Title: Turmeric as an Antioxidant

Student Name(s): L. Schultz

Abstract:

My purpose for doing this project is to test if turmeric is an effective antioxidant. The reason this is important is that turmeric can be used for medical reasons. If it is proved as an effective antioxidant, it will have the proven medical benefits. I believe that turmeric will be able to counter the affects of daphnia exposed to perchlorate. To gain my answers, I first counted the daphnia heart rate. Then I exposed them to perchlorate, giving them time to react before recounting the heart rate. This process was repeated, but using turmeric juice instead of perchlorate. From this experiment, I concluded that the turmeric was successful as an antioxidant. All of the daphnia's heart rates elevated once exposed to perchlorate, but decreased when exposed to turmeric juice. This contributes to life sciences as well as medical sciences because turmeric is helpful for medical reasons. My hypothesis was proven correct, turmeric is able to counter the effects of perchlorate on daphnia.

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

PS CB BI

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

L8

Project Number

2513

Title: Which Fruit Contains The Most Vitamin C?

Student Name(s): J. Towpasz

Abstract:

Which fruit contains the most vitamin C? Good sources of vitamin C are found in fresh fruits. Strawberries, kiwis, lemons, oranges, and grapefruits all have various levels of vitamin C. These fruits are the fruits I have chosen to test in my science project because they are commonly used. My hypothesis states if strawberries, kiwis, oranges, lemons, and grapefruits are tested for vitamin C content using titration process, then oranges are most commonly known for having the most vitamin C.

I mixed a bottle of tincture iodine with 500ml of water. Then placed equal amounts of iodine solution (15ml) in cups. Then 0.5ml of starch solution and added it to each cup of iodine. This makes the solution a blue - black color complex and easier to see. Next add fruit concentrate using a medicine dropper to iodine solution. Record the number of milliliters needed to change the solution from its blue - black color to a clear color.

The results of the experiment was that strawberries turned the iodine solution clear with the least amount of fruit concentrate, with 10.3 milliliters. Next came kiwi 12ml, oranges 12.6 ml, lemons 15.3ml, and grapefruit 21.6ml. The purpose of this experiment was to see if oranges had the most vitamin C and how it would compare to four other fruits. My findings should be useful to consumers because now they can use my information to know which fruit to buy when it comes to vitamin C content.

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

224

2019

Fair Category

L8

Project Number

2514

Title: Catch My Drift?

Student Name(s): G. deLevie

Abstract:

My experiment was conducted for the purpose of finding out how ocean currents affect life below the surface. With all the natural disasters happening in recent years, and with most of them involving some sort of water damage, I was interested in how these currents form and what they can do. For my experiment, I used a different number of candles to heat up a lasagna dish filled with vegetable oil and basil flakes. The basil flakes were to act as anthropogenic waste and organisms that are not strong enough to move on their own, such as plankton. I conducted three different trials using three different amounts of heat: one candle, two candles, and three candles. For the experiment, I wasn't looking to find the speed of the currents. I was looking for how the currents move and how the basil flakes move around. I found out after the trials that the hotter the oil was, the faster the basil flakes moved. Some of the flakes started to stockpile in different areas where there was less heat. This was alarming to me. Having all that trash building up in one place will not help marine life. Similarly, sea life congregating in one spot could cause other parts of the ocean to have less food and other animals that feed off of plankton could starve.

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

EV

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

L8

Project Number

2515

Title: The Bubble: A Moveable Filtration System to Remove Medical Waste From Lakes and Ponds.

Student Name(s): L. Southam

Abstract:

The purpose of my project was to create a filter to remove medical waste from lakes and ponds. Hospitals and nursing homes discard their medicines improperly by throwing them down the drain or into the trash. When it rains, those in landfills get swept into lakes and ponds. Those that go down the sink, go through water treatment plants that are not equipped to filter them out and are sent back into lakes, ponds and rivers. This is harming aquatic life, especially fish and can contaminate our drinking water. The US studied 139 American rivers, 80% were contaminated with medical waste, including antidepressants, hormones and painkillers.

I built a water filter that moves around ponds and lakes removing chemicals from the source. My invention has three different filters, the first is charcoal, the second fish filter netting, and the third moss.

To test my invention, I created four different “medically polluted” waters, using Motrin, Vitamins, Advil and Dayquil. I measured their parts per million (PPM) with a HM Digital TDS EZ water PPM tester and PH levels with Hydrion PH strips and then poured one liquid at a time through the filter, changing each layer of the filter between liquids. I tested the PPM and PH after each one. There was a significant reduction in PPM and PH readings for each liquid.

In the future, I would like to create a filter designed specifically for water treatment plants, as they currently don't have any mechanism for filtering medical waste.

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

EN EM EE

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

247

2019

Fair Category

L8

Project Number

2516

Title: Optimal Lighting for Gloeocapsa

Student Name(s): I. Rivera

Abstract:

Gloeocapsa is a photosynthetic algae which is used in scientific research. It may also play a role in wastewater remediation (Kim, 2015), due to its nitrogen-fixing ability (Wyatt & Silvey, 1969). We decided to test the optimal lighting for growing Gloeocapsa Algae. Our hypothesis is "If the type of light affects how the algae will grow then the grow bulb will grow the algae the fastest because it's specifically designed for plant that use photosynthesis." The hypothesis was incorrect. First, to test the hypothesis, we set up several test tubes rack, each with three test tubes, each filled with the same algae mixture, under a different type of light. It was placed under the lights for a sixteen hour dark cycle, followed by an eight hour light cycle. After keeping the algae under separate lighting conditions for 3 weeks, we set up the microscope to count how many algae cells grew under each type of light. We started off by first taking a picture of the clusters of algae under a 10x zoom microscope objective lens, using a digital microscope camera and counting the clusters. Then, a picture was taken using the 40x zoom microscope objective lens and counted the cells, multiplying the number by the amount of cell clusters in the 10x picture. This process was repeated until each test tube was counted. From this experiment, we concluded the LED light is the optimal lightning for culturing Gloeocapsa algae.

Kim, S. (Ed.). (2015). Handbook of microalgae

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

PS EM CB

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

209

2019

Fair Category

L8

Project Number

2517

Title: H2know

Student Name(s): J. Hernandez

Abstract:

There are many places in the world that have unfiltered water like Flint, Michigan. I made my three filters almost the same way. The first was a bio-filter that was made by sand, activated charcoal, gravel and cotton. The next is the improvised charcoal filter which was made by sand and charcoal. The last filter was the Multi-level filter made by cotton, sand, charcoal, and gravel. I hypothesized that the Bio-filter would work the best out of the three. I gathered a water sample from my local lake. I added a measured cup of the water sample in all three of the filters. After all the water was filtered I measured the Ph levels and clarity of all the water. After all my tests my hypothesis was proven, the Bio-filter did filter the water the best but it made the water more acidic for some reason, I am pretty sure that it was because of the activated charcoal. So the best choice if you have a lot of time would be the Bio-filter, but if you are on a time limit the second best choice would be the Multi-level filter because it gave the second best clarity of water in the fastest time.

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

EM EV EA

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

239

2019

Fair Category

L8

Project
Number

2518

Title: ONE MAN'S TRASH IS ANOTHER MAN'S ENERGY

Student Name(s): T. Fanelli

Abstract:

The objective of this experiment was to see if compostable trash fermenting cow manure can create enough gas to power a Bunsen burner. It was predicted that it would be capable of doing so. The purpose of this experience was to produce energy in a container with simple materials. A large 14 gallon container was turned into an air tight vessel with a feeding tube and a tube to let out/measure gas. Approximately 5 gallons of cow manure and water was added into the vessel through the feeding tube and remaining air was vacuumed out of the vessel, and the manure fermented. Later, chopped up food was also put into the vessel and fermented over the course of over 30 days, along with the occasional weekly "feeding" of trash. The gas in the container was measured each day for 25 days with a beaker. After 25 days of this, the data was analyzed. The following week, the vessel was allowed to produce bio-gas which was collected in a two-bucket measurement vessel. Using weight to put pressure on bucket, the Bunsen burner was ignited and left to burn off all gas. The hypothesis was proven,

The burning time only lasted 55 seconds per day, as only about 1200-1400 mL of gas was produced. It would, therefore, take a vessel about 65 times larger than the one made to produce enough gas to use one hour each day.

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

ET BI

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

L8

Project
Number

2520

Title: Defensive Behavior of Tobacco Hornworm Caterpillars

Student Name(s): T. Andrews

Abstract:

Hornworm Caterpillars are known to damage crops especially tomato and tobacco plants. By knowing the caterpillar's behavior it may be possible to eradicate them in a environmentally responsible manner. I tested Hornworm Caterpillars to observe and record their defensive reactions in regards to their body length. This information can help agriculturalists to determine the best time to introduce a biological predator. My hypothesis is that smaller Tobacco Hornworm Caterpillars are evasive when threatened and as they grow larger they have more of an aggressive response. I also hypothesized what their response would be when poked near the head versus the rear. I obtained 25 young caterpillar, separated and named them. I took initial measurements of each one's head capsule width and body length and proceeded to test each one by having them rest on a popsicle stick while I poked them with a wooden skewer. I recorded their reactions weekly for 4 weeks.

The data indicates that when poked near the head, the larger caterpillars reacted more aggressively than the smaller caterpillars. However all of the caterpillars tended to react more aggressively when poked near the rear and more evasively when poked near their head. Also, the data shows that the majority of the caterpillars were more aggressive as they grew larger.

The results tend to substantiate my hypothesis however further studies would be beneficial. The sample size should be larger for accuracy and it would also be beneficial to raise the caterpillars from eggs and test them much earlier.

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

AS BE

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

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4. Is this project a continuation? Yes No

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

150

2019

Fair Category

L8

Project
Number

2521

Title: The Primacy Effect

Student Name(s): H. Kline

Abstract:

People are always forgetting things, and sometimes we do not know why. This project explains why we forget things, and if this common problem gets better as we grow older. It doesn't matter how old we are, we are all human, and humans forget things. The question is; who has a better memory, children or adults? Volunteers, one group of children and one group of adults, were given a memory test to try and memorize. After ten minutes the volunteers were asked to recall as many items they could remember. My hypothesis was that children would be able to remember more words from the memory test. The results proved that my hypothesis was correct by showing us that the group of children remembered more words than the group of adults. This experiment tells us about why we forget so much, and if it may have to do with our age.

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

BE

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

L8

Project Number

2522

Title: Go Fresh For Best Vitamin C

Student Name(s): M. Green

Abstract:

In this project I tested whether or not freshly squeezed juices contain more vitamin C than processed or concentrated juices. I tested orange juice and lemon juice using the process of titration. Titration is the slow addition of one solution of a known concentration (called a titrant) to a known volume of another solution of unknown concentration until the reaction reaches neutralization. This is often indicated by a color change. I created an indophenol solution that shows whether a substance contains a high or low level of vitamin C. To find this out I had to measure the amount of drops of the juice it took to make the solution turn completely clear or at least really close to clear. If it did not take a lot of drops then it contained a higher amount of vitamin C but if it took a lot of drops then it contained less amounts of vitamin C. In this science project my hypothesis was proven because after running the tests multiple times, the freshly squeezed juices took the least amount of drops to make the solution colorless. The fresh squeezed juices provided the same result as the Ascorbic Acid (vitamin C) control sample. This science project has to deal with what I am learning in school because we are talking about genetics. Understanding how the foods we eat can affect health and wellbeing is useful to know. It might offset any genetic defect or deficiency we might have.

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

PS ME

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes 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

240

2019

Fair Category

L8

Project
Number

2524

Title: The Effect of Various Combinations of Materials as Biosand Filters, on the Filtration of Fresh Water

Student Name(s): S. McKenna

Abstract:

The purpose of this experiment was to see which order of materials in a biosand filter would filter nitrates, sodium, chloride, and E.Coli most effectively. It was predicted that the biosand filter with the order of materials of fine sand, coarse sand, and then gravel would be the most effective when filtering out nitrates, sodium, chloride, and E.Coli from the fresh water of Lake Lillinonah. The data showed that the biosand filter with that order of materials was in fact the most effective when filtering all ions and it was labeled sample 3. Also, there was no E.Coli count in sample 1, sample 2, sample 3, and the control. The water taken straight from Lake Lillinonah was the only sample with an E.Coli count and the count was 21.3 per 100 ml. Even though Lake Lillinonah does have an E.Coli count of 21.3 per 100 ml., it is considered safe to swim in because it is well under the E.Coli count of 88 per 100 ml. of water which is the unsafe level to swim in according to the State of Connecticut. From this data, it is concluded that the hypothesis was correct because sample 3 was the most effective filter when examining water for various ions. Given what is now known, further experimentation could be done to help understand how long each filter could last and to also see if collecting data in warmer months would affect the data.

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

EV EA

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

Yes No

CSEF Official Abstract and Certification

Word Count

194

2019

Fair Category

L8

Project Number

2525

Title: Homemade VS Regular Toothpaste

Student Name(s): M. Khawaja

Abstract:

Are you using the right toothpaste? Can there be a difference between your daily toothpaste and homemade toothpaste? Homemade toothpaste can be a safer, cheaper, and a more effective solution than regular toothpaste. In this experiment, 9 eggs were used as test subjects since eggs have the same enamel as human teeth. Homemade toothpaste was put against Colgate and Crest to gain comparative and accurate results. The eggs were initially hard boiled and then put in 3 different groups and each group had 3 eggs that were put in separate liquids such as coffee, tea, and Pepsi. After being left overnight submerged in such liquid, each group was assigned a specific toothpaste and the experiment was carried on. Subsequently, all the results were inspected and the results were as predicted. Homemade toothpaste had the greatest difference in whiteness surpassing Colgate and Crest. Homemade toothpaste does not contain fluoride, a substance which purpose is to help in whitening and prevent cavities but can also be toxic for your health and harmful for your teeth, and yet it still exceed in effectiveness. Thus it was inferred that homemade toothpaste is a more effective and safer option.

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

144

2019

Fair Category

L8

Project Number

2526

Title: Memory and Personality

Student Name(s): B. Williams

Abstract:

Everyone has a personality and remembrance/memory, so I wanted to test whether or not they correlate. I hypothesized that the personality traits introverted, judgmental, and intuitive are associated with decreased short term memory performance. First, I randomly selected 16 volunteers and have each volunteer a letter to identify. After that, each volunteer took a memory and personality test and I organized the scores and personalities into the top 20%, middle 60%, and bottom 20%. I then compared the scores to the personalities, and I found that the bottom 20% is extroverted and the top 20% is introverted. The top 20% and the middle 60% have a similar trait which is introversion. The bottom 20% and the middle 60% have a similar trait, which is extraversion. So in the end, my hypothesis was disproven, short term memory is associated with extraversion instead of introversion.

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

BE

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

168

2019

Fair Category

L8

Project Number

2527

Title: Artemia Vs Ocean Acidification

Student Name(s): B. Sanchez

Abstract:

This project explored how different acidity levels (pH levels) 6,7 and 8 affect the hatch and growth rate of Brine shrimp (*Artemia* spp.). My hypothesis was that if the Brine shrimp eggs are placed in water that has pH levels of 6, 7 and 8 then pH level 6 will have the lowest amount of eggs hatched and slowest growth rate because brine shrimp are commonly found in waters with a pH of approximately 8, which is a basic environment. If the pH was more acidic, it could affect their exoskeleton development. Based on the data I collected, I can conclude that my prediction about how pH 8 would have the most amount eggs hatched and pH 6 would have the least amount of eggs hatched was correct because the average amount of eggs hatched for pH 8 is 39 eggs and pH 6 was 12. This shows that pH 8 had the most amount of eggs hatched and pH 6 and the least amount of eggs hatched.

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

AS EV EM

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

193

2019

Fair Category

L8

Project
Number

2528

Title: Using a Constructed Wetland to Purify Grey Water

Student Name(s): N. Grant

Abstract:

A lack of fresh, clean water is a global issue. In some countries, clean water is such a scarce resource that women have to walk miles to obtain it. Using an affordable water recycling system can improve water quality globally and change the lives of many people. The objective of the project was to devise an inexpensive and effective way to purify grey water so that it can be reused on a single household scale. The project tests the use of wetland plants, growing in sand in a shoe-box sized container under a grow light, to purify grey water. Wetland plants clean water by filtering out sediment and absorbing nutrients in their root bed. The system was built using affordable or recycled household items such as storage bins, and recycled plumbing pipes. The system worked well and significantly cleaned the grey water poured into it. Before the water was put through the system, it was muddy and opaque. After traveling through the wetland root system, the water was transparent and contained no visible sediment. A system such as this portable wetland could save precious water resources and time spent collecting clean water.

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

EM PS 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

246

2019

Fair Category

L8

Project Number

2529

Title: Use of Bioluminescent Algae to Detect Water Contaminants

Student Name(s): S. Tsao

Abstract:

Millions of people drink contaminated water everyday. Contaminations can come from many sources such as runoff and corrosion, containing heavy metals, herbicides, and pesticides.

This research studies the effect of contaminants on the bioluminescent intensity of bioluminescent algae. Bioluminescent dinoflagellates are unicellular algae that float on or near the ocean's surface. They are found in all the world's oceans. Dinoflagellates produce their own food and oxygen through photosynthesis. Their bioluminescence is based on their circadian rhythm and bioluminate during their night cycle.

As the light emitted from the algae is at the blue end of the light spectrum, and at low levels, it is difficult for retail grade light sensors to detect, therefore an economical light sensor was built by using a full spectrum photodiode, connected to an Arduino microprocessor which converts light signal into digital signal which can then be read by a Mac.

Bioluminescent dinoflagellates were cultured in Erlenmeyer flasks with 100mL seawater medium. 0.2mL of 3 contaminants: Copper, Atrazine, Diquat were added to the Bioluminescent dinoflagellates medium at 3 concentrations: 10x, 5x, and 1x EPA limits over a 4 day period.

The results show that bioluminescent dinoflagellates are excellent detectors of copper, even at 1x EPA limit, within 24 hours the bioluminescent intensity reduced by 75%. Whereas for atrazine and diquat, bioluminescent intensity significantly reduced at 10x EPA limit, with insignificant reduction in bioluminescent intensity at lower levels.

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

EV EM MI

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

248

2019

Fair Category

L8

Project
Number

2530

Title: How Safe Are Connecticut Lakes For Recreational Activities in the Summer

Student Name(s): A. Perera

Abstract:

Increased blooms of toxic cyanobacteria during the summer months result in many recreational lakes being closed for public use. Some species of cyanobacteria produce dangerous toxins called cyanotoxins under favorable conditions. High amounts of toxic cyanobacteria in recreational waters can present a serious risk to human and animal health. During summer months, human activity around the water bodies increases which may lead to an increase in algae bloom.

The objective of the study was to focus on two popular lakes in Connecticut; Candlewood and Lake Zoar to determine human activity and monitor algae blooms. Water Samples were collected from these lakes during the summer months and cyanobacteria present in the water samples were characterized qualitatively and quantitatively. Quantification of Microcystin levels were performed on the water samples collected. Additionally, data was collected on human activity around these lakes during the summer months.

During the peak months in summer, both lakes had increased occupancy of homes, use of recreational facilities (golf courses), agricultural activities contributing to increased human activities. More species and higher counts of Cyanobacteria blooms were observed in Lake Zoar compared to Candlewood. In August, the Microcystin levels exceeded 4 µg/L, resulting in the closure of Lake Zoar. Blooms were observed in Candlewood, however, the Microcystin levels did not exceed the 4 µg/L. The results demonstrate that during the summer months more human activities occur around the water bodies contributing to increased amounts of cyanobacteria blooms and toxins.

Water sample analysis by Wong Lab WCSU.

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

MI EV PS

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

119

2019

Fair Category

L8

Project
Number

2531

Title: Improving Fuel Economy

Student Name(s): D. Boudreau

Abstract:

My experiment is about improving fuel economy by finding out which lubricant produces the less amount of friction to a wheel. I used a bicycle wheel and used weights tied to a string so to have the wheel spin at a constant speed as the weight drops. I used six lubricants which were coconut, olive, canola, soybean, castor, and glycerol oil. After all of the tests I did, the oils with the best results were olive and soybean oil. My conclusion is that olive and soybean oil are the best to use in your car's wheels and that glycerol is the worst because test shown that it made the wheel spin slower and made the wheels spin time decrease.

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

CH EE EM

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

L8

Project Number

2532

Title: From Green to Clean

Student Name(s): M. Pethrick

Abstract:

Clean water is an essential part of life. When it rains or when we wash our cars, water picks up debris, oil, dirt, and other pollutants that are all over our vehicles, streets, and parking lots. This dirty water, called run-off, flows through storm drains, which drains directly into streams and creeks, without being processed or cleaned. I was interested to learn whether I would be able to clean dirty run-off water by combining different materials that are readily available. A water filter is a device that removes impurities from water, using a physical barrier, a chemical process, or a biological process. I researched different materials that have been used in water filters and how filters are designed to capture and trap pollutants and sediment of different sizes. My experiment used three different water filter designs, each using different types of materials, to see which was the most effective in filtering the color and impurities from polluted water. Each design had six layers, which allowed for the different sized impurities to be trapped at different stages of the filter. I was very curious to see, if any of the materials that I used would also change the chemistry of the water(e.g.Total Alkalinity) through the filtration process. The main reason I conducted this experiment was to create a more efficient, affordable, and eco-friendly filter, that many could potentially benefit from. Especially if we use recyclables and use them for a more effective cause, such as water purification.

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

EV EM

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- Yes No

CSEF Official Abstract and Certification

Word Count

147

2019

Fair Category

L8

Project
Number

2533

Title: Dirty sponges: investigating microbial growth on different sponge materials

Student Name(s): A. Vargas

Abstract:

This experiment explores the bacteria growth on sponges. In the investigation, three sponges were swabbed for bacteria after being wiped on a surface at school. The sponge types include, synthetic cellulose sponge (regular conventional sponge), cotton sponge, and bamboo sponge. Each sponge was wiped on equivalent areas of the counter then swabbed to see how much bacteria was collected and harvested. To find the amount of bacterial growth the area of the bacterial colonies was measured, rather than a dilution method. The results of the analysis concluded that the synthetic cellulose sponge collects the most bacteria. This experiment does not support the hypothesis. It was hypothesized that the cotton sponge would accumulate more bacteria because it is the most absorbent. The investigation showed that synthetic cellulose sponges are more prone to bacteria than the other two sponges tested. Also, the most sanitary sponge is the bamboo sponge.

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

MI

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CSEF Official Abstract and Certification

Word Count

164

2019

Fair Category

LS

Project
Number

3001

Title: The Effect of Nitrogen on the Carbon Utilization of Microbial Communities in Different Types of Urban Ponds

Student Name(s): M. Shah

Abstract:

It has been established that the substrate utilization of microbial communities sampled from polluted wetlands significantly increases after treatment; however, these studies have sampled from larger bodies of water and cannot account for more stochastic ecosystems such as urban ponds. In this study, 3 urban ponds of varying pond buffer radii (Arboretum Pond: 187.1m, Lochen Mall Pond: 59.5m, Eastbury Pond: .8m) were sampled from commercial and residential areas in Connecticut. The study measured the utilization of carbon sources using BIOLOG Ecoplate™ techniques to examine the effects of ammonium on microbial communities that are crucial in nutrient cycling of urban ponds. Although it was expected that the ponds would respond similarly to added ammonium, Arboretum Pond experienced a decrease in total carbon utilization, Lochen Pond experienced little change, and Eastbury Pond experienced significant increases. Characteristics of each pond, namely the nitrogen content, pond buffer, pond use, and microbial functional diversity are analyzed to develop possible hypotheses on the carbon utilization patterns of each urban pond.

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

MI

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CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LS

Project
Number

3002

Title: Comparing the Extent of the Effect of Peer Pressure and Autonomy Support in High School Students and Teachers

Student Name(s): A. Kim

Abstract:

Interpersonal interactions have always been a significant piece of human social lives. Many begin to develop their sense of support and independence in their adolescence. The primary research question being investigated is whether adolescent perceptions of peer pressure and autonomy support are stronger compared to those of adults. The secondary question was whether there is a relationship between age and peer pressure (PP) and autonomy support (AS). It is hypothesized that the relationship between peer pressure and autonomy support is that the students will have a stronger perception of PP but a weaker perception of AS and vice versa for teachers. The independent variable was teachers and students surveyed, and the dependent variable was the perceptions of PP and AS. Participants were required to complete a survey that collected basic demographic information and investigated PP and AS. The survey was used the Likert scale, and there were twenty items. There were 49 participants: 33 students and 16 teachers. After receiving every survey back, the data was analyzed using standard deviation, correlations, and t-tests. After the data was collected and analyzed by the mentor, a correlation between age and AS was found, but not between age and PP. This is most likely due to the development of independence in adolescence, but further research could investigate how exactly AS develops over time. A weak correlation was found between AS and PP. These would suggest a need for a stronger emphasis on AS, similar to that of PP, for education systems and parents.

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

BE

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

110

2019

Fair Category

LS

Project
Number

3003

Title: Topological Analysis of Protein Folding of LRRK2 Mutants in Parkinson's Disease

Student Name(s): A. Su

Abstract:

Mutations in the Leucine-rich repeat kinase 2 (LRRK2) gene, which codes for proteins that play significant roles in maintaining normal brain function, are linked to an increased risk of Parkinson's Disease (PD). Using online tools and computer software such as NCBI variation viewer, Uniprot, PDB, Phyre2, Java, and KnotPlot, 13 point mutations were characterized and the topology of sections of proteins was studied. The hypothesis is that mutations would change the topology of the protein backbone. The results proved that LRRK2 mutations change the topology of the protein backbone and that some mutated protein backbones have trefoil as their knot type.

Keywords: Parkinson's Disease, mutations, LRRK2, protein backbone, topology

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

CB MA CS

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

LS

Project
Number

3004

Title: Live Cell Fluorescence Imaging Showcases Autophagy in Mammalian Cells when Mitochondria are Depolarized

Student Name(s): S. Tang

Abstract:

Autophagy is a cellular process in which harmful cytoplasmic materials like damaged organelles are sequestered into vesicles called autophagosomes. Fusion of autophagosomes with lysosomes creates autolysosomes to enable degradation of the defective materials and help maintain cellular homeostasis. One specific type of autophagy called mitophagy leads to degradation of mitochondria, cellular organelles that normally produce ATP but can also produce damaging intermediates. Improper regulation of autophagy and mitophagy is associated with neurodegenerative diseases, infectious diseases, diabetes, cardiovascular disease, and cancer. A better understanding of autophagy and mitophagy may lead to potential treatments through suppressing or inducing autophagy. My goal was to determine the rates of autophagosome formation, movement, and degradation when mitochondrial membranes are depolarized. LC3, a protein found in autophagosome and autolysosome membranes, was previously tagged with Green Fluorescent Protein and Red Fluorescent Protein to illuminate autophagosomes and autolysosomes. I transfected mouse NIH3T3 and human HeLa cells with RFP-GFP-LC3 to visualize autophagosomes and autolysosomes. Using fluorescence microscopy, I measured changes in autophagosome and autolysosome quantities before and after mitochondrial depolarization in live cells. At steady-state, HeLa cells have higher autophagosome to autolysosome ratios compared to NIH3T3 cells. After depolarization, both cell lines showed increased autophagosome formation and turnover rates, with NIH3T3 cells making autophagosomes three times faster than HeLa. NIH3T3 cells had larger increases in autophagosome numbers after depolarizing mitochondria, whereas HeLa cells exhibited faster autolysosome and autophagosome mobility. These data provide crucial measurements of autophagosome changes in both cell lines, which is an important step in understanding autophagy.

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

CB

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

LS

Project Number

3005

Title: Heart Disease in the Zebrafish

Student Name(s): R. Balamurugan

Abstract:

Heart failure is the leading cause of death for both men and women. One method of treatment to heart disease and failure is the usage of Beta Blockers, which slow heart rate and reduce blood pressure by reducing activation rates of beta receptors. Specifically, Beta-Adrenergic receptors activate consequently subsequent to increased rates of circulating catecholamines - specifically dopamine. The increased rate of catecholamines is also demonstrated during periods of high stress.

Subsequent to the activation of Beta receptors, various proteins directly activate through the body. One such protein is Signal Transducer and Activator of Transcription 3 (STAT3). In the heart, STAT3 activation increases the cardiac contractile response. When Beta receptor activation increases or decreases, the cardiac contractile response, and STAT3 activation rates increase or decrease respectively along with it.

To stimulate Beta Adrenergic stimulation - the increased level of catecholamines during a period of stress - dopamine and short periods of hand and roller swirling have been utilized. After ample research, observation of zebrafish embryos, and analyzation of beta blockers used for treatment of heart patients, it can be predicted that after treatments of dopamine and swirling methods, the increased Beta - Adrenergic stimulation will lead way to increased activation rates of STAT3 and an increased cardiac contractile response rate, resulting in heart failure. Further analyzation of STAT3 and the effects of Beta-Adrenergic stimulation on zebrafish embryos will reveal the precise morphological changes of the zebrafish embryo and the precise activation changes of STAT3.

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

ME CB AS

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 vertebrate animals controlled substances

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

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LS

Project Number

3006

Title: Investigating APOE Gene Expression in Cancer and Alzheimer's Patients: A Bioinformatics Study

Student Name(s): A. Schommer

Abstract:

Apolipoprotein E (APOE) is a protein that plays an integral role in transporting cholesterol and clearing plaques in humans. While studies have proposed a link between APOE and cancer, as APOE is part of several signaling pathways, many of which result in cancer and cell proliferation in general, others have investigated links between APOE overexpression and Alzheimer's Disease. Of the various APOE alleles, APOE E4 allele has been associated with a higher risk of Alzheimer's due to its reduced ability at clearing beta amyloid. These proteins have an association with cholesterol, as evidenced by APOE. APOE's association with cholesterol stems from its role, forming lipoproteins, which package cholesterol and carry them throughout the blood stream. This project aimed to investigate correlation between Sleep, Cholesterol levels and APOE expression in patients with cancer and Alzheimer's. The National Health and Nutrition Examination Survey (NHANES) was analyzed to study the link between sleep (known to help clear brain plaques) and heart disease. Insight into the role of sleep revealed APOE as gene to study, due to its role in atherosclerosis and sleep apnea. From this point, the Georgetown Database of Cancer (G-DOC) was used to obtain genomic data from clinical studies. Gene expression graphs were generated, and Student's T-Tests performed to assess the significance of the data. Results were consistent with expected data. Those with cancers, excluding brain cancer, and Alzheimer's patients showed upregulation of APOE,. Future work may seek to differentiate results between different alleles to assess the effects of each.

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

AT ME CS

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

279

2019

Fair Category

LS

Project
Number

3007

Title: Control of Varroa Destructor Infestation with a Dual-function, Thymol-Emitting Honey Bee Hive Entranceway

Student Name(s): R. Jain

Abstract:

In the last decade, one-third of all honey-bee colonies have vanished, in Colony Collapse Disorder (CCD). The root cause of CCD has been debated, with focus on pesticides, and varroa mite (vm) infestation of hives. Recent literature provides evidence that vm feed on fat bodies of honey-bees, which when depleted, weakens the honey-bee so that pesticides can cause death. Therefore, a simple and effective method to remove vm from hives is urgently needed, and is the focus of this research. To begin, a beehive entranceway was designed, that released thymol “miticide” onto the bees upon contact, as they enter/leave the hive. The entranceway is dual-function, also time-releasing gaseous thymol into the hive. A 20x20x150mm entranceway, with 13 alternating 9mm circular holes, was 3D-printed and coated with a 50/50-%w/w mixture of thymol/Hydromed-D in ethanol. The entranceway was placed onto a bee-hive, where bees demonstrated indifference to the entranceway. Under normal bee-behavior, GC-FID analysis of bee-body highlights as much as 28µg of thymol released onto the bee by contact-per-day. With a demonstrated 4-day exponential decay, the vm LC50 for thymol (56µg) is reached, only four days after entranceway installation. Similar analysis of the 4L headspace for a (19.75’’x16’’x20’’) hive revealed 5.44µg/L of thymol released, acting as ongoing vm control throughout the hive. Entranceway release of thymol surpasses that of the most widely-used thymol varroacide, and is temperature-independent throughout the practical range of use (2°C-45°C). Finally, GC-FID modeling suggests a 1-month lifetime of the entranceway, which is easily recharged without disturbing the hive.

Technical Disciplines Selected by the Student
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EN EM

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CSEF Official Abstract and Certification

Word Count

254

2019

Fair Category

LS

Project
Number

3008

Title: Investigating the Role of Substance P in Reducing Hunger Signals in Anorexia Nervosa

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

Abstract:

Anorexia nervosa (AN) is an eating disorder characterized by physical emaciation and body dysmorphia. It is the most fatal mental disorder, with a mortality rate around 5 percent. Despite this fact, AN is poorly understood by the scientific community and public alike. Its dismal post-recovery relapse rate up to 65 percent attests to modern treatment's insufficient understanding, suggesting that traditional treatment techniques--especially therapy and nutritional counseling--do not sufficiently target the realities of AN. Often believed to be the result of vanity and social pressure, AN is in actuality a pervasive, legitimate condition whose causes are rooted in genetics, neurology, biology, and culture. The mechanisms that cause and sustain the disease are numerous and complex. One pertinent and specific biological issue is decrease in appetite. AN patients often report the loss of hunger signals, perpetuating the weight loss symptomatic of the disease. Recent research has found that Substance P receptor (SP), a neuropeptide known for its potential role in controlling food intake, is significantly upregulated in AN. To investigate what this means for the neurobiology of AN, a meta-analysis of studies relating to SP, AN, and ghrelin, the hormone that stimulates appetite, was conducted. It was determined that the upregulation of SP in AN antagonizes GHS-R, ghrelin receptor, thereby decreasing appetite and accounting for loss of hunger signals in AN. This model offers important insight into the disorder, proposing the potential for improved treatments, pharmacological or other, that adequately address appetite loss and the broader neurobiological realities of the disorder.

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

ME BE

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

2019

Word Count

250

Fair Category

LS

Project Number

3009

Title: The Effect of Recurrent Hypoglycemia on Metabolic Enzyme Expression Levels

Student Name(s): J. Liu

Abstract:

Diabetes Mellitus is a disease characterized by elevated blood glucose levels. There are two types of diabetes- type1 and type2. Type1 diabetes is a condition where not enough insulin is produced, whereas type2 diabetes is when the body does not respond to insulin properly. Type1 diabetes treatment includes lifelong insulin therapy. Unintentional insulin excess during treatment can cause hypoglycemic episodes and may occur in patients with type1 diabetes who depend on regular insulin injections. Recurrent hypoglycemia is repeated deficiency of glucose in the bloodstream. This project investigated the effect of recurrent hypoglycemia on metabolic enzyme expression levels - specifically those in the glycolysis pathway. The independent variable is recurrent hypoglycemia. We compared samples from rats that experienced recurrent hypoglycemia (recurrent hyperinsulinemic hypoglycemia-3dRH3 or intensive recurrent hypoglycemia-3dRH6) and rats that experienced no hypoglycemia. The dependent variable is metabolic enzyme expression levels, specifically hexokinase, measured through mRNA. The lab collected hypothalamus tissue and extracted mRNA after the last hypoglycemic episode. A qPCR was done. Previous data showed that recurrent hypoglycemia lowers pyruvate dehydrogenase activity. We hypothesized that the mRNA taken from the rats that experienced recurrent hypoglycemia will be different from rats that experienced no hypoglycemia. The hypothesis was supported for HK2, HK4, but not HK1, HK3. 3dRH3 had no effect on all 4 hexokinases. However, 3dRH6 significantly increased the expression of HK2 and HK4. HK1 and HK3 had no change under 3dRH6. The results from this data will contribute to understanding the risks and metabolic adaptations associated with recurrent hypoglycemia.

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

ME

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

168

2019

Fair Category

LS

Project
Number

3011

Title: The Effects of Negative Thermal Stress on the Germination of Invasive Ornamental Seeds in Connecticut

Student Name(s): E. Brown

Abstract:

This study tested the effects of negative thermal stress on four seed types: *Berberis thunbergii*, *Zinnia elegans*, *Calendula officinalis*, and *Plectranthus scutellarioides*. Each seed species collection was split in half, with half of each species experiencing negative thermal stress. All of the seeds were then germinated for fifteen days and the number of seeds that germinated within each sample were counted. The difference in the percentage of germinated seeds from each species exposed to negative thermal stress was compared to the percentage of germinated seeds of the same species that were not exposed to negative thermal stress. This showed that the seed species out of the types used in this experiment that best survived negative thermal stress was the *Calendula officinalis*, followed by the *Zinnia elegans*, then the *Berberis thunbergii*, with the seed species that worst survived negative thermal stress being the *Plectranthus scutellarioides*. This showed that it is possible that where a seed is native to might not affect how it is affected by negative thermal stress.

Technical Disciplines Selected by the Student
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EM PS EV

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- Yes No

CSEF Official Abstract and Certification

Word Count

172

2019

Fair Category

LS

Project
Number

3012

Title: How could medications intended to cure Ebola through the NPC1 protein, negatively effect our bodies by latching onto different proteins?

Student Name(s): R. Vipparla

Abstract:

Ebola medications—Zmapp, Favipiravir, and GS-5734— function by attaching themselves to Neiman Pick proteins in order to cease the growth of Ebola in the carriers body. However, when the medication latches itself onto the protein, it not only stops the growth of the Ebola but it also minimizes the effects of the NPC1 (Neiman pick) protein. The human body can still function normally without the NPC1 protein, but what would happen if the medication latches onto the wrong protein and stops it from functioning? In order to conduct the investigation it was essential to find the amino acid sequence in the NPC1 protein and find out which other proteins match. Through extensive research, it turned out that the matching protein was Protein Patched Homolog 1 Isoform. This information is critical because the purpose of the Protein Patched homolog is to stop brain tumors from spreading. If the medications latch themselves onto the Protein Patched Homolog instead of the Neiman Pick Protein then the results could be fatal to the human body.

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

ME CB AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

LS

Project
Number

3015

Title: Effect of Metal Ion Chelation by Curcumin on the Progression of Alzheimer's Disease

Student Name(s): E. Silva

Abstract:

Over 44 million people worldwide suffer from Alzheimer's disease or a related dementia. Alzheimer's disease is a progressive disease that causes problems with memory, thinking, and behavior. Due to the increasing incidence rate for Alzheimer's disease and the high cost of treatment, coupled with the lack of major medical breakthroughs, an affordable option for care must be developed. The purpose of this experiment was to test whether or not curcumin can chelate free metal ions, making them incapable of fulfilling their role in the disease. In order to test the effectiveness of metal ion chelation by curcumin, the metal ions ferric oxide (Fe_3O_4), manganese dioxide (MnO_2), and zinc (Zn) were added to distilled water and three curcumin solutions. One curcumin solution contained sodium hydroxide, one contained sodium acetate, and the other contained potassium biphthalate. An X-ray fluorescence spectrometer was used to quantify the concentrations of free metal ions in the mixtures. The ferric oxide stock solution had a concentration of 1265 ppm. After the addition of curcumin to the different solutions, the mean concentration decreased to 211.25 ppm. Further tests will be conducted using manganese dioxide and zinc. A decrease in the concentration of free metal ions and an increase in the concentration of curcumin-metal complexes means that curcumin may be a potential method used in slowing the progression of Alzheimer's disease. If continued research and testing positively correlate with the hypothesis, curcumin may be widely implemented into the diets of Alzheimer's patients.

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

BI

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

LS

Project
Number

3016

Title: The Effects of the Acidic Components of Acid Deposition on the Growth and Development of *Raphanus sativus*

Student Name(s): E. Skrabacz

Abstract:

This experiment aimed to find how the sulfuric and nitric acid components of acid deposition impact developing radish plants. Dilute nitric and sulfuric acid solutions were made to the pH of 4.2. Over the course of 21 days, thirty radishes were grown. Ten of them were watered with distilled water, ten received the sulfuric acid solution, and ten received the nitric acid solution. The nitric acid solution grew the plants at the fastest rate and had an average root length of approximately 4.5 centimeters after the 21 days. The sulfuric acid solution showed a very slow growth rate with an average root length of 3.8 centimeters after the 21 days. Both of the acidic solutions' plants showed signs of necrosis (degeneration of plant cells) as their leaves began to develop discolored spots. Lastly, the distilled water's plants had an average growth rate that fell in between the sulfuric and nitric solutions' and ended with the highest average root length at 5 centimeters while showing no signs of necrosis. The results support that the degree to which plants are affected by acid deposition is dependent on the ratio of sulfuric to nitric acid and that acid deposition negatively affects plants overall. Since the nitric acid solution grew plants at the fastest rate, but also had adverse effects, the results also suggest that small concentrations of nitric acid might be beneficial to the growth of plants and that radish plants could help mitigate the harmful effects of acid deposition.

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

PS EV

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

245

2019

Fair Category

LS

Project
Number

3017

Title: Environmental Stimuli to Increase Cell Proliferation and Subsequent Elongation of Ejote silvestre

Student Name(s): C. Hirsch

Abstract:

After researching the effects of global warming, it was found that Connecticut is expected to see a rise in both population and average daily precipitation. These two things can put stress on our agricultural efforts, so it was decided to research some ways to boost plant production. The most notable method that was discovered involves playing sound during their growth process. Because of this, an experiment was designed investigating the effects of different precipitation levels and sound waves on the growth of Ejote silvestre. Plants would be subjected to either a 1kHz or 10kHz tone for 1 hour each day after watering. Different daily precipitation levels of 1mL (representing daily average rainfall in drought conditions in Connecticut), 2mL (representing daily average rainfall under normal conditions), and 5.75mL (representing projected daily rainfall averages for 2029) were also tested in combination with the tones. After a 7-day testing period, it was found that of the plants that sprouted, those that were subjected to a 1kHz tone for 1 hour each day had a higher average height from their base (15.8cm) than those that were not exposed to the sound (8.0cm). Interestingly, plants that were exposed to the 1kHz tone also appeared to be better hydrated, as they showed fewer signs of wilting than those in the control group. Results for plants exposed to the 10kHz tone were inconclusive. This data shows that subjecting ejote silvestre plants to sounds can increase growth and possibly boost water absorption.

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

PS

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

LS

Project
Number

3018

Title: The Effect of Screentime on Loneliness

Student Name(s): J. Rivard

Abstract:

Since their release in 2007, iPhones have grabbed the nation's attention. A key feature of iPhones is the ability to use social media applications, such as snapchat, twitter, instagram, and ect. Millennials are the first generation to have grown up with the constant presence of social media and the internet. In turn they have reported more cases of mental illness than any other generation. Many individuals compare themselves to what other individuals do, act, and look like, possibly leading to insecurities and feelings of loneliness. This study will try to determine if loneliness is correlated with an excess amount of social media usage on smartphones. The human participants, seniors at my school, will sign a consent form and will be surveyed anonymously (using a four digit code) to determine their levels of loneliness. Using the same four digit code, they will fill out a form each week for three weeks about their screen time on their iPhone. (They get this data from the new screentime application on the iPhone.) This data will be analysed to determine loneliness. It is expected that the students with the highest social media usage will most likely be students to have higher levels of stress due to feelings of loneliness because of their being exposed to stimuli that provoke a sense of isolation from peers. The students will be advised that they are able to drop out of the study at any time and will also be provided with a list of guidance resources.

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

BE

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

LS

Project
Number

3019

Title: Structural Changes in the Prefrontal Cortex in an Activity-based Animal Model of Anorexia

Student Name(s): R. Dey

Abstract:

Anorexia nervosa (AN) is a psychiatric condition and eating disorder characterized by extreme weight loss and preoccupation with body image. It is commonly found in adolescent women. Currently, there are no long term effective pharmacological treatments so a clear neurochemical mechanism that underlies the disease is necessary. The purpose of this study was to further describe the neurobiological basis of AN, which is not completely understood. To elucidate structural changes in the brains of mice with AN, the number of neurons and cells within the prefrontal cortex (PC) were compared between female adolescent AN mice and non-anorexic mice, sedentary control (SC). The mice used were induced using the activity-based anorexia model (ABA), a bio-behavioral phenomenon described in rodents that refers to the weight loss, hypophagia, and paradoxical hyperactivity that develops in rodents exposed to running wheels and restricted food access providing a model for the key symptoms of AN. Cells were isolated using the isotropic fractionator method and quantified in flow cytometry. It was hypothesized the number of neurons and the cell count would be different in the AN mice compared to the SC. The hypothesis was supported because there was a higher cell density and neuron count in the ABA model. It can be concluded that there are structural changes in the PC in AN mice that potentially influence eating behaviors related to AN. This study does not provide an explanation behind this phenomenon. Therefore further research is needed to characterize the specific neural pathways involved in this disorder.

**Technical Disciplines Selected by the Student
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ME

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

LS

Project Number

3020

Title: Association of Music Perception and Memory

Student Name(s): A. Northrup

Abstract:

Association of music perception and memory exists in older patients with neurodegenerative diseases (NDD). It is unknown whether reduced short-term memory (STM) is associated with decreased music perception among healthy teens. If the association exists, perhaps it can be a diagnostic tool for NDD as people age. The aim of this pilot cross-sectional study is to test the feasibility of a larger study, and to provide a preliminary magnitude of association between STM and music perception among adolescents. STM was measured through Digit Span and Spatial Span. Music perception was measured through musical scene analysis tests, identifying deviant notes/beats in: (1) timbre detection (Control), (2) local note detection (Pitch), (3) global note detection (Melody), (4) local tempo detection (Beat), (5) global tempo detection (Rhythm); and (6) Tune Recognition tests using ten famous songs and the same songs pseudo-reversed. Ten participants, aged 15-18 years, 70% female, and 100% with background musical training, were enrolled in at least one AP class in a public high school. A moderate size correlation was found between STM and pitch (Digit Span: $\rho = -0.30$; Spatial Span: $\rho = -0.24$), with similar but weaker findings for melody. No association was found between STM and either beat or rhythm. Faster reaction time was correlated with better Tune Recognition (Pitch: $\rho = -0.51$; Melody: $\rho = -0.12$; Beat: $\rho = -0.49$; Rhythm: $\rho = -0.25$). The results suggest that a larger study is feasible and a link between STM and music perception should be studied further among teens.

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

BE

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CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

LS

Project
Number

3021

Title: Efficiency Of Copper Removal Using Phytoremediation Techniques

Student Name(s): S. Hatter

Abstract:

Chlamydomonas sp. has been used in phytoremediation processes with success in many studies and has been shown to remove heavy metals from aqueous environments. Copper, a naturally occurring transition metal, can reach toxic levels in drinking water from leaching pipes and fixtures. Copper toxicity can cause physical ailments such as anemia and high blood pressure, as well as psychological ailments such as anxiety and depression. Phytoremediation has shown success on larger scales, which has prompted the possibilities of its use to remove heavy metal contamination in municipal drinking sources. Due to the documented ability of algae to absorb ions and the success of field studies, it was expected that algae would show potential to remove copper levels in drinking water. Chlamydomonas reinhardtii was placed into a copper concentrate. Tests for copper removal were performed over 7 days using a YSI 9500 Photometer. The highest removal rate was 58% after 2 days of being exposed to algae. The results show that Chlamydomonas reinhardtii can successfully be used to remove copper from drinking water. This can be used with other techniques, such as chemical filtration, to prevent having to demolish infrastructure piped with copper water lines, which would be a costly project. This procedure can also be used in countries where copper levels are high and the current removal techniques are expensive or inefficient. Using phytoremediation techniques to remove this toxic metal before it is ingested will help people avoid copper toxicity syndrome and the side effects that come with it.

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

EM

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

254

2019

Fair Category

LS

Project Number

3022

Title: Early Diagnosis and Tracking of Parkinson's Disease via Supervised Machine Learning Algorithms

Student Name(s): K. Xiong

Abstract:

Parkinson's disease is a chronic neurodegenerative disease that interferes with the ability to function in everyday life, affecting over 10 million people worldwide. Current diagnosis of Parkinson's disease is unreliable and time-consuming, relying on qualitative rather than quantitative data. Further, the majority of clinical diagnoses of PD (~75%) are confirmed at autopsy. Current diagnostic procedures ignore the presence of a prodromal stage, which is marked by non-motor symptoms. Once motor symptoms finally appear, over 60% of dopaminergic neurons are already damaged. As such, a reliable method for early diagnosis of PD in the prodromal stage is highly desirable. In this research, machine learning models were created to diagnose and track the progression of Parkinson's disease from its earliest of stages. Data from 730 patients (489 PD and 241 control) from the Parkinson's Progression Markers Initiative was obtained, and preprocessed to remove unimportant features using a two-sample Kolmogorov–Smirnov and Pearson correlation tests. A Random Forest model was first developed to examine both neuropsychological and biospecimen data, to provide a PD diagnosis, with >99% certainty (based on the ROC accuracy). In phase two, a regression model was created to track the progression of Parkinson's disease, based on the UPDRS rating scale. A Stochastic Gradient Boosting model predicted the severity of Parkinson's disease, beginning in the prodromal stage, with an R2 of 0.67. These combined results highlight the usefulness of machine learning methods to help doctors diagnose the onset and progression of PD, and determine necessary treatments, given the patient's stage of disease.

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

CS ME MA

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- Yes No

CSEF Official Abstract and Certification

Word Count

265

2019

Fair Category

LS

Project
Number

3023

Title: Testing and Subsequent Optimization of Various Polyphenol Molecules for Effectiveness of Non-Covalent Inhibition of TEM-1 Beta Lactamase in Penicillin-Resistant E. coli Bacteria

Student Name(s): O. O'Reilly

Abstract:

With antibiotic resistance on the rise worldwide, antibiotic “escorts,” or secondary molecules that defeat antibiotic-resistance mechanisms, are becoming increasingly necessary to treat dangerous infections. The penicillin-resistant bacteria Escherichia coli exhibits this need perfectly, having evolved an enzyme called TEM-1 beta-lactamase that breaks down penicillin. Because of this, penicillin treatments of E. coli infections now require a non-toxic escort drug to inhibit beta-lactamase; covalent inhibitors already exist, but polyphenol molecules show promise as non-covalent inhibitors because they contain a large number of H-bond donors and receivers, allowing them to bond more strongly with the enzyme, and are orally bioavailable, which would allow them to be taken in conjunction with penicillin. In order to test their efficacy, polyphenol molecules from the polyphenol database Phenol-Explorer were input into the molecular modeling program VEGA ZZ and docked with beta-lactamase. The simulations supported the efficacy of the polyphenols as inhibitors; polyphenols such as sesamol and rhamnnetin had optimal binding affinities 1.8 kcal/mol higher than those of penicillin, and subsequent optimization of the rhamnnetin molecule yielded optimal binding affinities 3.1 kcal/mol greater than penicillin. Several molecules also had unusually high average binding affinities; myricetin and chrysin had average binding affinities 1.3 and 1.2 kcal/mol greater than penicillin, respectively. The implications of these simulations are that the aforementioned polyphenols, contained in trace amounts in common foods, would be effective escorts of penicillin antibiotics treatments of E. coli, and that they would be orally bioavailable. With proper optimization, these molecules could potentially replace pre-existing covalent inhibitors of beta-lactamase.

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

BI AT CB

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

238

2019

Fair Category

LS

Project
Number

3024

Title: The Application of Cyanobacteria as an Environmentally Friendly Alternative to Wood Pulp in Paper Goods

Student Name(s): T. Greene

Abstract:

Global Climate Change, deforestation and invasive species, are all huge issues that plague the world today. Paper, a mass produced and commonplace product in today's society, leads to massive deforestation and the CO2 levels rising as a result from the boiling of the tree pulp for many hours. Cyanobacteria is an easily renewable and cultivated organism. It is a photosynthetic bacteria that uses CO2 rather than Oxygen. An issue with Cyanobacteria is that it can heavily impact an ecosystem when in bloom by producing cyanotoxins that when ingested can be deadly. This was seen in Florida during the Summer of 2018, where a tide of Cyanobacteria killed thousands of fish. By cultivating the Cyanobacteria and combining it with other plant fibers such as, string algae (an invasive species) and agar from seaweed, (which will provide structural integrity), we hope to create a paper-like product. The bacteria will be grown in 20 gallon tanks with excess CO2 being bubbled in. The growth will be periodically monitored with a spectrophotometer to measure the density of the bacteria in the tank. When the desired quantity of Cyanobacteria has been grown it will be filtered from the tank and dried. The dried cyanobacteria will be combined with dried string algae and agar to make a pulp much like paper. The predicted paper will be a natural and biodegradable paper-like substance that has structural integrity enough to mimic a paper plate.

**Technical Disciplines Selected by the Student
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EM EV

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

2019

Word Count

250

Fair Category

LS

Project
Number

3025

Title: Genetic Examination of Chromatin Structure in Yeast Cells

Student Name(s): A. Chowdhary

Abstract:

Regulation of gene expression is an essential process for maintaining proper cellular function; misregulation can lead to various diseases, from cancer to autoimmune disease. Understanding the impact of chromosome structure and function of associated proteins is critical towards a complete model of gene expression. *Saccharomyces cerevisiae* presents a tractable eukaryotic system to identify principles of gene regulation conserved from these unicellular yeast to humans. Histones, protein scaffolds for DNA packaging in the nucleus, can regulate expression of genes by changing accessibility of chromosomal DNA. This study aimed to characterize the relationships between 2 different histone proteins in yeast: H1 and H2A, which are encoded by HHO1 and HTZ1. Previous studies had suggested an important role for these histones in cell survival and growth. We aimed to develop a system to characterize this relationship by using the auxin inducible degron system to degrade the proteins and measure the immediate impacts on growing *Saccharomyces cerevisiae* cells. Previous studies had attempted to knock out both of these proteins completely, but were unable to demonstrate prompt effects on cells due to the fast replication rate of *Saccharomyces cerevisiae*. The current project has developed a rapid, inducible degradation system to quickly assess phenotypes, such as cell growth and structure, resulting from modulation of the levels of these important regulatory proteins. Future studies using this system will allow investigation of the roles of histone proteins in gene regulation and other cellular processes, thereby enabling fast readout of phenotypes important for eukaryotic biology, and potentially human disease.

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

CB

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

199

2019

Fair Category

LS

Project
Number

3026

Title: Applied Bioinformatics to Gene Essentiality

Student Name(s): T. White

Abstract:

The term CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats. It, paired with the protein Cas9, is a precise genetic engineering technique now being used on humans to solve certain diseases like Huntington's for example. The genetic engineering technique only became relevant in current events once the technology got good enough to start experimentation on larger organisms. Within this experiment, the technique has been paired with an applied bioinformatics system through Biopython. Within Biopython I will be comparing gene essentiality through CLUSTALW as well as BLAST. First thing to do is download the code for humans (not expecting high conservation within the genes). Take a small number of essential genes (to show a high conservation rate) (top 40-50) and take the sequences of the genes in humans and then five other species. Run Blast then, through Clustalw for proteins and see how well conserved they are- the essentials should be highly conserved from species to species. This project outlines that the main goal was to create systems to allow for more efficient testing within laboratories. Bioinformatics eliminates initial "test tube" testing and allows one to test an hypothesis and account for %error within a shorter amount of time.

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

CS CB

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- Yes No

CSEF Official Abstract and Certification

Word Count

197

2019

Fair Category

LS

Project Number

3027

Title: Phytoremediation of 17 β Estradiol Using Lemna minor in Freshwater Bodies

Student Name(s): J. Salem

Abstract:

As the world continues to industrialize and use estrogen based steroids on humans and livestock, estrogens will become an increasing environmental concern. Estrogen compounds can contaminate freshwater bodies and lead to disruptions in the reproductive systems of aquatic species, especially amphibians. What is proposed is to use bioremediation to extract excess hormones from the environment using a plant that is resilient to changes in the environment, reproduces quickly, and has hyperaccumulating properties. A candidate which fits these criteria is Lemna minor. To accomplish this, L. minor was grown in its own controlled, closed system environment to be cultivated and placed into closed containers where 17B-estradiol was added to the system in various concentrations. A Cecil CE 2041 UV Spectrophotometer was used to analyze the concentration of estradiol in the water system after 10 days and calculate if the hormone was remediated. The test demonstrates the overall abundance reading averaged 0.15, which is slightly higher than the abundance at 280 nm during the control test. Potential future applications of these methods can be used for different types of hormones, and the environmental usefulness of L. minor can be further optimized to include simultaneous bioremediation and biofuel production.

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

BI PS EM

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LS

Project
Number

3028

Title: Creation and Development of a Neural Network with Large Scale Data to Diagnose Alzheimer's Disease and Dementia

Student Name(s): J. Meindl

Abstract:

Alzheimer's disease and other dementias critically harm the lives of millions of people worldwide. Diagnosis is difficult and expensive, however early diagnosis is extremely important in order for medications to improve the lives of those affected. In addition, early diagnosis has been shown to save 15% of the \$341,000 average treatment cost of which families typically pay 70%. In this research, a neural network was designed and implemented using data obtained from the National Alzheimer's Coordinating Center to create an algorithm that diagnoses patients with dementia earlier and without seeing a costly specialist. The dataset contained records from over 100,000 patient appointments at 39 Alzheimer's Disease Centers around the US with variables including age, ability to cook and pay bills, living environment, and over 1,000 others. Neural networks are a machine learning system modeled after brain neurons and are very effective at finding nonlinear relationships between variables. Instead of using off-the-shelf models, this research utilized the computer language Python to create an original model from scratch. Multiple classifications were tested, including different dementia stages and binary classifications. To optimize the algorithm, cross-validation was used to test ranging regularization alpha values and different numbers of hidden layers and nodes within the network. Out of sample tests indicate the algorithm diagnoses dementia very accurately, with classifications above 95% accurate using data that can be obtained without physician involvement. This algorithm could greatly improve the ease of diagnosing dementia, therefore giving access to life improving treatments earlier and more cost-effectively.

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CS ME MA

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- Yes No

CSEF Official Abstract and Certification

Word Count

241

2019

Fair Category

LS

Project
Number

3029

Title: The Effect of Tidal Inundation and Nest Flooding on the Behavior of Salt Marsh Birds

Student Name(s): N. Prinz

Abstract:

Increases in temperature, sea level rise, and changes in precipitation all from global warming are causing increased tidal inundation in salt marshes. Salt marsh birds are affected by increased tidal flooding because their nests are on the high marsh area where they are vulnerable to the high tides. The nests being built in the high marsh means that the hatchlings and eggs are likely to drown during flooding events, which are becoming more frequent and at a greater magnitude because of sea level rise. This study will look at how the adults interact with their young during flooding events. The independent variables are the type of species of bird, tide height, and age of the young. The dependent variable is the amount of time the adults spend with their young during flooding events. It is hypothesized that the largest bird being looked at, the Clapper Rail, will attend to the nests for the greatest amount of time, the lower the tide height the more time all species will attend their respective nests, and the older the young the more time all species will attend their respective nests. Videos of the nests were taken during high tide and were analyzed by establishing the amount of time that each type of behavior occurred for the duration of the video. It was found that the Saltmarsh Sparrow spent the greatest average amount of time being absent from it's nest compared to the other species.

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

AS

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

257

2019

Fair Category

LS

Project
Number

3030

Title: Rapid, Smartphone-Based Diagnosis of Skin Melanoma through Differences in Tumor Cell Thermal Regulation Combined with Diffuse Spectroscopic Analysis

Student Name(s): M. Woo

Abstract:

Although melanoma is treatable with early detection, it accounts for nearly 80% of all skin cancer-related deaths. Diagnosis is limited to time-consuming and expensive biopsies, leading to late detection. Recent research suggests, however, that increased metabolic activity of skin cancer cells causes more pronounced heating after external cooling relative to normal cells (15-25oC in 50sec for melanoma versus 15-21oC for normal cells); additionally, slight color differences distinguish between malignant and benign lesions. This research focuses on the development of a smartphone-based device to easily diagnose a suspicious lesion through analysis of surface temperature change and the simplified diffuse reflectance spectrum. First, a suspicious lesion is artificially cooled to 15oC and thermal images are obtained for 1 minute using an infrared smartphone camera (a PCR-thermocycler was adapted to mimic thermal profiles). A new smartphone app converts the thermal metadata for comparative analysis against data from skin cancer patients, diagnosing the lesion in seconds with ~96% accuracy. This diagnosis is reinforced by the supporting detection/analysis, where a traditional smartphone image of the same lesion, taken through a newly designed-3D printed analysis accessory, is converted to a predictive ratio based on red, green, and blue color proportions. This value is compared to internal/standard data for normal and melanoma lesions to produce a unique diagnosis with 90% accuracy. As complementary techniques, a two-fold lesion diagnosis is provided by the smartphone and app in only 5 minutes with a combined sensitivity of 87% and a specificity of 98.8%, yielding an overall accuracy of ~98.8%.

Technical Disciplines Selected by the Student
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ME EN AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

151

2019

Fair Category

LS

Project
Number

3031

Title: Using Surface-Exposed Loop Regions of putative FadL-like Outer membrane proteins of *Treponema pallidum* as Vaccine Targets

Student Name(s): A. Chiu

Abstract:

In recent years, considerable progress has been made in identifying integral outer membrane proteins (OMPs) of *Treponema pallidum*, subspecies *pallidum*, the syphilis spirochete. These molecules are important because they facilitate nutrient uptake, and because their surface-exposed loops are potential targets for vaccine development. This project focused on a five-member family of OMPs with similar to FadL bacterial fatty acid transporters. The predicted protein structures for all five FadLs were compared using existing computer programs, such as Clustal Omega. This was done to determine how closely *T. pallidum* FadLs resemble the solved structures of other related bacterial FadLs. Amino acid sequence differences in the extracellular surface-exposed loops for FadLs from *T. pallidum* laboratory strains and patient isolates were also compared using a combination of multiple sequence alignments and modeling. The goal of this project is to compare these *T. pallidum* strains to identify how closely related each one is.

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

ME CB MI

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

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

4. Is this project a continuation? Yes No

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

246

2019

Fair Category

LS

Project
Number

3032

Title: Augment Symbiotic Nitrogen Fixation in *Helianthus annuus* L. by Inoculation of *Rhizobium* diazotrophs to Improve Drought Tolerance

Student Name(s): K. Liu

Abstract:

Climate change has been an increasingly dangerous threat to the environment. Alternative forms of fuel need to be found in order to sustain human activity. An alternative form of fuel which produces fewer greenhouses gases are biofuels like sunflower oil. However, as drought has become more prevalent due to global climate change, sunflowers have not been able to be efficiently utilized as a fuel. *Rhizobium* bacteria has been found to help symbiotically fixate nitrogen in the roots of plants. The increased nitrogen in the plant helps to absorb more nutrients and water allowing the plant to survive better and longer in conditions of non-drought and drought. Sunflowers were inoculated with *Rhizobium* bacteria then grown and finally subject to drought stress. The leaves of the sunflower were measured for chlorophyll content using a modified version of Hiscox JD & Israelstam, GF chlorophyll extraction process. The results did not show a significant increase in chlorophyll content in inoculated sunflowers but did show an increase in height and a shorter period of growth in inoculated plants. Sunflowers can be used in areas susceptible to drought stress and those that also need alternative sources of energy. Sunflowers are not currently used as a form of biofuel due to the fact that they are not cost effective compared to other forms of oil (like those from soybeans). Sunflowers produce more oil than soybean oil but with the increase of drought tolerance, sunflowers may be more cost efficient in the near future.

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

PS EM EA

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Word Count

250

2019

Fair Category

LS

Project
Number

3033

Title: The Effect of Light Color on the Mass of Leafy Green Algae (*Ulva lactuca*) Eaten by the Periwinkle Snail (*Littorina littorea*)

Student Name(s): N. Mongillo

Abstract:

Studies show that environmental light color impacts marine organisms' behaviors, including food consumption. Studies also demonstrate that exposure to lighter shades of environmental color enhances growth. Therefore, this study examined the effects of light color on the leafy green algae consumption of the periwinkle snail under the guidance of a biologist at a research facility. The independent variable was the color of light snails were exposed to as altered by colored cellophane, and the dependent variable was the mass of algae consumed. Four groups of one gram of algae and four groups of fifteen snails were separated from each other. Organisms were placed in tanks, and each tank was wrapped in a different color of cellophane to change the inner light color, with the light source being natural light. Cellophane colors were red, green, and blue with clear as the control. After two weeks, the difference in algae mass from the start to end of the trial was calculated to determine food consumption. It was hypothesized that snails under natural light conditions would consume the most due to the fact that several studies found increased growth of organisms living under natural light or lighter colored environments; however, the results of the current study proved to be inconclusive as algae grew over the course of the testing. ANOVA testing run on snail mortality data proved to be insignificant. Thus, the research question was not answered, but there is more evidence to support the idea that snail grazing can stimulate algal growth.

**Technical Disciplines Selected by the Student
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Word Count

251

2019

Fair Category

LS

Project
Number

3034

Title: Establishing Limits of NAP Buffer eDNA Preservation under Extreme Conditions through Cell Quantification and the use of the Polymerase Chain Reaction

Student Name(s): R. Cohen

Abstract:

Efficient removal of invasive species occurs when they are detected early, otherwise they become difficult to remove and can have detrimental effects on their introduced environment. The use of eDNA sample analysis – a sample taken from the environment containing secreted DNA—allows for earlier detection.

However, eDNA samples are susceptible to degradation, which can cause false-negatives. Since freezing is not feasible for preservation in remote locations, buffers such as CTAB and Longmire’s have been shown to preserve environmental DNA samples for up to 150 days at room temperature. Recently, a less toxic NAP buffer has been shown to preserve DNA more effectively, however; prior to this research concerns existed as to whether it might inhibit the PCR reaction.

To determine whether NAP Buffer is effective for eDNA preservation and quantify a rate of eDNA degradation, human cheek cells suspended in water were used to mimic eDNA. Concentration of cells, temperature and exposure time were varied for the samples. A PCR reaction followed by gel electrophoresis revealed which samples were degraded past the point of detection. Based on the presence or absence of expected base pairs on the gel for each sample, it was concluded that NAP buffer is an effective preservative that does not inhibit the PCR reaction, and that increased cell concentration in the eDNA sample correlates with low degradation. Thus, the use of NAP buffer combined with highly concentrated cells in eDNA samples can greatly decrease the concern of false negatives due to degradation in invasive species research.

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

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Word Count

206

2019

Fair Category

LS

Project
Number

3035

Title: Flu Strain and Vaccine DNA Sequence Similarity and Its Effect On the Season's Outcome

Student Name(s): F. Smith

Abstract:

In the U.S. the flu season can be a dangerous time for those who are unvaccinated. However, it can also be dangerous even if you get the vaccine, despite the popular belief. Those who receive a flu shot can still be at risk of getting the flu, but the virus isn't obtained from the shot. The flu virus kills thousands every year, and there does not seem to be a steady trend that follows. Flu strains contain two proteins: hemagglutinin and neuraminidase. These proteins' DNA sequences were placed in software to be compared and to obtain a percentage of similarity between two sequences. Certain flu seasons were selected based on if the strains didn't have exact identical vaccines to treat them. These strains were tested to see if the statistical significance between the two were high or low, and were predicted to be lower in the years the flu season was considered severe or moderately severe. The data collected reflects that the base sequences do not seem to have an effect on the outcome of a season besides the 2009 swine flu pandemic. Sources suggest that the more moderately labeled seasons could be from the worsening of a spread, depending on how many people are unvaccinated.

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

EM CS EV

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Word Count

244

2019

Fair Category

LS

Project
Number

3036

Title: Clinicians' Opinions Regarding Using a Radio Frequency Identification-Based Device to Measure Gait Speed in Clinical Settings.

Student Name(s): S. Tavakoli

Abstract:

Population-based studies show that gait speed, or how fast someone walks within a certain distance, predicts important clinical outcomes in older persons (e.g., hospitalization, disability, mortality). However, gait speed is not routinely collected during office visits and it is unclear how physicians would use their individual patients' gait speed data to improve care. Building on an existing study indicating that Radio Frequency Identification Device (RFID) technology offers a feasible and valid means of assessing gait speed in a geriatrics clinic, we sought to determine if and how clinicians would utilize their older patients' gait speed data. A total of 36 primary care physicians (56% female; 25% non-white; ages 30-73; 75% board-certified geriatricians) completed a brief, anonymous online survey. The majority (64%) do not regularly assess patients' gait speed, with lack of time and the need for examiner training reported as barriers. Yet most (68%), believe the RFI device would be a useful way to assess patients' gait speed and they would use this information to determine if a patient's physical function has changed, to plan appropriate treatment or to compare a patient's gait speed with national age/gender norms.

Clinicians generally believe that it is important to assess older patients' gait speed during routine office visits, but barriers often preclude assessment. RFID technology may offer a way to overcome barriers to assessing gait speed in clinical practice and may provide clinicians with important data that can be used to optimize treatment.

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

BE ME AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

204

2019

Fair Category

LS

Project
Number

3039

Title: Does the Type of Tourniquet Effect how Fast Blood Flow is Stopped?

Student Name(s): V. Porcaro

Abstract:

The purpose of this project is to see what Tourniquet will slow down the flow of the "Blood" in the fastest time. The hypothesis was that if the CAT Tourniquet is the most effective tourniquet then it should stop the flow faster because it's the most commonly used tourniquet for Paramedics Police Officers and EMT's. This hypothesis was unsupported because no tourniquet stopped the flow of "blood". All of the tourniquets maxed out at 3:00 minutes, some of the tourniquets put way too much pressure and cut the pork in half, and the other ones could not hold constant pressure. Even though the "blood" flow was not stopped it was noticed that some of the tourniquets could not hold a constant or steady pressure. The experiment showed no tourniquet was more effective than the other. Another big issue was that when somebody applies a tourniquet the Arteries/Veins are right next to bone. This means the tourniquet applies pressure to the artery forcing it into the side of the bone. If the experiment were to be repeated a cut of meat that has a bone in it might be preferable. In any emergency situation anything you can use to stop the blood flow is beneficial.

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

ME EN

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LS

Project
Number

3040

Title: Designing a Metal Organic Framework-Nanocapsule for delivering hydrophilic drug cargo

Student Name(s): C. George

Abstract:

Nanotechnology is a new way to deliver drugs to cells. However, most nanocapsules are formulated to carry hydrophobic drugs. Metal-organic frameworks are made from metal ions and organic linking groups. They have limited preference to solubility so they can deliver many different drugs. The question is if metal-organic frameworks can act as nanocarriers for hydrophilic cargo and effectively deliver drugs to targeted cells. In our study, we synthesized the nanocapsule with zeolite methylimidazole, a metal-organic framework made from zinc ions and 2-methylimidazole, or ZIF-8 MOF. In the MOF we incorporated a dye to act as a drug. We encapsulated the MOF in a crosslinked micelle called a nucleic acid nanocapsules, or NAN, made with single stranded DNA and peptides. Next, we analyzed our products. We used various characterization techniques to synthesize, characterize and image. In the study, we proved that we can make the ZIF-8 MOFs successfully. We also proved that the nanocapsules can open in a low pH and with an enzyme activator like they would in a cell. This showed that the nanocapsule shell and the MOF can be opened separately which demonstrates that the nanocapsule has the potential to deliver drugs to targeted cells. However, it still must be proven that the nanocapsule can successfully travel into cells and accurately deliver the drugs without harming healthy cells. Further, it must be proven that a drug will act the same as the dye in the particle to ensure the nanocarrier will be successful.

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

BI CH

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- Yes No

CSEF Official Abstract and Certification

Word Count

226

2019

Fair Category

LS

Project
Number

3043

Title: Antibacterial Properties of Lavender Terpenes

Student Name(s): G. Martin, G. Martin

Abstract:

Terpenes are naturally-occurring compounds found in all plants, giving them their flavors and smells, as well as being a natural defense mechanism to the weather and pests. Along with this, terpenes afford plants and herbs many of their medicinal properties. The goal of this project was to isolate terpenes from lavender and determine their antibacterial effectiveness towards safe relatives of the human ESKAPE pathogens.

Lavender was grown from seed under grow lights in potting soil. All plants were germinated from the same batch of seeds under the same conditions. Once mature, plants were transplanted to their own sections in the seed tray. Terpenes were extracted from homogenized plants using ethyl acetate, acetone, and methanol. Thin Layer Chromatography (TLC) was performed on the extract in comparison to standards of the major terpene components of lavender essential oil (linalool, limonene, linalyl acetate, and a-pinene) and stained with standard p-anisaldehyde TLC stain. Terpene standards and extracts were also used in a paper disk assay against the following safe relatives of the human ESKAPE pathogens: E. coli, B. subtilis, A. baylyi, E. aerogenes, P. putida, S. epidermidis, and M. smegmatis, to determine their antibacterial activities. During the period of time in which the plants were growing, the tests were performed on extracts of French Lavender, and isolates of the terpenes linalool, limonene, linalyl acetate, and a-pinene.

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

PS MI CH

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- Yes No

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Word Count

254

2019

Fair Category

LS

Project
Number

3044

Title: The Effect of Sucrose on Inhibition of Pigments in Invasive Arctic Ice Algae

Student Name(s): J. Milidantri

Abstract:

Red algae is a newly-discovered issue plaguing Arctic ice such as that found in Greenland. Photosynthetic algal blooms, “red tides”, grow in the summer and produce a biological sunscreen to protect themselves. The ability of ice to reflect light, its albedo, is hindered by the algae’s sunscreen. Less reflection leads to more light absorption, resulting in heat which increases the rate of ice melting. A mixture of pigments found in red algae—primarily chlorophylls a and b, and beta carotene—were tested to inhibit their ability to absorb light and sustain the algae. This was done by extracting the same pigments found in freeze-dried spinach, a simpler process. Pigments were extracted using 80% acetone and emulsified freeze-dried spinach in Petri dishes, sitting for 24 hours. Sucrose solutions of 0.01, 0.1, 0.2, 0.3, and 0.4 molarity were mixed with the liquid pigment extracts, of which the spinach leaf remains had been filtered out, incubating in the dark for an additional 24 hours. Sucrose was chosen for its non-toxicity, availability, and the fact that it, in older studies, inhibited the photosynthesis of some other plants. A spectrophotometer was used at nanometers 350-700 with 50 nanometer intervals. The smaller the value of absorption, the more inhibition; this is because less light is being absorbed by the pigments, meaning they are less effective at doing their job. The results proved that sucrose is effective in inhibiting the pigments found in red algae. Math modeling was calculated to show that as molarity increases, inhibition increases.

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

EM CB MI

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- Yes No

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2019

Word Count

144

Fair Category

LS

Project
Number

3045

Title: Phytoremediation of Lead-Contaminated Water by Sunflowers

Student Name(s): L. Doyonnas

Abstract:

The objective of this study was to test how phytoremediation plants clean up water contamination and to measure the rate of lead consumption (1). We used sunflowers, which are well-known phytoremediation plants, and grass which is known to be unsuitable for phytoremediation. To measure the effectiveness of phytoremediation, we observed four containers with lead-contaminated water: container A: Sunflowers with EDTA, container B: Sunflowers, container C: Grass, and container D: No plants (The control). There are concerns in the lab such as the disposition of the plants that absorbed the heavy metal, and the efficiency of the absorption. We concluded that the sunflowers were very successful at removing lead, especially with the addition of EDTA. However, during the experiment, the lead disappeared in all containers contrary to our expectations. This disappearance may have been caused by the rocks and bacteria in the water.

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

EM PS EA

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- Yes No

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Word Count

244

2019

Fair Category

LS

Project Number

3046

Title: Sleep Deficiency among High School Students

Student Name(s): Y. Wang

Abstract:

Introduction:

High school students who do not get enough sleep have a higher risk of obesity, diabetes, injuries, poor mental health, and problems with attention and behavior.

Objective: This study aims to examine the predictors of enough sleep (8 hours) on an average weekday night using logistic regression.

Methods: Youth Risk Behavior Surveillance System (YRBSS) 2017 data were used for this study. Logistic regression was used to assess the predictors.

Results: About 24.8% of 6979 high school students had 8 or more hours of sleep on an average school night. On average, the students in the higher grades were less likely to have enough sleep. Asian students were less likely to have enough sleep compared to American Indian or Alaska native. Compared to the students who have never had a drink of alcohol other than a few sips, students who started drinking at 8 years old or younger were less likely to have enough sleep. Compared to the students who have never had marijuana, students who started it at 14 years old or younger were less likely to have enough sleep. Compared to the students who were very underweight, students who have normal weight or overweight were more likely to have enough sleep.

Conclusions: In this study, we identified several important predictors for enough sleep (8 hours) on an average weekday night e.g., race, grade, drinking, marijuana use and weight. This provided important information for educators as well as parents provide timely intervention.

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

BE MA

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228

2019

Fair Category

LS

Project
Number

3047

Title: The Effect of Fertilizer Application on the Nutrition of Kale Plants as Measured in Brix and Visible Growth

Student Name(s): E. Lerner

Abstract:

The purpose of this experiment was to test the assimilation of fertilizers on plant nutrition, particularly as it pertains to urban or at-home gardeners. To study this two test groups of kale plants were grown with different fertilizers. In addition, a control group and various commercially grown kale plants were tested. Kale was tested because of its public popularity, status as a superfood, high nutrient levels, and resiliency to cold weather. Plant nutrition was measured using a Brix refractometer and visible growth was recorded. The plants were grown in crates initially outside and then in a greenhouse. They were watered and weeded as necessary. Fertilization was completed every two weeks in accordance with the instructions on the fertilizer's packaging and testing was completed every two weeks. Overall, the water-soluble fertilizer was the most beneficial to the plants. The plants treated with this fertilizer had the highest average increase in Brix levels (1.73) and the highest average final visible growth (3.33). This indicates that, despite its documented resiliency, kale nutrition can be negatively impacted by low temperatures. It also shows further support for the water-soluble fertilizer because those plants' nutrition was most resilient to low temperatures. In addition, testing of commercially grown kale showed similar Brix readings with the experimentally grown kale of comparable age. This supports the viability of home-gardening as a vegetable source.

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CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LS

Project Number

3048

Title: The Effect of Ocean Water's pH on Asian Shore Crab (*Hemigrapsus sanguineus*) Growth

The Effect of Ocean Water's pH on Asian Shore Crab (*Hemigrapsus sanguineus*) Growth

Student Name(s): T. Barry

Abstract:

Ocean acidification is the process in which oceans become more acidic due to water absorbing carbon dioxide. Pollution has increased the amount of carbon dioxide in the atmosphere causing harm to various ocean species. With over 3.5 billion people relying on oceans for food, ocean acidification needs to be studied. How will asian shore crabs in long island sound be affected by the change in pH of the water? This study aimed to determine the effect of ocean acidification on growth of Asian shore crabs. If the pH of the water is below tolerable levels then the crabs will be unable to adjust and slow growth. The independent variable is pH of the tank. The dependent variable is crab growth. Juvenile crabs were collected from Hammonasset Beach in Madison, CT. Fifteen crabs were collected per experimental group with a carapace width of 6-10mm. Initial carapace lengths were measured and recorded. There were four experimental groups: 10 gallon tanks of different pHs (6.5, 7.0, 7.5, 8.2). Using a PROPER pH API chemical tank pH was maintained. Water at each pH was slowly introduced to crabs before they were added to the tanks. PH was monitored with strips weekly and new water's pH was calibrated before adding. Two grams of frozen chicken were put in each tank three times weekly. Weekly the carapace was measured to determine average total growth. Data was analyzed with an ANOVA test that compared the average growth in each experimental group. There was no significant p-value found.

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253

2019

Fair Category

LS

Project
Number

3049

Title: Sorption of Polycyclic Aromatic Hydrocarbon into 1,4 Bio-Derived Butanediol Bags in the Waters of the Long Island Sound

Student Name(s): Z. Shortt

Abstract:

By 2050, the amount of plastic in the oceans will equal the amount of fish by mass. Plastics are extremely harmful to marine life due to their tendency to absorb toxins and become consumed by marine life. When is microscopic size, these plastics are called microplastics and commonly consumed by fish due to being indistinguishable from plankton. The negative effects of bioaccumulation of plastics in marine life works its way up the food chain to every animals who consume marine life including humans. Mater-Bi, a bio-plastic created by Novamont, and used in plastic bags among other products is composed of the chemical 1,4 Bio-Derived Butanediol. This plastic is revolutionary due to a significantly lower carbon footprint than traditional plastics and the ability to fully compost. As Mater-Bi will most likely become more widespread, this research examines it's toxin sorbance. The Long Island Sound is where the majority of Fairfield County's oceanic plastic pollution will end up, making it an ideal testing location. The Polycyclic Aromatic Hydrocarbons(PAH) concentrations are extremely significant in the Long Island Sound. These toxins are carcinogenic, causing multiple types of cancers in both humans and marine life. To test for toxin, Beta-cyclodextrin was used to react with the PAH's, in control samples which were pure sea water, and in the samples which contained plastics. After the reaction, a mass spec was used to determine the light absorption of each solution after the reaction in comparison to sea water to measure differences in PAH concentrations.

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

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Word Count

249

2019

Fair Category

LS

Project
Number

3050

Title: Addiction and Regeneration in Planaria

Student Name(s): N. Annadurai

Abstract:

Addiction is a significant issue in society and many people die in its hands. It has harmful effects on the physical and mental health of the affected organism. The objective of this experiment was to observe the effect addiction to a particular substance had on the regeneration rates and chemical memory of planaria. Addiction can occur with many types of substances, which is why I used one from each classification: caffeine (stimulant), kava (depressant), and curcumin (anti-depressant). Each induces different effects on the human body and therefore, each also has a different effect on the regeneration of the planaria. The differences in the regeneration rates for each substance will be compared to the control to see which substance had the most effect. To test the chemical memory of the planaria, classical conditioning is used. This simulates addiction in the planaria before they are cut, allowing us to see if this can be remembered after being cut. Once they fully regenerate, the frequency of their display of the conditioned response will be compared to the control. This provides much insight into how these substances could affect stem cell regeneration. These cells are helpful because they act as a repair system in the body, but addiction is an additional factor that could affect the ability for these cells to function properly. At this moment, the delivering of our materials has been delayed, and the results are still inconclusive. However, in the upcoming months, final data will be taken and analyzed.

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

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Word Count

257

2019

Fair Category

LS

Project
Number

3051

Title: Comparing Methods of Measurement of Cell Signals in Macrophages

Student Name(s): N. Sudhir

Abstract:

Macrophages are the first line of defense in the the immune system. They detect and attack invaders, and release cytokines, or proteins, such as IL-12, to coordinate a more targeted attack with T-cells. Previous experiments have noted that when using single-cell microfluidic devices, a few individual cells secrete far more IL-12 than the rest, indicating the existence of “super-secretor” macrophages. To confirm that the macrophages are specializing, however, there should be data to reflect this using multiple methods of measurement. The purpose of this study is to find whether the two experiments best suited to confirm this, flow cytometry and fluorescence in situ hybridization, have comparable results. Each experiment uses different methods of imaging with different strengths and weaknesses in addressing the existence of super-secretors, but if the two methods show consistent and comparable results, they can be used in conjunction to confirm the phenomenon of macrophage specialization. The independent variable of this study is the type of experiment being performed, and the dependent variable is the resulting measurement and concentration of the IL-12 cytokine in the samples. It is hypothesized that the two methods will show comparable results. The method of the analysis for comparison between the two experiments will be a t-test comparing the proportions of cells deemed “super-secretors” by both methods of analysis. If these methods are comparable, they could be used to confirm the existence of super-secretors, which has broad implications in expanding our knowledge of the immune response system and cell communication.

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

CB MI

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

254

2019

Fair Category

LS

Project
Number

3052

Title: Developing a Functional Tracheal Replacement Graft: Studying the Effects of Graft Stiffness on Host Response

Student Name(s): S. Edelstein

Abstract:

The field of tracheal engineering has been struggling due to the need for a graft that integrates with the host without causing a strong immune response. A previous study (Zhao 2016) developed a tracheal graft that is biocompatible and that has mechanical characteristics that prevent collapse. However, such grafts showed stenotic narrowing of the graft when implanted in rats and monkeys likely due to the stiffness of the nitinol stent. This new study works to develop injection molded, rubber tracheal stents of varying stiffnesses that will elicit less of a stiffness-mediated response since it has been found that stiffness-mediated pathways (Hippo and TGF- β) contribute to this stenotic response. 2D studies on the effects of stiffness-mediated pathway inhibitors, Verteporfin and SB-431542, on pulmonary fibroblasts revealed a downregulation of myofibroblastic pathways, specifically the Acta2 gene, when cells were given increasing doses of Verteporfin and SB-431542. By evaluating the mechanical properties of these new graft stents, a range of tensile and mechanical properties within the range of native tissue was achieved. This will enable the study of the fibrotic response in vitro and in vivo using grafts of different stiffnesses, as well as candidate inhibitors to knock-down stiffness-mediated pathways of interest to evaluate their effects on overall graft failure. This will allow for the development of a tracheal replacement graft that will lessen the chance of acute host response and provide an improved tracheal replacement for the field in order to treat infection, cancer, prolonged intubation, or trauma injuries.

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

EN ME BI

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

270

2019

Fair Category

LS

Project
Number

3053

Title: A Rapid, Solar-Powered, Portable Breast Cancer Diagnosis via Salivary CA15-3 Detection

Student Name(s): H. Clausi

Abstract:

Over 252,000 women in the US are diagnosed with breast cancer (BC) annually; for 50,000 of these patients, the disease is fatal, making breast cancer the second leading cause of cancer death for women. Early detection and treatment are paramount, to increase the probability of recovery. Current BC detection often begins with radiological screenings, followed by a biopsy of the suspicious growth. All methods are costly, difficult, and highlight the need for a simple and rapid BC screening diagnostic. In this research, a solar-powered, rapid BC-biosensor was created, that is based on detection of elevated, BC-specific CA15-3 antigen in saliva. Using a dye-sensitized solar cell (DSSC) design, the light-accepting electrode was prepared by thermal deposition of TiO₂ (450°C) onto 2x2" FTO-glass, followed by 20 hours of sensitization in 1mM Nile-Red. The biomimetic, CA15-3 responsive counter-electrode was prepared by drop-casting 50µl of 50U/ml CA15-3 and 1ml pyrrole electrocatalyst onto a 2x2" FTO-glass, which was dried, and submerged in Proteinase-K (500µg/ml in PBS) overnight, to create the CA15-3 binding sites. The final CA15-3 sensitive, DSSC-BC biosensor was assembled with 100µL of I⁻/I₃⁻ electrolyte, and placed under constant 10lumen visible lighting for measure of CA15-3 concentrations in artificial saliva. In use, 100µl of saliva is added to the biosensor, and the response measured. When compared to addition of saliva without CA15-3, the response of the biosensor was linear (R²=0.98), from 58mV for 25U/ml CA15-3 (for a normal patient), 89mV for 30U/ml (indicative of early stage BC), to 125mV for 50U/ml (highlighting stage-IV BC).

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

ME BI EN

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

LS

Project
Number

3054

Title: Targeting T Cell Acute Lymphoblastic Leukemia with Peptides Derived from Centipede S.s. Mutilus Through Computational Modeling

Student Name(s): S. Johnson

Abstract:

T Cell Acute Lymphoblastic Leukemia (T-ALL) is a type of blood cancer with approximately a 25% 3-year survival rate. Current chemotherapeutic strategies have significant limitations, often causing severe side effects. To further improve accuracy of treatment, several key differences between healthy and malignant cells were identified, including increased expression of CD30, convoluted nuclear membrane, and phosphatidylserine on the outer leaflet of the cellular membrane. The Chinese red-headed centipede (*S.s. mutilans*) has been used for thousands of years to treat cancer in ancient Asia and was thus distinguished as a viable source for peptides. Spectral and other data was compiled from various sources. The data was then processed and visualized using bioinformatics software (ZIMM and VMD). Peptides of interest were selected based on physicochemical properties, including Scolorpedes I (SI), SIV, SV, SVII, 2M35, 2MUN, 6BI9 and 2MZ4. VCell and NueroGens software were used to determine if an interaction occurs between the membrane and peptides at 311.15 K. The program showed that peptide SVII effectively broke down phosphatidylserine by limiting the number of available calcium ions, and a decreased level of phosphatidylserine is known to signal and induce apoptosis in the cell. Additionally, it showed no hemolytic effect on healthy cells. Therefore, SVII is determined as a viable targeted therapy for T-ALL based on computational models. Many factors were considered to make the model as precise as possible, including pressure, temperature, and the surrounding environment. The results provide a valuable candidate for anticancer drug development and offer effective strategies for discovery.

**Technical Disciplines Selected by the Student
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ME AT BI

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

LS

Project Number

3055

Title: Oysters: The Forgotten Filters

Student Name(s): J. Tangari

Abstract:

A widespread problem is beginning to jeopardize many lives of organisms around the world. Due to harmful runoff (fertilizers and pesticides), many different bodies of water are becoming contaminated. This runoff often contains high levels of phosphates and nitrates. This can harmfully effect water quality, and subsequently, the life conditions of organisms within the water. Towns are spending millions of dollars building wastewater treatment systems to filter these harmful contaminates out; however, oysters are a cheaper/efficient alternative to building these complex structures. They're filter feeders, meaning that as they eat (breath in water); they filter out many particles and contaminates out of the water. In the experiment, known concentrations of each chemical (sodium phosphate and sodium nitrate) were added into a one-gallon tank and were tested over a span of nine days. It was hypothesized that the part per million level of each contaminate would decrease by at least a quarter of the preliminary levels. Over a span of nine days, the nitrate concentration decreased by seventy-five percent of the preliminary concentration and the phosphate concentration was completely gone. It was concluded that the hypothesis was supported. Both contaminates decreased by at least a quarter of the preliminary levels. The result showed rapid decline in both contaminates, but more specifically the phosphate, which was eliminated from the water. This showed that the oysters can truly filter many harmful contaminates out of water, which will help to create and restore flourishing ecosystems in many different bodies of water around the world.

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

BI AS EA

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

249

2019

Fair Category

LS

Project Number

3056

Title: A Bioinformatics study on the genetic mutations of the HFE gene in order to cure and suppress Hemochromatosis

Student Name(s): K. Gadhachanda

Abstract:

Hereditary hemochromatosis is a genetic disorder that causes iron accumulation in more than a million people in the United States. The purpose of this project was to understand and research methods that can possibly cure or effectively reduce iron accumulation in such individuals suffering from Hemochromatosis. This genetic disorder is commonly caused by two mutations in the HFE gene which leads to the defective protein Heparin, with the mutations occurring in two amino acids, Histidine at the position 63 and Cysteine at position 282 being replaced with Aspartate (H63D) and Tyrosine (C282Y) respectively. Histidine at position 63 plays a very important role in iron binding. Using Bioinformatic tools the sequence of Heparin was compared with its mutant and found to possess these two mutations. A comparative study between the structures of Heparin and the mutated protein H63D that does not have the imidazole ring of Histidine to which the Fe²⁺ binds revealed that losing the Histidine at position 63 affects Heparin and its capability to sequester iron from blood. Structures of other iron binding proteins like Ferritin and Transferrin that also bind to Fe²⁺ were also studied, and this structural data reveals the possibility of these proteins moonlighting to perform the function of Heparin, because Fe²⁺ binding in these proteins also occurs at the imidazole ring of Histidine. This bioinformatics exercise reveals that use of such moonlighting proteins could be one possible way to deal with hemochromatosis, other possible ways may include gene therapy via SNPs (single nucleotide polymorphism).

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

LS

Project
Number

3057

Title: Angina Diagnosis and Trends Analysis Using Machine Learning Techniques

Student Name(s): A. Sadlowski

Abstract:

According to the American Heart Association, angina is the most common symptom of coronary heart disease, affecting 17 million people in the US annually. Angina is a type of chest pain caused by the heart muscle not receiving an adequate amount of oxygenated blood, potentially signaling a heart attack. However, other less severe conditions can also cause angina-like pain such as heartburn or a pulled muscle. Currently, the diagnosis of angina relies on tests such as Electrocardiogram (ECG), cardiac catheterization or laboratory tests. They are expensive, invasive and time consuming. In this project, an innovative, cost-effective, fast way of using machine learning techniques to determine if a patient has angina through prediction algorithms, is proposed by using behavioral risk factors. A database of 1,558 records were used. Linear and nonlinear approaches of supervised classification models were designed to extract angina relevant factors. Upon assessment, the Support Vector Machines (SVM) model outperformed other models and gained over 85% AUC accuracy. This is the first study of angina diagnosis not involving any invasive medical tests, but with accurate prediction capabilities. The SVM classifier was then applied to diagnose angina using national and Connecticut referenced data for years 2014 to 2017. Additionally, statistical methods were developed to analyze angina trends for different age and gender groups based on predicted results. Both nationwide and Connecticut data proved that males are less likely to have angina compared to women. Meanwhile, Connecticut residents get angina at a later age compared to the national average.

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

ME BE AT

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

275

2019

Fair Category

LS

Project
Number

3058

Title: Crossing the Blood-Brain-Barrier using Melittin Encapsulated PLGA Nanoparticles to Target Lipid Simulated Cancer Cells

Student Name(s): A. Kim

Abstract:

Central Nervous System cancers affect thousands each year. Treatment is extremely difficult due to the selective permeation of the Blood-Brain-Barrier (BBB), which blocks >95% of molecules, negating passage of possible drugs and treatments for cancers, and many neurodegenerative and CNS diseases. Researchers have highlighted that melittin (a peptide found in honey-bee venom) can selectively disrupt cancer cells, based on the cell's lipid-bilayer composition. For normal cells, the aminophospholipid phosphatidylserine (PS) and phosphatidylethanolamine (PE) predominant in the inner membrane leaflet, while the outer membrane is composed of a phosphatidylcholine (PC) lipid bilayer. Conversely, for cancer cells, the outer membrane is composed of a PE/PS lipid bilayer, for which melittin is selective. This research developed a new melittin-encapsulated PLGA CNS-cancer nanotherapeutic, that demonstrated the ability to pass through a BBB model, and selectively disrupt simulated brain cancer cells. 80nm PLGA nanoparticles were synthesized using a double-emulsion procedure; 83 mg of these were submerged in .35mM melittin, producing melittin-encapsulated-PLGA nanoparticles (M-PLGA-NPs) of ~200 nm diameter. A combined Blood Brain Barrier Profusion/Electroformation Chamber was constructed for in vitro validation of M-PLGA-NP function. M-PLGA-NPs were loaded into a 2x4mm PDMS cassette containing a b-MVEC cell culture membrane BBB model. Movement of the M-PLGA-NPs through the BBB model was confirmed via FTIR spectroscopy. Once through, the nanotherapy entered the electroformation chamber portion, and disrupted previously created cancer cell giant-unilamellar vesicles (GUVs), made of PE/PS outer membrane bilayers. Selectivity of M-PLGA-NP disruption to cancer cells was confirmed, as the BBB-transported nanotherapy did not destroy normal cell GUVs.

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

ME EN BI

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

4. Is this project a continuation? Yes No

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

251

2019

Fair Category

LS

Project
Number

3060

Title: The Effect of Spatial Awareness on the Human Brain

Student Name(s): L. Lawson

Abstract:

The purpose of my experimental study was to report findings on the effect on the human brain amongst teens. I drew interest of the topic from an article that discussed the brain and how it handles perception as well as spatial awareness. My hypothesis states spatial awareness amongst teens would be low and a contributing factor would be the brain's attention span. In order to test my hypothesis, I created a forty-six second video prompting participants to count the number of times the feet of the individuals jumping in sync hit the floor. Throughout the video, distraction such as a dog and a mascot were placed to grab the attention of the viewers. Afterwards, participants completed a twelve question survey that highlighted different aspects of the video, including how many times did the feet of individuals jumping in sync hit the floor. I gathered that approximately forty percent of participants correctly answer the question. The majority of individuals (at least fifty percent) had some difficulty, but managed with the distraction to complete the task. My hypothesis did hold true with teens scoring low on the video testing their spatial awareness. This study of spatial awareness and attention span, applies to the epidemic of teen texting and driving. This study can contribute to how the brains of teen drivers function when prompted with driving, along with distractions such as stop lights, pedestrians, and phones. Generating more no hand devices such as bluetooth call can help lower the deaths from this epidemic.

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

CB

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

209

2019

Fair Category

LS

Project
Number

3061

Title: Deuterium Oxide (D₂O) on Maintaining Viability in Coliphage Bacteriophages under Low Temperatures to Model Live Attenuated Viral Vaccine Additives

Student Name(s): A. Morgan

Abstract:

Live attenuated vaccines are often not stable at normal temperatures, deteriorate quickly and become ineffective. The Ebola vaccine, rVSV ZEBOV, is one of these vaccines that is damaged due to the molecular movement of its storage solution and can only be stored for long periods of time at extremely low temperature such as -40 Celsius. A bacteriophage is analogous to the viral particles that are the vector bases for vaccines and is a good model for how an actual vaccine would react to its environment. Heavy water (D₂O) is composed of deuterium, an isotope of hydrogen that is twice as heavy, When viral particles are stored in heavy water this increased mass slows down the molecular speed of the water molecule, causing less trauma to the bacteriophage, increasing the amount of time the viral sample remains infectious. In this experiment, D₂O proved to be a more advantageous storage solution for bacteriophages that slowed the degradation of the infectivity titer to 6% that of deionized water and protected the qualitative health of the phage over time. Compared to normal deionized water, D₂O maintained viability in viral particles significantly better, showing that D₂O would be a promising additive to vaccine storage solutions that could extend their shelf life and raise storage temperatures.

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

BI MI ME

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

2019

Word Count

249

Fair Category

LS

Project Number

3062

Title: The Effect of Type of Stress on Academic Performance

Student Name(s): H. Qian

Abstract:

Education plays a large role in any person's life. However, what factors outside of school affect a student's performance?

It was hypothesized that a student who experienced more internal stress would perform better academically because they would be more focused on their personal growth. This year's research aimed to validate last year's study, which resulted in findings that correlated to the aforementioned hypothesis.

This research was conducted on 41 students from Trumbull High School ranging from 9th to 12th grade. Participants were distributed an online survey which gathered information on GPA, stressors, and stress type.

The results did align to the original hypothesis, as 68% of "A" students stated they experienced more internal stressors while only 55% of "B" students stated the same. Inversely, 32% of "A" students stated they experienced more external stressors while 45% of "B" students stated the same. Interestingly, 39% of all participants ranked insecurities (a type of internal stress) as their top stressor. This was the highest among the four types of stressors asked (sports, friends, insecurities, and physical health). However, 47% of "A" students stated that insecurities were their top stressor while only 30% of "B" students stated the same. C students made up 4% of participants and therefore was disregarded due to insufficient representation.

The study found that students who stressed more about internal stressors, specifically insecurities, performed the best academically. While results did support the hypothesis, a

Technical Disciplines Selected by the Student
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BE

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

237

2019

Fair Category

LS

Project
Number

3065

Title: Acid Rain Effects on Marigolds

Student Name(s): M. Moran

Abstract:

The effects of acid rain have long since been studied, discussed and worried about, especially since we have been the most prevalent cause of its presence. An understudied aspect of the impacts from acid rain, however, is the relative importance of which chemical species is in the rain itself. The decision was made to execute an experiment on a commonly grown flower, marigolds (*Tagetes erecta*), to see how it would react to the different concentrations of sulfuric acid, which was used to substitute the acid rain itself but still have the same effects as acid rain would. With knowing the effects of acid rain on cars, human, and buildings, these plants should slowly die at different rates depending on how much of the sulfuric acid concentration the plants are being watered with it. Throughout the experiment you saw the results of the hypothesis becoming true and showing that even the smallest amount of sulfuric acid, had a big impact on the plants. This meaning that if these small amounts of acid are harming a commonly grown plant, it is harming a lot more than just the plants around us. After running a replicated study a negative correlation was found between the concentration of sulfuric acid and the height of the plant after 4 weeks. This shows that we need to start investing more money into solutions for reducing the amount of acid rain that we are causing.

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

EM PS EV

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LS

Project
Number

3066

Title: Association of Tachycardia in Academic Performance in Youth

Student Name(s): M. McHale

Abstract:

Throughout the schedule of a student, elevated and decreased heart rate are experienced as a result of the stimuli experienced in each class. This project serves to show a relationship between tachycardia or bradycardia and an increase in student performance, measured through changes in the GPA. An increase of stimuli in class, which can be implemented through tests, presentations, or other stressful situations, is likely to show a heart rate that is well above the 60-100 beats per minute range of 15-18 year old. Data is gathered via personal heart rate monitors (FitBits) as well as a daily questionnaire. Through a week-long study, the resting heart rate of each participant can be determined and then used to compare against their heart rate during class hours. It's expected that a consistently higher heart rate will happen during classes that the participant has a higher grade relative to their GPA. Although stress, seen through tachycardia, has negative effects on performance and health, this is a result of constant mental engagement with the student. Bradycardia, which is evident when the student is not engaged or being challenged, is predicted to be associated with classes that receive grades lower than the individual's GPA. Also, by filling out daily surveys used to measure the influence of outside stressors, other variables will be taken into account. The results of this study will give both teachers and students an increased understanding of the type of classroom experience, either strenuous or subdued, that yields the best academic performance.

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

ME

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

LS

Project Number

3067

Title: What is the Effect of Heavy Metals on Plants?

Student Name(s): K. Nadama

Abstract:

Has the question ever crossed your mind on why a plant that grows well in one environment might not grow well in another? Well this is due to plants being adapted to their specific environment at which they grow best in. Various plants are even adapted to in some amounts, to toxic heavy metals. In my project, I tested the effect of heavy metals on plant growth. The hypothesis is, if the plant is adapted to colder climates, then it'll be genetically resistant to heavy metals because it's adapted to a harsher environment. For the heavy metal, I used nickel in the form of nickel sulfate. Use of those plants were inspired by Mendel's work. The 3 plants used were basil, garden cress and peas. The nickel sulfate was mixed into the water and put in a leak-proof glass container. The plants were grown from the 8th of January to the 26th of 28th of February, a month. The garden cress, grew a total of 3.2 inches, the basil grew a total of 4.5 inches and finally, the peas grew a total of 6.03 inches. These results prove the hypothesis of if the plant is adapted to a colder environment then it'll grow faster. Complications that happened in the experiment include that the plants weren't grown for long enough to show significant differences in height. If the project were to be performed again, then I would start the experimental process earlier to allow the plants to grow.

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

BI PS

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

LS

Project
Number

3068

Title: Oil Spill Bioremediation

Student Name(s): A. Boudreau

Abstract:

I am doing this for a project because oil spills that occur in marine and fresh water environments are harmful to the organisms. I wanted to research at which temperature bacteria would be most beneficial to degrade oil and allow marine organisms not to be harmed. My hypothesis is that the room temperature environment will be best. I filled 4 tubs with salt water. I added 4ml of oil into the tubs and came back the next day to add 1ml of bacteria solution and the brine shrimp into the tubs. Tub 4 would be in the incubator for 30 degrees Celsius, tub 2 refrigerator for 20 degrees Celsius, tub 1 at room temperature and tub 3 with ice in it at room temperature. I would then observe how many brine shrimp are still alive. My results show that after 20 hours, all the brine shrimp in the incubator had died. The container with the ice dropped from 20 brine shrimp to just 2. Room temperature also dropped down to 3 while the refrigerator only dropped to 14. At 48 hours, the refrigerator container lost 2 while all have died in the ice and only 1 was left alive in the room temperature. The last day of data shows that only the brine shrimp in the refrigerator were alive with a total of 8 remaining. My results show that my hypothesis was proven wrong. Instead of the room temperature being the best it was the refrigerator that worked the best.

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

EM EV MI

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

200

2019

Fair Category

LS

Project Number

3070

Title: The Correlation of Nitrogenous Species on the Aboveground and Belowground Biomass of *Spartina alterniflora* (common cordgrass) in a restored Salt Marsh, Barn Island, CT

Student Name(s): S. Bouchard

Abstract:

Salt marshes play a key role in maintaining the health of estuarine environments. They are facilitators of various nutrient exchanges such as nitrogen, sulfur, and carbon. The focus of this study is on nitrogen, which has been known to lower root mass. Nitrogen pollution, in the form of fertilizers and manure runoff, contributes to ocean acidification and eutrophication. In this survey, plant samples were taken from three different locations of a Connecticut salt marsh (Barn Island, Stonington) and weighed to determine the above and belowground biomasses. Pore water samples were taken and analyzed for ammonium, nitrate/nitrite, and total nitrogen. The site that experienced the highest nitrogen levels (of 5.46 mg/L) showed higher root masses ($P=0.02$). The primary form of nitrogen was ammonium. This indicates that nitrogen species may be correlated to plant biomass. However; the results in this survey go against previous research, that Nitrate/Nitrite lower root mass and increase shoot mass. The sites with lower shoot nitrogen levels experienced lower root masses, while the site with the highest nitrogen levels had the highest root mass. In future studies, an in-situ study that investigates the correlation between nitrogenous species and plant biomass should be conducted.

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

EV EM EA

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

LS

Project
Number

3071

Title: Extraction of Environmental Deoxyribonucleic Acid and the Preservation of it in Silk Fibroin

Student Name(s): T. McKenna-Hansen

Abstract:

Every living organism leaves traces of DNA in the environment, or eDNA. eDNA can be extracted from the environment enabling the detection of a species, no matter its age, gender, or physical observation. eDNA can be equated to that of a fingerprint left behind by every species. This method of testing provides researchers with a safer, more reliable method of endangered species monitoring because the actual animal does not have to be present at the given time. Due to eDNA's rapid rate of degradation, it is proposed silk fibroin can stabilize and retain its structure. eDNA is obtained by filtering a sample of water through a .45µm pore size filter. 30µl of restriction buffer is added to the filtered sample before it is centrifuged for 3 minutes at 15,000 rpms, in which will produce a visible sample of DNA. From there it can be bound to silk fibroin, due to its flexible structure and easily manipulated format, by mixing them. Three water samples were filtered from different closed tank systems containing *Oreochromis niloticus*, *Gracilaria*, and *Homarus americanus*. These samples were tested on the Cecil CE 2041 in which each lambda max was found. Using the equation for DNA purity, it was found that each sample contained measurable amounts of DNA, with the *Homarus americanus* having the purest sample with a lambda max at 260 nm. This project proves the viability of the method, potentially aiding in future conservation efforts of certain animal species as well as possibly discovering new ones.

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

BI CB EM

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

199

2019

Fair Category

LS

Project
Number

3072

Title: Effect of C-Reactive Protein on the Development of Atherosclerosis in ApoE Knockout Mice

Student Name(s): B. Kerr

Abstract:

Heart disease is a serious health issue caused by atherosclerosis, extreme arterial plaque buildup. A possible cause for plaque buildup is inflammation due to C-reactive protein (CRP), which correlates with heart disease risk. To address this concern, I determined if the amount of plaque buildup in arteries depended upon CRP. To test this hypothesis, a mouse model of atherosclerosis was used in which the ApoE protein was knocked out; these mice develop severe plaque in arteries. I used three groups of mice to test this: mice with the ApoE gene knocked out, mice with CRP and ApoE genes knocked out, and control mice. After analyzing arterial plaque buildup of each group, CRP and ApoE double-knockout mice had significantly lower area of plaque than ApoE knockout mice. Additionally, I measured blood cholesterol levels of each group and observed no change between cholesterol in mice with CRP and the CRP knockout mice. This indicates CRP plays a significant role in the development of arterial plaque, the major cause of atherosclerosis. Additionally, the effect of CRP is likely due to reduced vessel inflammation, and not cholesterol. This research supports the possibility that blockade of CRP may reduce human heart disease.

**Technical Disciplines Selected by the Student
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ME AS

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- Yes No

CSEF Official Abstract and Certification

Word Count

227

2019

Fair Category

LS

Project Number

3073

Title: Bad to the Bone: A Study of Glutamate in Bone Broth

Student Name(s): N. Khanna

Abstract:

Many people drink bone broth for its many health benefits, such as its nutrient rich nature and gut-healing properties. While it has many benefits, one concern about bone broth is that it contains an unsafe level of glutamate. Glutamate is an amino acid that acts as a neurotransmitter, or a chemical that nerve cells use to send signals to other cells. Too much glutamate in a cell can cause over excitation and lead to cell damage. Bone broth also contains glutamine, which is an essential amino acid and is healthy. Glutamine is also the precursor to glutamate. In this experiment, samples of bone broth with different cooking times were tested for the amount of glutamate present in them. It was hypothesized that the amount of glutamate present in the samples would increase as the cooking times increased. After using a glutamine and glutamate determination kit and measuring the absorbency of the samples in a spectrophotometer, it was found that the amount of glutamate increased as the cooking times increased. This research can be used to inform people about which cooking times contain a safe and healthy amount of glutamate.

During this project, there were some difficulties. For example, the glutamate standards weren't linear like they are usually supposed to be.

In the future, this project can be continued by testing both the glutamate and glutamine levels.

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

ME BI CB

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- Yes No

CSEF Official Abstract and Certification

Word Count

212

2019

Fair Category

LS

Project Number

3074

Title: Using Personal Food Computers with AquaCrop to Increase Efficiency of Water Use in Agriculture

Student Name(s): S. de Lange

Abstract:

Inefficient water usage is a large problem with the growing human population. Over 60% of freshwater is used for agricultural purposes and by 2050, 67% of people are predicted to live in areas with water stress. Personal food computers (PFCs) may be able to decrease the amount of water used for agricultural purposes. PFCs are completely controlled environments for agriculture, meaning climatic variables including temperature, humidity, and CO₂ can be manipulated inside of the PFC. A drip system was built to control the amount of water used. AquaCrop, a software program used to help determine the amount of water used for plants in arid landscapes, was used to determine the amount of water used in the PFC and one outdoor plant. A third plant was grown outside and rainfed. The plants used were window box roma tomatoes. The tomatoes grown outside died as sprouts due to destructive weather and ice. Although the tomato plants in the PFC survived, they never grew tomatoes due to a lack of water. The dry biomass for the tomato plant grown in the PFC was 30 grams. It was determined that AquaCrop should not be used with PFCs to gain maximum water use efficiency because the PFC will retain too much water, therefore over watering the plant.

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

PS EA EM

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

LS

Project
Number

3075

Title: Combinations of Phloroglucinol, Kaempferol, 3,5 Dimethoxyphenol and 1,3,5 Trimethoxybenzene as Novel Treatments for Non-Hodgkin Lymphoma

Student Name(s): D. Zhou

Abstract:

Non-Hodgkin's lymphoma (NHL) is a common cancer, killing about twenty thousand people worldwide each year. Existing chemotherapeutic drugs have severe side effects and high cost, limiting their use on lymphoma patients. Many chemicals from plants have anticancer effect but never been studied for the treatment of lymphoma. My project aims to test if these chemicals can work to kill lymphoma cells individually or synergistically. Four of these chemicals, Phloroglucinol(PG), Kaempferol(KF), 3,5 Dimethoxyphenol(DMP) and 1,3,5 Trimethoxybenzene(TMB), were chosen in my experimentation. PG and KF were chosen because of their proven effectiveness in treating other cancers; DMP and TMB were selected due to their similar chemical structures to PG and KF. These chemicals and their combinations were treated on U937 lymphoma cells. MTT assays and cell attachment assays were used to determine the number of viable cells and metastatic ability after treatment and incubation. Significance of results were analyzed using T-test. ImageJ was used to take photos of chemicals and to analyze the proliferation. My test results indicate that all four chemicals have anticancer effects on U937 lymphoma cells; furthermore, combinations of the chemicals are more effective than individual ones. The combination of DMP + TMB at 0.2 μ M concentration was the most effective, blocking 70% of the cells versus 30% by individual chemicals. My next step is to test the effects of these chemicals with current chemotherapeutic drugs. These findings could lead to further investigation of anticancer effects of chemicals from plants, and potential development of alternative treatments for NHL.

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

ME CB BI

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CSEF Official Abstract and Certification

Word Count

235

2019

Fair Category

LS

Project Number

3077

Title: Chlorophyll Deficiency in Acidic Soils on *Eruca vesicaria sativa*

Student Name(s): O. Fassman

Abstract:

With the acidification of rainwater, *Eruca vesicaria sativa*, or arugula, is left vulnerable. Nitrogen oxides and sulfur dioxide are released by the burning of fossil fuels and in the atmosphere they react with oxygen and water, forming acidic pollutants. In this experiment, acidic solutions with pH values between 6.5 (control)-4.5 (based on varying pH values of rain around the world) were tested on arugula microgreens to simulate the acidification of soil as a consequence of acid rain. This experiment evaluated the effect of chlorophyll deficiency, caused by acid destroying chloroplasts, on the photosynthetic processes by measuring plant and root elongation. There was a statistically significant difference in total chlorophyll content between samples 5.5 and 5.0. However, in the elongation assessment, there was a statistically significant difference between samples 5.5 and 5.0, and 6.5 and 5.8 for height and root length, respectively. According to the analyses, arugula can survive at pH values of 6.5-5.5, but any acidity below that, growth is greatly impeded, despite the chlorophyll content only being significantly compromised below a pH of 5.0. Since elongation is a manifestation of the photosynthesis process, directly related to chlorophyll content, the data suggests that a pH below 5.8-5.5 (varying between measures) creates a chlorophyll deficiency in the plant, detrimental to the plant's photosynthetic processes. With photosynthesis inhibited, the plant is unable to survive, grow, and ultimately, produce the nutrients essential for human and animal life.

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

PS EV EA

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

LS

Project
Number

3078

Title: From Brown to Green: Sunflower Survival in Brownfields

Student Name(s): G. Galatioto

Abstract:

All across the world miles and miles of land are not being used. Brownfields take up a lot of land, but nothing can be done with that land because of the pollutants it contains. Phytoremediation, the direct use of plants to remove contaminants in soils, is a cost efficient way to remove pollutants and restore land. Sunflowers are a plant proven to be effective for phytoremediation. It was hypothesized that the sunflower seeds would not do as well in environments with higher concentrations of iron nitrate than they would in a controlled or low to medium iron nitrate environment. Six sunflower seeds were placed in bags with either a 100% iron nitrate solution, a 50% iron nitrate 50% water solution, or a controlled solution. After the experiment, the hypothesis was proven correct because only 2 of the 6 seeds germinated in the 100% solution and had a small average radicle length of 1.23cm while the sunflower seeds in the controlled environment had all 6 seeds germinate and had an average radicle length of 2.76cm. The seeds also did well in the 50/50 environment with 5 out of 6 seeds germinating and having an average radicle length of 2.45cm. Results show that sunflowers can survive in environments with low to medium concentrations of pollutants. This means that sunflowers could be used for phytoremediation in environments with low to medium concentrations of pollutants and areas of contaminated land can be restored and once again have a purpose.

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

EA PS

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

4. Is this project a continuation? Yes No

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

88

2019

Fair Category

LS

Project
Number

3079

Title: The Helping Hand

Student Name(s): S. Oak

Abstract:

In this project, a prosthetic hand was made to fit a model person. It's effectiveness was evaluated by its success in completing 6 different tasks. Suggestions for adjustments focus on making a stronger grip, since the design works well in lifting light weight items, but, heavy items and gripping tightly proved difficult for this prototype. The prototype was not even strong enough to open a door. A few ideas for a solution to this problem would be to make the fingertips stronger, by using better gripping dental bands.

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

EN ME EE

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

214

2019

Fair Category

LS

Project
Number

3080

Title: Stroop Effect

Student Name(s): G. Zeferino

Abstract:

The Stroop Effect is an effect that not many people know about. The Stroop Effect are psychological tests where instead of reading what the printed word says, you read the color of the printed word. For example, when you read the word, "Red" (colored in Red) it seems easy because the printed word itself matches the ink color. However, when you read the color of the ink in the word, "Green" (colored also in Red) it may be harder to comprehend, or take more time.

In this science experiment, I am investigating the Stroop Effect. My hypothesis will be that females will complete the stroop test faster and more effective than males.

I am testing ten female volunteers and ten male volunteers between the ages of sixteen and seventeen, to determine if gender affects the results of the Stroop Effect Test, and how. To do this, all volunteers will take two Stroop Effect tests individually. From there, I recorded the data onto my lab notebook, and determined if there was a drastic difference between the results of the males from the females.

In conclusion, I observed that the females completed the Stroop Effect tests faster. This related to other studies that showed that females read more efficient than males, and females comprehend better than males.

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

BE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

LS

Project Number

3082

Title: Analyzing the Environmental Effects of Solar and Wind Farms in the Gobi Desert

Student Name(s): A. Morgan

Abstract:

The purpose of this project was to determine the effect of solar and wind farms on the expanding Gobi Desert. It was hypothesized with the increase of solar and wind farms, the rate of desertification in the Gobi desert would decrease because these farms increase precipitation, which increases the vegetation in deserts, and therefore slows the process of desertification. Specifically, the wind turbines enhance the air's vertical mixing, bringing warmer air from above to lower levels. On the other hand, the dark color of solar panels absorb heat from the sun, instead of reflecting it like sand does in the desert. Both of these result in a decreased difference in temperature between higher and lower levels within the troposphere which causes increased precipitation. In order to test the hypothesis, an original weather model was written and coded in Python. Data to test the model was extracted from the Google Earth Engine. The model considered the inputs of surface temperature, number of wind turbines, and number of solar panels. A sensitivity analysis was then performed, changing the values of the number of wind turbines and solar panels to find the optimal combination of the two in order to decrease the rate of desertification most efficiently. Cost was also considered via an index. The data collected confirmed the hypothesis that an increase in solar and wind farms resulted in a precipitation increase in the area. The cost of these farms, however, outweighed the increase in precipitation after a threshold was reached.

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

CS EV EA

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

257

2019

Fair Category

LS

Project
Number

3084

Title: Utilizing a GFP to BFP Reporter Construct to Quantify Gene Targeting Efficiency

Student Name(s): J. Wu

Abstract:

To quantify the occurrence of homologous recombination (HR) to non-homologous end joining (NHEJ), a GFP to BFP reporter assay first reported in Glaser et al. (2016) was recreated and verified. Two LentiCRISPRv2.0 plasmids and two px330-mCherry plasmids were cloned, each containing either a gRNA sense or antisense sequence targeting nucleotide 196 in GFP. The LentiCRISPRv2.0 and px330-mCherry plasmids were transfected into 293T and U2OS cell lines that stably expressed GFP, causing the plasmids to create double strand breaks (DSBs) in the nucleotide sequence for GFP. A sequence for BFP homologous to the targeted section of GFP was co-transfected with the plasmids as a donor oligonucleotide. Repair of the DSB by NHEJ would lead to insertions/deletions and loss of fluorescence. Alternatively, repair by HR would utilize the donor oligonucleotide for BFP, facilitating the expression of BFP instead of GFP. A defective plasmid would fail to create a DSB and thus would not affect GFP expression. This color-coded system provided a simple method of differentiating between HR, NHEJ, and defective plasmids. Loss of fluorescence tests, where the plasmids were transfected into the cell lines expressing GFP but the donor oligonucleotides were not, were conducted to verify the effectiveness of the plasmids. Conclusive data collected through an EVOS microscope and flow cytometry showed a significant loss in GFP expression for the cell lines transfected with plasmids. Both the plasmids and donor oligonucleotides were then co-transfected into 293T cells. EVOS images showed GFP expression, BFP expression, and loss of fluorescence, verifying the reporter's viability.

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

CB BI AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

LS

Project
Number

3085

Title: Non-invasive, Early Detection of Invasive Ductal Carcinoma (IDC) via Deep Convolutional Neural Networks Using Breast Cancer Histology Images

Student Name(s): A. Murali

Abstract:

Breast cancer is responsible for causing the greatest number of cancer-related deaths among women, impacting 2.1 million women every year (WHO). Breast cancer is the most common form of cancer in women, with invasive ductal carcinoma (IDC) representing 80 percent of all breast cancer diagnoses. One way to reduce the number of deaths caused by breast cancer is to perform early diagnosis to detect the presence of a malignant tumor before it becomes too harmful. While there are several methods of diagnosing and testing a tumor, they all have their own sets of problems: they are time-consuming, expensive, and limited in their ability to diagnose a variety of tumors. Accurately identifying breast cancer subtypes is an important clinical task, and automated methods can be used to save time and reduce error, potentially saving many lives. This study presents a deep learning approach for automatic detection and visual analysis of IDC tissue regions in whole slide images of breast cancer. The approach is similar to how the human brain uses different interpretation levels of most representative and useful features, resulting in a hierarchical learned representation. These methods have been shown to outpace traditional approaches to challenging problems in several areas such as speech recognition and object detection. The deep learning framework used was a convolutional neural network (CNN). The model utilizes the Keras library to create the CNN and a dataset from Case Western Reserve University comprising over 270,000 images of patches of breast cancer specimens. The model achieved 88-90% accuracy.

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

CS ME AT

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CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

LS

Project
Number

3087

Title: Testing how Environmental Factors Affect the Decomposition Rates and pH levels of Common Household Materials

Student Name(s): A. White

Abstract:

A controversial topic that is constantly discussed is climate change. It's proven itself to be an issue that needs to be addressed. Having no silver bullet as a solution, minor successes can help in the upheaval. This experiment will test to find environmentally safe alternatives to recycling. Typically, waste is chemically broken down in landfills, that generate greenhouse gases. Often times recyclables are not accounted for, leaving them to be handled like other nonrenewable waste. In this experiment I tested to find the pH levels in compost as well as the decomposition rates of biodegradable materials including: paper towels, cardboard, and newspaper. I expected the compost that had added amplifiers would have the most acidic ph and greater decomp rate while the compost bin that was inside with no amplifiers would have a more basic ph and the least amount of decomposition. Several compost bins were placed in different environments to test how fast they breakdown biodegradable materials. Two of the compost bins were located inside while the others were located outside. Each of the one's inside and outside had amplifiers in them to increase the decomposition rate of the bins. The results collected from this experiment supported my original hypothesis, that the compost bin outside with amplifiers had the greatest amount of decomposition, almost double the composition rate of the compost with no amplifiers. This information can be applicable anywhere organic waste is produced by transforming it into a fertilizer and creating a new environmentally safe outlet for waste.

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

EV

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

LS

Project Number

3088

Title: Design of a Dual-Acting Riboflavin and UV-Enhanced Contact Lens Disinfecting System

Student Name(s): J. Speaker

Abstract:

There are currently 40 million contact lens wearers in the United States today that are susceptible to sight-threatening infections caused by microorganisms. There are a variety of chemical disinfection techniques that are commonly used, however, each type is problematic. The antimicrobial effectiveness of UV and riboflavin (vitamin B2) has been demonstrated in vitro and clinically, however it has yet to be demonstrated for contact lens disinfection. In this research, the feasibility of UV and riboflavin disinfection, as well as a prototype of a commercial device that is effective at sterilizing contact lenses is demonstrated. Cultures of *Staphylococcus aureus*, *S. epidermidis*, and *Pseudomonas aeruginosa* were established, and exposed to 365 nm UV light at a fluence of 9 mW/cm² for 10 to 30 min, alone and with 0.1% riboflavin. Bacterial killing by UV irradiation was greatly potentiated by the presence of 0.1% riboflavin. Killing of bacteria decreased with increased concentration of bacteria in suspension. Silicone hydrogel soft contact lenses were incubated with bacteria and recovery of viable bacteria from the contact lenses was reduced by 3 log units when exposed to UV in the presence of riboflavin. A commercial PuriLens® UV contact lens sterilization device was employed to evaluate killing of *S. epidermidis* in suspension, and the speed of bacterial killing was increased 3-fold by the addition of 0.1% riboflavin. Current investigation is focused on developing parameters for a contact lens disinfection device employing UV, riboflavin, and oxygen enhancement of the photochemical reaction.

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

EN ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

213

2019

Fair Category

LS

Project Number

3090

Title: Investigating Action Potentials of *L. terrestris* for Pharmacological Effects

Student Name(s): H. Kim

Abstract:

Vehicular crashes and falls are the most common reasons behind spinal cord injuries (SCI). These injuries boost physical and emotional distress alike. However, an optimal animal model for studying SCIs has not yet been established. This study attempted to investigate effectiveness of *Lumbricus terrestris* as an appropriate animal model for studying SCIs by examining three criteria: reproducibility, sensitivity, and specificity. It was initially hypothesized that *L. terrestris* would fulfill the three criteria. Controlled amounts of pharmacological solutions of alcohol, acetylcholine, or lidocaine were injected near the ventral nerve cord of *L. terrestris* under anesthesia, and the action potentials were acquired subsequently. The action potentials were triggered with electric stimulation and analyzed with derived parameters such as latent period, wave width, peak point, trough point, and area under the curve (AUC). While the study showed that *L. terrestris* fulfilled two of three criteria — reproducibility and sensitivity — it did not fulfill specificity, which disproved our hypothesis. Compared to prior research about the effects of the tested drugs on the action potentials of established vertebrate animal models, the results of this study mostly demonstrated significant differences, making it difficult to conclude that *L. terrestris* can show the unique characters of each drug with regards to action potential. Further study might be needed with other neurologic drugs.

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

ME EN AS

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- Yes No

CSEF Official Abstract and Certification

Word Count

220

2019

Fair Category

LS

Project Number

3091

Title: The Effect of Different Atmospheric Temperatures on Rhanus Rhanistrum

Student Name(s): Z. Verraneault

Abstract:

Plant growth can be greatly impacted due to atmospheric temperatures. Most plants typically prefer to grow in an 18° to 25° degree Celsius environment. The focus of this experiment was to observe different atmospheric temperatures affect how Rhanus rhanistrum crops grow. The expected outcome for the experiment is for the higher temperatures (24°-27° Celsius) to promote plant growth while the plants enduring colder temperatures will be negatively impacted and have lower growth rates because of the cooler temperatures. Five sets of fifteen radish plants were grown in 5 different atmospheric temperatures (18° C, 21° C, 24° C, 27° C, and a varying outdoor temperature) for three weeks. The plants were watered 3 times a week and measured at the beginning of each week. The data showed an optimal growth rate at an atmospheric temperature of 24° C. At this temperature, the plants grew an average height of 10.1 cm and showed no signs of leaf decay or wilting. Radish crops could be favorably grown in locations that range within the 24° C zone. Some states that meet these requirements are Ohio, Indiana, and Kentucky which range from 20° C to 24° C in the spring and summer months. Cultivating radish crops in these locations would allow for maximum plant growth and potential boost agricultural profits made by these plants.

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

PS

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

269

2019

Fair Category

LS

Project Number

3093

Title: Magnetically-Positioned, Lipase-Induced Degradation of Arterial Plaques with Simultaneous Smartphone Detection of Post-Dissolution Products

Student Name(s): H. Hussain

Abstract:

Coronary artery disease (CAD) is currently the leading cause of death worldwide. Current methods of treatment for CAD include bypass surgery and medications to manage the condition.

Therefore, a simple, inexpensive, and effective treatment is needed to manage the disease in its

earliest stages. Of late, Fe-3O₄ nanoparticles have gained notoriety as motorized nanocarriers for targeted therapeutics. Concurrently, human pancreatic lipase is known to break down digestive

fats, and may provide an opportunity for in situ arterial plaque degradation. This research seeks

to create a motorized, easily maneuverable Fe-3O₄ -lipase (LM-NP) therapy to remove arterial blockage, with immediate detection. Human pancreatic lipase was first loaded onto 10-30nm Fe-3O₄ nanoparticles via a chitosan binding layer, resulting in 400nm motorized therapeutics, that deliver 3µg-lipase/mg-Fe₃O₄ in only 15min. For in situ sensing of lipase release, and subsequent dissolution of LM-NPs in the bloodstream, a magnetic-sensing filament (MSF) was created by embedding magnetite within a conductive carbon thread. Exposure of a 4cm thread-tip to 2mg

Fe-3O₄-NPs decreased thread resistance from 98 to 93Ω, increasing the current drawn from 43 to

46mA. In the final sensor design, 25cm MSF is integrated into an NFC-tag, which is read by a new Smartphone-app. In simulation, 2mg of 3µg-lipase/mg LM-NPs were magnetically inserted

into an artery-model containing triglycerides. When compared to normal pH conditions, current

Technical Disciplines Selected by the Student
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ME EN AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

197

2019

Fair Category

LS

Project
Number

3095

Title: Determining the Potential of an Encapsulin-Ferritin System as a Reporter for Magnetic Resonance Imaging

Student Name(s): K. King

Abstract:

There is a lack of noninvasive reporters and contrast agents for magnetic resonance imaging (MRI). One common reporter is ferritin (i.e. human ferritin) due to its biocompatibility and containment of iron oxide ions, but the recent discovery of encapsulin in bacteria and archaea identifies a much larger protein nanocompartment. To test if an encapsulin-ferritin system can be formed we transduced *E. coli* with an empty vector (Puc19), a vector containing encapsulin and GFP (GFP-CLP30-Enc), and a vector containing encapsulin and ferritin (hferr-CLP30-Enc). This allowed us to observe and further support the concept of linkage to a C-terminal loading peptide (CLP) allowing for foreign loading in encapsulin. Supplementation of samples' environments with iron also allowed for observation of iron loading, the rate of which was then compared between the cells. The encapsulin-ferritin system's potential, as supported in this experiment, for increased iron loading suggests it could be an alternative option as a reporter for MRI, which would expand the field and have implications in both research and in medicine as does the supported potential of encapsulin to bind to a variety of proteins so long as they are linked to CLP.

**Technical Disciplines Selected by the Student
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CB BI

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CSEF Official Abstract and Certification

Word Count

215

2019

Fair Category

LS

Project
Number

3096

Title: Determining the Role of β -Carotene on the Circadian Rhythm of *Neurospora crassa* Relative to the Prevention of Parkinson's Disease

Student Name(s): B. Learnard

Abstract:

Parkinson's Disease (PD) is a progressive neurological disease resulting from the degradation of dopamine. PD affects both motor function and cognition over time. Patients may experience mood disorders, sleep abnormalities and autonomic system failures. There is no cure for PD patients and the current treatment drug, Levodopa, can have long term effects such as dyskinesias and circadian rhythm oscillation dysfunction. Early treatment is critical to ensure stability for patients in order to obtain long term high functionality. Maintenance of the circadian rhythm prolongs neurological function and motor function. Antioxidants limit destruction from free radicals, that damage cells, resulting in both aging and illness. *Neurospora crassa* has been used as a model organism for circadian rhythms in past scientific research. *Neurospora crassa* treated on petri dishes with a control, 2.5 ppm, and 5 ppm concentrations of Sabouraud dextrose agar and Beta Carotene all spored 24 hours after plating. Upon forced oxidation, the treatment with a concentration of 2.5 ppm, had a circadian rhythm that was regulated to a sporing time of 18 hours after plating. The decrease in sporing time, in the result of forced oxidized beta carotene, shows the necessary role of antioxidants on the regulation of circadian rhythm. Future applications would be used with higher doses of Beta Carotene and various ages of fungus.

Technical Disciplines Selected by the Student
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BI ME MI

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CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

LS

Project
Number

3097

Title: Centrosome Checkpoint in Dedifferentiated Stem Cells

Student Name(s): N. Patel

Abstract:

Germline stem cells (GSCs) of *Drosophila* male testis are used to study the behavior of human stem cells. These cells divide into two different cells where one remains a stem cell and the second is a differentiated cell. There have been cases, however, where this differentiated cell becomes a stem cell, again, in a process called dedifferentiation (Inaba, M., Dr., & Yamashita, Y. M., Dr., n.d). It is not known if this cell will behave the same way a regular GSC would (Venkei, Z. G., & Yamashita, Y.M., 2015). This project aimed to find if one factor, the centrosome checkpoint, that GSCs possess is also present in cells that dedifferentiate. This checkpoint prevents the cell from dividing uncontrollably and possibly creating a tumor (Knoblich, J. A. 2010). We used green fluorescence protein (GFP) to tag cells that have dedifferentiated and a colcemid treatment to misorient the centrosomes in all GSCs of the testis. With antibodies, we stained mitotic cells to mark cells that skipped the correcting its centrosomes' positioning and moved on to mitosis. Comparing the rate of mitotic cells in GFP negative to positive cells allowed us to see if dedifferentiated cells possessed a centrosome checkpoint or if they moved on to the mitosis. We concluded that these dedifferentiated cells do not possess a centrosome checkpoint as the mitotic rate was higher in GFP positive cells than negative cells. This was because the rate of cells moving on to mitosis was higher in dedifferentiated cells than regular GSCs.

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CB MI

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CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

LS

Project Number

3098

Title: Using Artificial Neural Network Machine Learning Algorithms to Detect Melanoma Skin Lesions

Student Name(s): K. Tenerowicz

Abstract:

Melanoma is characterized as the most aggressive type of skin cancer, though an early diagnosis and subsequent treatment has a 99% survival rate. One of its hallmarks is an abnormally shaped skin lesion. As these lesions are often confused with benign moles, it would be greatly beneficial to identify whether each one is malignant. Thus, a supervised machine learning artificial neural networking system was coded using Python to classify skin lesions. The program used TensorFlow to calculate the numerical value of each node and connection. The program was trained using data from 550 skin lesion scans. It implemented a form of backpropagation: the delta rule. Using this, the error of each node's weighted outputs approached a global minimum. After this initial training, the testing phase was run with 225 lesion scans where the program classified each image on its own as benign or melanoma. It was then analyzed by comparing its accuracy to other programs with established degrees of accuracy. Because the program correctly identified 88% of the lesions as malignant, the program was deemed successful and the difference between this and the average success rate of the other programs was found to be insignificant. Results may be useful in helping identify the characteristics of a melanoma and providing medical experts with objectively categorized images. Future developments may look into tracking the advancement of the lesion over time. Research on this engineering project will be guided and supervised by Dr. James Duncan from Yale University.

**Technical Disciplines Selected by the Student
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CS ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

LS

Project
Number

3100

Title: The Effect of Seasonal Temperature Variation on Phytoplankton Biomass

Student Name(s): A. Paliwal

Abstract:

Phytoplankton are important to marine and coastal ecosystems due to the role they play as primary producers and their role in nutrient cycles. Since phytoplankton have a large impact on the health of these ecosystems, their biomass can be used to evaluate the health of marine and coastal environments. This experiment aims to explore the impact of seasonal temperature variation of phytoplankton populations. The variables being compared are temperature and phytoplankton biomass which is proxied through chlorophyll A levels. It is hypothesized that temperature increasing and being sustained above 18.3 Celsius, which signals the seasonal shift to spring, will correlate with an increase in the phytoplankton community levels of Morehead City, North Carolina. This is hypothesized because photosynthesis processes ramp up in the spring which means that there should be an increase in the population of phytoplankton. The chlorophyll a data was collected by the mentor in this experiment and the temperature data was collected from a NOAA database. Excel was used to analyze the data. A graph was created and a T-Test was then conducted which resulted in a P-value of 3.08×10^{-6} that signified significant correlation of Chlorophyll A levels above 18.3 degrees being higher than those below. This signifies that phytoplankton levels will rise during warmer temperatures during spring and summer in marine and coastal ecosystems. When researching phytoplankton blooms, these conclusions give information on when they are most likely and can help provide more details about how phytoplankton are affected by global warming.

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

EV MI

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- Yes No

CSEF Official Abstract and Certification

Word Count

254

2019

Fair Category

LS

Project
Number

3102

Title: Investigating How Different Types of Milks Affect Dextrose Levels by Using an Enzyme Substrate Complex Assay

Student Name(s): A. Kabra

Abstract:

Dextrose levels have long been used to predict conditions in Homo sapiens such as hyperglycemia and diabetes mellitus because of the way glucose reacts in vivo. Dextrose is the name of a simple sugar and is biochemically identical to glucose, or blood sugar. Here, I investigate the impact of different milks on dextrose levels in an effort to control the amount of glucose in Homo sapiens who have conditions like hyperglycemia and diabetes mellitus. Reactions between dextrose (200 mg/dL of dextrose was added) and milks took place in transparent, plastic cups, with dextrose levels being evaluated using a glucometer and multiple test strips. Upon completion of the experiment, it was observed that all milks consumed some dextrose (which means that the net change in dextrose levels of the reaction was less than the amount of dextrose added to each milk). Additionally, it was observed that camel milk had consumed the most dextrose, only increasing the dextrose level by 20 mg/dL (for every 200 mg/dL addition). My results support the possibility that camel milk can reduce dextrose levels significantly, which has also been shown by previous studies. This explanation would imply that all milks (especially camel milk) contain a certain amount of insulin, which can decrease dextrose levels in humans and help control conditions like hyperglycemia/diabetes. Repeating the assay with RIA and more time would allow results to be more accurately characterized. Further research, such as investigating camel milk's antihyperglycemic properties (similar to insulin), would help build upon my research.

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

BI ME CH

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- Yes No

CSEF Official Abstract and Certification

Word Count

204

2019

Fair Category

LS

Project
Number

3103

Title: Effect of External Exposure of Low-Intensity Light on Breast Cancer Cell Proliferation With Plexiglass-Bead Radiation Absorption and Emission

Student Name(s): E. Ngo

Abstract:

The Resonant Recognition Model (RRM) states that an external electromagnetic field at a distinct activation frequency produces resonant effects on protein biological activity. Through two calculations involving Electron-Ion Interaction Potential and RRM Postulates, it can be concluded that the light emitting system used to irradiate the cells should be within the range of 3500nm-6400nm to demonstrate the proposed effects on proto-oncogenes. This study sought to modify current radiation therapy practices through the incorporation of plexiglass beads, a novel approach that disperses radiation more evenly amongst affected cells. Thus, optimizing the exposure presents a more effective approach to treat surface and near-surface tumors. As overexpression of the mdm2 proto-oncogene leads to a decreased expression of the p53 tumor-suppressor protein, it is common that this imbalance contributes to the development of cancer. From extensive research and warrant from the aforementioned calculations, it can be predicted that exposure of cancerous cells to light radiation of the specified range will reduce mdm2 proto-oncogene expression and will display an increase in p53 production. The findings of the research are still in progress. Further research will delve into the understanding of the overall effect and precise refraction of the plexiglass beads upon implementation.

**Technical Disciplines Selected by the Student
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CB ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

LS

Project
Number

3104

Title: Mobile Phone EMFs and Induced Acoustic Behavior of Apis Mellifera As Related to Colony Collapse Disorder

Student Name(s): Q. Mullineaux

Abstract:

The decreasing pollinator population poses an imminent threat to global ecological health. In this study, the effect of mobile phone induced radiation was tested on honeybees as a potential factor behind honeybee loss. To simulate a beekeeper with an in a pocket, a mobile phone was placed at varying distances from the Langstroth hive. Inside the hive, a high sensitivity microphone recorded the acoustic behavior of the honeybees for up to 10 hours. Recordings were taken on warm sunny days to avoid disturbances in the audio files associated with adverse weather conditions. For each audio recording Audacity was used to produce spectrograms and waveforms that uncovered trends in the hive's behavior. An acoustic signal called "piping" was emitted by worker bees during some trials to indicate distress. These graphs, alongside the presence of bee pipes, revealed that EMFs impacted the honeybee's behavior, specifically shown by the alterations in the frequency of their communication which dropped to as low as 250 Hz when the phone was placed in active communications mode, half of the normal frequency. It was also shown that the amplitude of the Honeybees' communication depended on the phone's proximity to the hive. The radiation emitted from mobile phones was minimal when compared to emissions from substations, power lines, or transformers, which often appear in close proximity to commercial and natural bee colonies. The results of this experiment suggest that these EMFs are a factor in the weakening the pollinator populations around the earth.

**Technical Disciplines Selected by the Student
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AS EV BE

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

276

2019

Fair Category

LS

Project
Number

3106

Title: Rapid, Low-cost, Felt-based Immunosensor for Early Detection of Dengue Virus via Salivary Dengue NS1 Antigen

Student Name(s): M. Jester

Abstract:

Dengue fever infects 400 million annually, where nearly 500,000 of those infected progressing into the often-fatal Dengue Hemorrhagic fever or Dengue Shock Syndrome. Fortunately, if Dengue is detected and treated in its earliest stages, the mortality rate can be decreased from 20 to <1%. Rapid Diagnostic Tests (RDTs) may allow for early detection and care-management of Dengue, controlling progression of the virus. The Dengue-NS1 antigen is present in all serotypes of the disease, and is the most promising diagnostic marker for such an RDT. To date, early detection systems for Dengue-NS1 have been developed, however they are costly, invasive, and cannot reliably detect NS1-antigen concentrations found in human serum. This research focuses on the development of a felt-based immunosensor, that can detect NS1 antigens simply from human saliva, using portable, flashlight-induced luminescence. A felt substrate is first functionalized with single-walled carbon tubes (SWCNTs) containing N-(3-Dimethylaminopropyl)-N'-ethylcarbodiimide hydrochloride (EDC). NS1 antibodies are then attached to EDC bonding sites, and act as receptors for NS1 antigens. In use, drops of saliva are added to this felt-SWCNT-EDC sensor, where NS1 antigens are captured. An anti-NS1 antibody-HRP conjugate is added, followed by the addition of 1mM DuoLux luminescent peroxidase substrate. Positive detection of 0.5ng/ml Dengue-NS1 (well below the 3.8ng/ml saliva-NS1 content needed for early detection) is realized by UV flashlight-induced, visible green-luminescence of the saliva-treated sensor. The immunosensor's visual response for saliva-NS1 was validated via surface-luminescence spectroscopy; response was linear with NS1 content ($R^2=0.98$), highlighting the sensor's reliability for early detection of all Dengue serotypes.

**Technical Disciplines Selected by the Student
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ME CH

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4. Is this project a continuation? Yes No

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- Yes No

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Word Count

147

2019

Fair Category

LS

Project
Number

3107

Title: Finding a Therapy for Wolfram Syndrome: Exploring a Calcium Signaling Pathway as a Target for a Disease Without a Cure

Student Name(s): S. Munshani

Abstract:

An aberrant interaction between wolframin and neuronal calcium sensor 1 (NCS1) explains the clinical implications of Wolfram Syndrome, an orphan disease without a cure. When wolframin, encoded by the gene WFS1, is mutated, this protein-protein interaction is disrupted. Using molecular docking platforms (PyMol and PyDock) I am able to show that these proteins nest so that the calpain cleavage site of NCS1 is protected by the N-terminus of wolframin. This in silico prediction was supported by the ability of a glutathione S-transferase tagged version wolframin to pull down NCS1 in a calcium dependent manner. Quantitative polymerase chain reaction (qPCR) with hepatocellular carcinoma cell lines demonstrated that expression levels of wolframin and NCS1 levels are coregulated. These results indicate that the functional expression and interaction of the two proteins plays a pivotal role in cell health and provides a pathway for targeting therapeutics to treat Wolfram Syndrome.

**Technical Disciplines Selected by the Student
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CB BI ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

255

2019

Fair Category

LS

Project
Number

3108

Title: Chirality of ClavA peptide may have effects on antimicrobial activity

Student Name(s): A. Radulescu

Abstract:

A surge in bacterial antibiotic resistance has created the need for revolutionary medicine. The application of naturally occurring antimicrobial peptides (AMPs), which allow all organisms to defend against pathogens, has provided some of the first steps down this novel avenue. In order to further the implementation of these peptides as novel antibiotics, we studied how amino acid chirality in one AMP could influence its antimicrobial activity. Previous studies suggest AMPs synthesized with non-natural D amino acids can show either improved or diminished activity when compared with natural L AMPs. This may be due to increased stability or different interactions with target molecules. Using the AMP Clavanin A (ClavA), found in the tunicate *Styela clava*, we examined the effect of both the L and D enantiomers on the survival of *E. coli*. We also applied this test to hRBCs to explore the cytotoxicity of the ClavA enantiomers. D and L ClavA showed no significant difference in their antibacterial activity, measured as the minimum inhibitory concentration. This may be due to a mechanism of action which is membrane-based or targeting some other molecule that lacks chirality. In contrast, when bonding Zn(II) to L-ClavA we see that there is a 16-fold decrease in MIC which is not reflected for D-ClavA-Zn(II). This drastic improvement in activity is often observed when the AMP has an internal target, most often DNA. This serves as a strong introduction to learning more about the effects that L and D ClavA have on human and bacterial cells.

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CB BI MI

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- Yes No

CSEF Official Abstract and Certification

Word Count

244

2019

Fair Category

LS

Project
Number

3110

Title: The Mystery of the World of Healing Herbs

Student Name(s): M. Chhatre

Abstract:

Herbs have been used for centuries by various cultures as a form of medicine. However, in today's world man-made antibiotics have replaced these ancient herbs as a more common mode of treating illnesses. These antibiotics usually come with a big price tag and numerous side effects. In this study, three herbs - cilantro, basil, and rosemary were investigated for their antibiotic properties. Based on published research with other herbs, the hypothesis guiding this experiment was that these herbs would express antibacterial properties. The bacteria used in this study was E. coli, with the disk diffusion method in which, sterile disks were soaked in an herbal extract and dried before being used for testing. The testing procedure included mixing E. coli into nutrient broth and spreading small amounts of this mixture on nutrient agar in petri dishes. Four such plates were used, each with varying concentrations of the herbs, and one positive and one negative control. The plates were examined after 24 hours and 48 hours of incubation at 32oC. All three herbs showed a zone of inhibition, leading to the conclusion that all three of these herbs possess antibacterial properties with cilantro and basil showing larger zones of inhibition, compared to rosemary. Future studies include finding out if these herbs are bacteriostatic or bactericidal in effect. Herbs are very accessible and by taking advantage of their antibacterial properties the common man could possibly prevent a trip to the doctors and save on expensive medicines.

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

MI ME PS

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CSEF Official Abstract and Certification

Word Count

236

2019

Fair Category

LS

Project
Number

3111

Title: Trx2 Deficiency Induced Impaired Mitochondrial Integrity and Adipocyte Dysfunction

Student Name(s): G. McGonagle

Abstract:

Previous research has been conducted studying the crucial role of the Thioredoxin-2 (Trx2) protein in the mitochondria, and the impacts of its deficiency through mutation. This research explores how those with a Trx2 deficiency mutation may suffer from mitochondrial dysfunction and Type 2 diabetes development.

Excess reactive oxygen species (ROS) have damaging effects, such as RNA and DNA damage, the oxidation of fatty acids and amino acids, and the deactivation of enzymes.

However, normally, the Trx2 protein prevents the production of excess ROS.

Adipocyte (fat cell) dysfunction is linked to Type 2 diabetes. In Type 2 Diabetes, adipocytes cannot control blood glucose balance through adipokine (cell-signaling protein) secretion.

Glucose cannot properly enter the cells, preventing energy production, causing insulin and glucose levels to rise in the blood, and leading to mitochondrial dysfunction and insulin resistance.

The samples were taken from two groups of mice: the wild type/control mice and the "Knockout" mice (TRX2 gene removed), with varying types of fatty tissue and age groups.

Both protein expression and mRNA expression were detected using Western Blotting techniques and real time Quantitative Reverse Transcription PCR (rt-qPCR), respectively.

Trx2 deletion resulted in decreased mitochondrial gene expression, Oxidative Phosphorylation dysfunction, impaired lipid metabolism and impaired adipokine secretion. Reduced expression of adipokines indicated an inability to properly control blood glucose balance. This mitochondrial and fat cell dysfunction suggests that Trx2 deficiency leads to Type 2 Diabetes development.

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

ME CB

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

258

2019

Fair Category

LST

Project
Number

3501

Title: The role of the prk-2 gene in cancer-related pathways in *C. elegans*

Student Name(s): D. Ladd, D. Jencks, A. Czech

Abstract:

Cancer is a mysterious and complex disease that strikes roughly 1,735,350 new people annually, ravaging through families. One pathway for cancer to develop is through defects in the pim-1 gene, which is normally responsible for cell cycle progression, apoptosis, and transcriptional activation. This gene often plays a role in different forms of leukemia and prostate cancer. Our project aims to explore the role of the prk-2 gene in *C. elegans*, which is a homolog of human pim-1. We used two strains of *C. elegans*, N2 (wild-type) as our control group, and a prk-2 knockout strain as our test group. These strains were subjected to assays to measure general health, including lifespan, fecundity, locomotion, and morphological observations. We then treated both strains of *C. elegans* with two concentrations of mitoxantrone, a common chemotherapy drug, an inhibitor of pim-1 in humans and measured its effects using the same assays. We found that the prk-2 knockout strain had decreased overall health, including a slightly lower fecundity of 7 vs. 8 eggs/hr in the N2 strain, disorganized egg cells, and misshapen prk-2 worm trails, but not a decreased lifespan. We also found that mitoxantrone had negative impacts on both strains, specifically decreased fecundity and lifespan. This work is the first reported characterization of the prk-2 mutant strain of *C. elegans*. It suggests that prk-2 plays an integral role in *C. elegans* health, and is also involved in cancer-related pathways. This work builds towards knowledge and future treatment for different cancers.

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

ME BI CB

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

LST

Project Number

3502

Title: Identifying Segmented Nuclei to Advance Medical Research Using Convolutional Neural Networks

Student Name(s): A. Hindy, T. Fouts

Abstract:

The objective of our project is to create a convolutional neural network that can detect nuclei in pictures of large amounts of cells in order to help doctors test the effects of drugs on these nuclei. The data set started with 600 images of segmented nuclei from muscle cells, nervous cells, and bone cells taken through a microscope at varying magnifications, reproductive stages, fluorescent and brightfield lighting. In order to accurately train and test the Neural Network, the data was augmented multiple times, using horizontal and vertical flips, angular rotations, gaussian blurs, inverted colors, and various other methods. These augmentations increased the size of the dataset to over 30,000. The data was resized to a standard 128x128 size, and fed into the neural network. After training, the data was processed further, with a one inch pixel border surrounding each image in order to prevent incorrect predictions with neighboring cells. The accuracy of the neural network was calculated for different weights and balances, allowing us to reach the conclusion that the eLu Neural Network yielded the most accurate results. The most accurate tests resulted in a 96% accuracy, proving that our neural network is statistically accurate compared to other state of the art models. It was concluded that our network produces results that are accurate in identifying images of cells in an image of a nuclei. Further study is needed to train and refine the network more, as well as finding a larger data set that would make training easier.

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

CS ME AT

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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

220

2019

Fair Category

LST

Project Number

3504

Title: Developing a Vertical Aquaponic Garden that is not Reliant on an Electrical Source

Student Name(s): S. Grott, J. Coleman, A. Toof

Abstract:

Aquaponic gardens have been around for a long duration of time, but also cost upwards of \$150. We plan to create a space-friendly aquaponic garden that will be able to provide nutrient-rich meals without the use of electricity and while not breaking the bank. By doing this, our goal is to be able to have an inexperienced person create meals, while also gaining experience in gardening. Living in an apartment, there is a restricted amount of electrical outlets, not to mention the lack of outdoor area to start a garden. The layout of the aquaponic system would be pleasing to the eye, while also putting a pet fish to use. We decided to germinate the seeds using a mix of water and hydrogen peroxide, which aims at speeding up the growth. We had two techniques which included starting them in conical tubes in moist kimtech wipes, and another in a glass dish. We're able to successfully start the seeds, then transferred them into the tanks. We ended up putting mesh in the net cups so that the fish would not pull the fragile roots through, which would make them die by sitting at the bottom of the tank. We also recorded the weight of this fish, along with the temperature of the tanks, and observations of plant growth.

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

EN PS AS

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

236

2019

Fair Category

LST

Project
Number

3505

Title: Development of an Algae-based Buffer System to Mitigate Excess Nitrogen and Acidification in Marine Environments

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

Abstract:

Over the last several decades, marine biome ecosystems have undergone extreme destruction from ocean acidification and hypoxia. The purpose of this study was to combat these problems by examining the extent to which different species of marine algae could regulate levels of acidity (by the absorption of CO₂ through photosynthesis) and nitrate concentration (by extracting it from the water and converting it to living tissue) in a manipulated seawater environment. It was hypothesized that *Gracilaria debilis*, a species of red algae, would be most effective overall in absorbing the provided CO₂ and nitrates. In order to ensure there were enough samples to run multiple tests, various (11 total) algal species were cultured in a seawater medium. The 6 species (2 of each green, red, and brown) that showed the most efficient growth rates after 3 weeks were to selected to move on to the experimental process. The samples were then placed in a new environment equipped with CO₂ bubblers, where pH levels would be observed for a week. For the nitrate experimental portion, a similar process was followed, except two drops of “plant food” fertilizer were added to the medium. Using proportions between algal mass/growth and final values for pH change/nitrate absorption, we were unable to determine a clear outlier, although our results suggest that marine algae may be an effective, organic buffer to combat increasing acidity levels and nitrate concentrations in our oceans.

**Technical Disciplines Selected by the Student
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EM PS EA

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- Yes No

CSEF Official Abstract and Certification

Word Count

256

2019

Fair Category

LST

Project
Number

3506

Title: Examining Eye Movement During Decision-Making to Characterize Attention in People with Obsessive-Compulsive Disorder

Student Name(s): T. Livesay, S. Schaaf

Abstract:

Obsessive-Compulsive Disorder is a chronic disorder in which individuals experience excessive thoughts that cause repetitive actions. OCD individuals tend to struggle with indecisiveness and difficulties with simple decision-making. We will investigate abnormality in attention processes by tracking eye movement. Whether fixation pattern of individuals with OCD are different from those in healthy individuals, and whether these differences may contribute to difficulties with decision making in OCD remains unclear. OCD and non-OCD individuals completed a simple decision task, choosing between a fixed payoff and lottery with a chance of a positive payoff. A Tobii T60 XL Eye Tracker was used. It is hypothesized that individuals with OCD will spend proportionally less time on the lottery visual stimuli than other parts of the screen, and therefore are less likely to integrate information about a choice, leading to poor decision-making. The students were tasked with preprocessing raw eye tracking data and analyzing it to determine the validity of hypothesis. In addition, extensive literature review was conducted on current analysis methods to inform the analysis strategies used. For analysis, fixation number and duration were used in an ANOVA test. After completing analysis, findings thus far indicate OCD individuals fixate more frequently and for a mean longer duration, in contrast to the hypothesis. Since choices are often complex and made rapidly, they are affected by how much attention is paid during the task. These findings help clarify understanding of decision-making for OCD individuals, as attention does not seem to be the factor causing poor decision-making.

Technical Disciplines Selected by the Student
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BE ME

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CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

LST

Project
Number

3507

Title: Generation of probiotic strains with increased lactose degradation capabilities for lactose-free yogurt production

Student Name(s): J. Goodrow, M. Hernandez, H. Bill

Abstract:

Lactose intolerance is a condition where the body cannot digest lactose in dairy products. This causes digestive complications, resulting in symptoms such as bloating and gas. In addition to the uncomfortable side effects, individuals with this condition also face a lack of affordable alternative dairy products. This could be due to the extended, expensive process required to degrade the lactose in dairy products. This process includes purification of the lactase enzyme, which breaks down the lactose, followed by a period of treating the milk with the enzyme, and then tests on the product to ensure quality. To combat these issues, we used UV radiation to generate random mutants of commonly used strains of probiotics and screened them on a selective media, where colonies that degrade lactose turn pink. We focused our efforts on *Lactobacillus rhamnosus* GG, after we observed faster growth and darker pink colonies on our media compared to other strains. We screened promising mutants using a glucose oxidase-based spectrophotometric assay with inconclusive results due to the color of the MRS broth used. Then we screened them using Benedict's test with a modified MRS media lacking glucose. We found that three of our mutants consumed significantly more lactose compared to the control. One mutant, RGG 3-24, consumed all of the lactose in the media, while RGG 4-6, and RGG 4-22 consumed approximately 91% of the lactose. These results are extremely promising, and future work is underway to further characterize these strains, including testing them in dairy fermentations.

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

MI BI

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- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

LST

Project
Number

3510

Title: The Effect of Caffeine on Memory and Learning of C.elegans

Student Name(s): E. Haller, N. Padgett

Abstract:

Caffeine is a highly used substance. The Harvard School of Public Health states that of Americans over 18 consume coffee daily and drink an average of 3.1 cups a day. While caffeine has been studied in some capacity, we tested how caffeine affects learning using *C. elegans* as a model. We had a control group, and a group that was given caffeine in a low dose. We then subjected the groups to a pathogen avoidance assay. In this assay, we exposed them to a pathogenic bacteria, *S. marcescens*, which harms them. After initial exposure, the nematodes learn how to avoid the pathogens based on smell. We hypothesized that the group of nematodes grown on caffeine would learn to avoid the pathogen more than the control. After 24 hours we determined the preference index, which measures the extent that worms prefer the food source. However, both groups had the same preference for the food source. This does not support our hypothesis, however our experiment had limitations. First, we might have had contamination on the food source, which would affect the nematodes' preference. Second, we could have had a larger amount of nematodes on each plate. Third, we only performed our assay once due to time limitations. Future studies are required to confirm this by using more nematodes, more replicates, and other doses of caffeine. We could also use other assays for learning to confirm the lack of effect caffeine had in our experiment.

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

CB ME BI

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- Yes No

CSEF Official Abstract and Certification

Word Count

259

2019

Fair Category

LST

Project
Number

3511

Title: Cigarette vs. E-Cigarette Affect on Lungs

Student Name(s): A. DeGunia, B. Doughty

Abstract:

Smoking is a bad habit that has negative effects on people's health and is very common for people of all walks of life. Some falsely believe that smoking e-cigarettes are a healthier alternative to smoking conventional cigarettes. To see how similar or different cigarettes and e-cigarettes are to determine whether or not they are safer or just as dangerous this experiment was conducted. In this experiment, the levels of nicotine was tested in both conventional cigarettes and e-cigarettes. The cigarettes and e-cigarettes were attached to the inside of a water bottle at separate times. The water bottle was used to simulate breathing.

The bottle was attached to a hose going in a plastic container, the smoke that was emitted from them was trapped in cotton balls. We used these cotton balls to figure out how much nicotine was in the water by putting them in the water and seeing how much the water level rose. That would tell us about how much nicotine was in both the cigarette and e-cigarette and give us our data. The more nicotine showed the more dangerous the e-cigarette or cigarette was. E-cigarettes had less nicotine than cigarettes but not by much. They came very close to having the same amount of nicotine, and we have concluded that they are equally as dangerous although there's no information on the long-term effects of e-cigarettes, from the information gathered and the data collected, the dangers of cigarettes have been altered to make others feel they are safer.

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

ME

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

LST

Project
Number

3513

Title: Using *C. elegans* to Determine Effect of Superfruits on Cognitive Function

Student Name(s): L. Ferrucci, M. Wilson

Abstract:

Alzheimer's disease, a form of dementia that often surfaces in old age, causes memory loss and a decrease in cognitive abilities. Millions of people worldwide are diagnosed with Alzheimer's or a similar degenerative illness each year. The disease is most immediately caused by brain cell death; a lack of brain cells renders it increasingly difficult for the brain to make neurological connections, which directly affects memory. One theory holds that this brain cell death is caused by free radicals, the damaging effects of which antioxidants have been shown to halt or even reverse. This study focuses on the antioxidant content of several superfruits and uses *C. elegans* to examine the effect of the antioxidant activity in these superfruits on memory and cognitive function. Extracts were obtained from four superfruits and mixed with ethanol, sodium carbonate, and Folin-Ciocalteu (F-C) reagent. The F-C reaction represents an antioxidant procedure that measures the reductive capacity of the antioxidant. A spectrophotometer was used to determine the relative antioxidant concentrations of the superfruits. In the next phase of testing, *C. elegans* will be exposed to each superfruit, and several memory tests, including the tap withdrawal test, will be administered. Testing has shown that, of the four fruits tested, maqui berry has the highest antioxidant content, followed by blueberry, acai, and mangosteen. It is hypothesized that the *C. elegans* exposed to superfruits with higher levels of antioxidant activity will demonstrate less extreme reactions to tap stimulus, indicating heightened memory and cognitive function.

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

BI ME CB

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

LST

Project Number

3514

Title: Developing a Biopesticide BT Stain Both More Resistant to UV Rays and More Effective Against Agricultural Lepidopteran Pests

Student Name(s): K. Williams, E. Russell

Abstract:

Pest management is a very common agricultural problem that has been faced by all civilizations, and overcome partly by the use of pesticides. *Bacillus thuringiensis*, also known as BT, is a strain of bacteria that is the most commonly used biopesticide for lepidopteran larvae (caterpillars), but it can be hard to use effectively. BT works by perforating the midgut of larvae, which requires the caterpillar to eat something that contains the toxin. Because of this, BT is often applied as a foliar spray. However rainwater washes the toxin off plant surfaces and they are UV-sensitive, resulting in an inefficient and temperamental process. In our research, we attempted to find a new strain of BT from soil with high UV exposure, to determine if UV affects the amount of BT strains we isolate and also if the strains are more UV-resistant. Strains of BT were isolated from soil with varying environments and relative sunlight levels utilizing a heat shock procedure. Fifty-seven potential strains were isolated from three environments and selected based on their morphology and Gram staining. Through selective media, this number was then narrowed down to twenty-nine potential strains. We attempted to further prioritize strains using a PCR method with degenerate primers for the BT toxin genes, however PCR products were not obtained. Interestingly, the soil sample containing the highest number of BT candidates was from the environment with the highest UV exposure. Future work will further characterize these strains and evaluate their effectiveness in controlling *M. sexta* larvae.

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

MI PS EM

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

LST

Project
Number

3515

Title: The Analysis of Lead Nitrate(II) in aquatic Environments Using the SCiO Handheld Scanner

Student Name(s): S. Margolin, A. Doman

Abstract:

Lead poisoning can result from the presence of lead in water, housing, the environment or other sources. When lead is present in drinking water it cannot be detected without formal laboratory testing. As lead can bioaccumulate, the consumption of lead-contaminated water over an extended period of time can result in long term health problem. In particular, ingestion of high concentrations of lead by children of developing ages can result in severe and irreversible neurological defects. This experiment was conducted using lead in the form of lead nitrate (II) to create a fully dissolved aqueous lead standard. By using the SCiO scanner to create a database of scans based on five different lead standards, which supports the development of a comprehensive application. Rhodizonic acid was used on half of the samples to increase the accuracy of the SCiO scanner because the concentration of lead nitrate (II) was measured in ppb. 546 scans of the samples were taken with 67 scans of 40 mL of distilled water, 294 scans of the five lead standards without Rhodizonic acid, 177 scans from the five lead standards with Rhodizonic acid and eight scans from an unknown lead concentration. The culmination of the samples was edited in the SCiO Lab developer tools and a model was created which determines the concentration of lead in a scale ranging from 0.00 ppb to 40,611 ppb. This application can transform the practice of lead testing, providing a significantly faster, less expensive and more consumer accessible testing.

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

CH EV

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

231

2019

Fair Category

LST

Project Number

3517

Title: Cosmic Powered Microbe Water Filtration System

Student Name(s): M. Lopez, J. Folcik, J. Rivera Olivo

Abstract:

Currently, around the world, 1 in 9 people lack access to clean water. In the United States, 844 million people per year are without clean water due to natural disasters. Having access to safe and clean water contributes to improved health and helps prevent the spread of infectious diseases. This project is looking at creating a filtering system that allows first responders to have potable drinking water on hand. We are looking to create portable and low-cost commercial filtration system that could be available to first responders when natural disasters occur. We have continued building on our research from last year by making a filtration system that filters bacteria and particles from flood waters to create potable drinking water utilizing reverse osmosis, ultrafiltration, and chlorine oxidation and disinfection. Building on our research from last year, we have been combining different numbers of ultrafiltration filters as well as chlorine oxidation and disinfection filters to create filtered water that tests at the lowest parts per million (ppm) measurement. Currently, in one filtration the water tests at an average of 50 ppm and with three filtrations of the same water testing at an average of below 50 ppm. We consider this experiment successful because tap water tests at an average of 140 -400 ppm, and we have been able to create filtered water that averages at less than the acceptable rate for tap water.

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

MI EM EA

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- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

LST

Project
Number

3518

Title: Effects of Metformin on the Regeneration Rates in Planarians

Student Name(s): L. Garcia, A. Datilus

Abstract:

Regeneration is a process an organism undergoes to restore a lost appendage. Although regeneration was discovered long ago, it is not well understood because the genes that regulate this process have not been discovered. The two major types of regeneration are epimorphosis and morphallaxis. Epimorphosis involves the dedifferentiation of adult structures to form an undifferentiated mass of cells that then differentiates as needed. Morphallaxis involves the repatterning of existing tissues. Signals from cells around the site will send neoblasts, which are undifferentiated pluripotent cells. These neoblasts can have a myriad of responses and eventually will disperse and differentiate, forming new tissue. Morphallaxis is a process that is repeatedly occurring in our primary model of planarians. Planarians are free living, non-parasitic flatworms that are commonly used as models, due to their simplistic structure and anatomy. We chose this model due to their immortality, simple structure, and their capability to produce telomeres at the same rate and quantity over time. Our research investigated the effect of metformin, a diabetes drug that has shown effects in other aging and regeneration models, on regeneration in planarians. In our research, the planarians were amputated below the pharynx, and then dosed with metformin at the following concentrations: 0, 0.15, 0.25, 0.50, 0.75 mM. Our results indicate that metformin does increase the regeneration rate by 8 days. Furthermore, this research could possibly have dramatic implications in the sectors of cosmetics and anti-aging, wound therapy, and medical science.

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

MI BI CB

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- Yes No

CSEF Official Abstract and Certification

Word Count

196

2019

Fair Category

LST

Project
Number

3519

Title: Who done it: Can fingerprints be identical between twins

Student Name(s): A. Scrivines, J. Vilorio

Abstract:

Fingerprints are made in a unique way, when a child is developing in the womb of the mother. There are many mixed information's that explain how everyone has a different fingerprint. In our project were going to try to investigate the information available, test it and make clearly explain our findings. After learning that all fingerprints are unique, we wondered if this were true for genetically identical individuals like identical twins or other closely relate individuals like fraternal twins. To test our hypothesis, that identical twins have the same genetic makeup and therefore have identical fingerprints, we decided to collect and compare fingerprints from one set identical twins and one set of fraternal twins. Using fraternal twins would allow a comparison to be made in understanding if genetics did play a significant role in fingerprints. We asked 2 set of twins, being one fraternal and the other identical to be fingerprinted and then using a magnifying lens to perform a 2-point fingerprint comparison, we determined that the neither the identical twins or the fraternal twins had identical prints. We did note that the identical twins had more similarities in general patterns than the fraternal twins.

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

EN BE

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- Yes No

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Word Count

210

2019

Fair Category

LST

Project
Number

3521

Title: Extracting, Cloning, and Comparing the Glyceraldehyde 3-Phosphate Dehydrogenase Gene in Native and Invasive Plant Species

Student Name(s): L. Darrin, D. Swigart

Abstract:

Invasive plant species pose a major threat to terrestrial ecosystems, affecting biodiversity, the economy, water quality, fire risk, and other destructive consequences. As invasive plants begin to compromise native plant populations, it becomes incredibly difficult to reverse this process and eradicate the intruder without harming the local population or damaging the environment with the use of dangerous chemicals and pesticides. The purpose of this project was to analyze the glyceraldehyde 3-phosphate dehydrogenase (GAPDH) gene in multiple plant species (*Arabidopsis thaliana*, *Epipremnum aureum*, and *Ampelopsis brevipedunculata*) to identify differences in each sequence. Because the GAPDH gene is a housekeeping gene responsible for the coding of glycolysis, a necessary function of plant life, understanding differences in the sequence of this gene may help scientists develop specific target “treatments” for invasive species infestation. It was hypothesized that each plant species would have a unique GAPC DNA sequence. For each species, DNA was extracted and the region of GAPC gene amplified using PCR. PCR products were then purified and ligated into a plasmid vector. *E. Coli* bacteria was transformed with said plasmid, which was in turn isolated and sequenced. Finally, a bioinformatics analysis of the cloned gene was performed. Results were analyzed by comparing the electrophoresis data as well as the bioinformatics analysis.

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

CB PS EV

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

LST

Project Number

3522

Title: The Effect of Biochar on Plant and Microbiological Growth

Student Name(s): J. Michaud, D. Rediger, J. McConnell

Abstract:

Biochar is compressed charcoal that removes impurities that inhibit plant and bacterial growth from soil. It is also thought to promote plant growth by adsorbing excess nutrients and supporting the growth of beneficial microbes. However, its growth-promoting qualities have not been adequately investigated. We hypothesized that biochar adsorbs and prevents the leaching of nitrate and phosphate in soil, promotes the growth of beneficial microbes, and positively impacts plant growth.

We used nitrate test strips and a standard spectrophotometric assay for phosphate to quantify the nitrate and phosphate levels in the soil as lettuce plants grew, and in leaching experiments. We found that the concentration of nitrate that leached out of soil was lower with higher amounts of biochar, which supports our hypothesis that the biochar adsorbed nitrate. However we did not observe this with phosphate, which might be because phosphate levels were already much lower than nitrate, and thus it was harder to measure changes in these levels. We also isolated microbes via serial dilution to determine the total number of bacteria in each soil. As hypothesized, we found that addition of biochar to the soil promoted bacterial growth. Lastly, we measured the effect of biochar on lettuce seed germination, and found that biochar improved germination rates.

Overall, our hypothesis was supported. Biochar effectively adsorbed nitrate, and promoted microbial and plant growth. This suggests that biochar is an effective soil amendment that can help farmers maximize nutrient usage from fertilizers like compost and promote overall soil health and plant growth.

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

PS MI 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

247

2019

Fair Category

LST

Project
Number

3523

Title: The FarmBox mini: A compact, automated farm for anywhere and any time

Student Name(s): M. Chin, K. Rao

Abstract:

In many places, there is a lack of easy access to fresh, nutritious, and affordable vegetables. These places include urban, remote, and barren areas, with little access to outdoor space for farming. The FarmBox mini was designed to provide people with easy access to fresh, nutritious vegetables anywhere and any time, saving them space, time, and money. The FarmBox mini accomplishes this goal with its unique combination of existing and proven technologies, all inside a small box: Click and Grow seedpods, vertical hydroponic farm, Arduino microcontroller, robot arm, and vending machine. This lets people plant seedpods in the hydroponic farm, which then grows the crops using only water and LEDs, and uses a robot to harvest and dispense crops people select. A successful prototype was designed and built to prove this concept. During the design process, several different hydroponic systems, crops, and robots were evaluated. Through testing, it was concluded that: a vertical hydroponic system saved space and worked best inside a vending machine; pre-made Click and Grow seedpods simplified the design and produced high-quality crops; the most efficient height of the LEDs was 18 inches above the plants; the water level should be kept at 1.25 inches to ensure the seedpods receive enough water; and a six-degree of freedom robot arm was most cost-effective, but flexible enough to harvest and dispense the crops. After proof of concept, it was concluded that the FarmBox mini aligns innovation with utility, and achieved its goal.

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

EE PS

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

161

2019

Fair Category

LST

Project
Number

3524

Title: How do electromagnetic forces affect plant growth?

Student Name(s): A. Vasantlal, A. Vasantlal

Abstract:

Our question was "How do electromagnetic forces affect plant growth?". Over the course of 2 weeks, we found that plants with electromagnetic forces will grow slightly faster than plants without electromagnetic forces. There is a minimal difference but the difference is still present. The magnets were made up of enameled copper wire, electrical tape, a clay pot, a screw, and a type C battery. The enameled copper wire allowed the wire to wrap around the screw several times without redirecting the direction of the electricity. Also, the seeds under the electromagnetic forces germinated faster, as both seeds sprouted 2 days before the control group. Plant A, the plant under electromagnetic forces, had the same amount of sunlight and depth of the seed as Plant B, the control group. Our hypothesis was proven correct through our tests of the electromagnetic plant receiving accelerated plant growth. The final difference between the two plants was 1 centimeter, resulting in electromagnetic plants to grow faster.

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

PS EE

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

235

2019

Fair Category

PT

Project Number

4001

Title: Taking Flight

Student Name(s): H. Yang, L. Tang

Abstract:

Since 1903, humans have captured the skies and expanded their knowledge about flight. More than 100 years later, research, prototyping, and making improvements are still imperative aspects of flight in a modern world.

The objective of this project was to design and prototype a small, remote controlled plane capable of sustaining flight. To achieve this objective, research was done to further expand our knowledge on the basis of flight. Then, different designs were considered and the best was selected. Afterwards, the prototyping process began with piecing together smaller parts into larger parts. These larger parts were carefully measured and glued together to form the shape of a plane. Additionally, mechanical parts were inserted into their respective places and adjustments were made to compensate for errors throughout the build process. Finally, smaller details were added to finish off the prototype.

To test the prototype, a large area was used as the runway. The plane was given full throttle and moved down the runway. However, the plane did not lift off after multiple trials. After testing, the results showed excess weight on the wings resulted in the plane staying on the ground. Given these facts, the prototype was unsuccessful in sustaining flight and reaching our objective. For future improvements, a less angled airfoil would be implemented for less wing weight. On top of that, a stronger motor and a larger battery would be utilized for more thrust.

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

EE AT MA

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

203

2019

Fair Category

PT

Project
Number

4002

Title: copper plating

Student Name(s): n. barros, D. Ramroop

Abstract:

The purpose of this project was to see if we were able to copper coat quarters, nickles, and dimes. Also to see if the coins would change in weight after the copper coating process. The reason behind this project was to see if it is possible for copper to plate the metal on these coins. We thought that the longer we left the coins in the solution the better the coat will be and the heavier they would become. We made the copper sulfate solution then attached the alligator clips to the negative and positive nodes of a 9 volt battery and connected the positive clip to the copper tube and the negative to the coin. Then 5 of each coin in five different time frames. The weight of the coins before we started were quarters=5.7g, dimes=2.3g, and nickels=5.0g. There was a slight change at the 2 min mark where the quarter gained 0.01g the dime gained 0.1 and nickle gained. The third and final round of testing was 3 min. Each coin gained a extra 0.1 grams in weight. Our conclusion was proven correct. the more time you leave the coins in the solution the heavier and more copper is plated on the coin.

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

CH EE

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- Yes No

CSEF Official Abstract and Certification

Word Count

230

2019

Fair Category

PT

Project Number

4004

Title: Using copper instead of stainless steel to build an HHO Generator to prevent the production of toxic chromium ions.

Student Name(s): A. Ajdinovski, A. Zoghol

Abstract:

In the modern world, fossil fuels have become a vital pillar of daily life. However, they come with their disadvantages. Not only are fossil fuels depleting drastically, but they continue to harm the environment. Even hydrogen producing factories make this pollution. To fix this problem, our group developed a cost-effective, eco-friendly, and rapid method of producing HHO gas for industrial and commercial purposes. Common electric HHO generators often use stainless steel as electrodes which results in the production of chromium ions, a cancer-causing byproduct. To prevent the production of such gases, our group designed and assembled an electric HHO generator using copper electrodes with a PVC and ABS housing. By utilizing copper, not only did we prevent harmful pollution, but we produced more HHO gas (due to the use of a better conductor). To test the generator, a car battery (as the electrical source) and an electrolyte solution of table salt (7.5 tsp) and tap water (42 oz) were used. The generator produced a generous quantity of HHO gas but due to extensive problems, the exact amount could not be measured.

Proved to be efficient, cost-effective, and rapid, our electric HHO generator could potentially put an end to our dependence on fossil fuels. As an alternative to fossil fuels, the HHO gas produced can be used to power cars, spaceships, chemical reactions, and manufacturing/industrial processes.

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

CH EN EM

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

241

2019

Fair Category

PT

Project Number

4005

Title: Multifunctional Temperature Device

Student Name(s): Y. Liu, M. Lu

Abstract:

A child needs only to be in a car for an hour to overheat and die. While parents surely mean well, mistakes happen to the best of us. Thus, this project hoped to address one of the gravest mistakes that parents make: forgetting their child in a dangerous situation.

The objective of this project was to design a device that would be able to detect when someone/something reached an undesired temperature; then it was to send a notice by flashing an RGB LED as well as sending a text. To accomplish this, a device was created using a TMP36 sensor, jumper wires, a breadboard, an Arduino Uno, an RGB LED, and a GSM shield, and was able to register temperatures through the TMP36, respond accordingly with the LED, and send messages relaying this information. Along with this project, a band was designed that would allow this temperature device to easily be attached to different objects, giving the device more multifunctionality.

The device was tested using a variety of objects, including a space heater and a cooler. When the ambient temperature (adjusted using the aforementioned objects) went above or below the set range, it was able to flash red, green, or blue accordingly (using the LED), as well as send a text relaying pertinent information. Thus, the device was successful. In the future, the next goal will be to fix connection issues with the GSM and to implement the device's band.

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

CS AT EE

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

221

2019

Fair Category

PT

Project
Number

4006

Title: Cold Pack Chemistry

Student Name(s): N. Lampley, M. Moreland

Abstract:

For our science fair project we choose to do Cold Pack Chemistry: Where Does The Heat Go? The purpose of this experiment is to find out how long it takes calcium ammonium nitrate to settle at one temperature, while it is sitting in a cup of room temperature distilled water and being gently stirred. If you change the amount of calcium ammonium nitrate dissolved in the water, then the temperature of the water will decrease. When doing the experiment first we put on safety goggles and nitrile gloves so we could keep the calcium ammonium nitrate away from our eyes, and skin. Next we labeled the cups 1-5 and filled them with 100 ml of distilled water. After that we measured the calcium ammonium nitrate (amount depending on what cup # it is). Then we poured the calcium ammonium nitrate inside of the cup with water, and recorded the temperature with a digital thermometer every 15 seconds until the temp settles. We repeated this for all cups and all three trials. When we completed all three trials we realized that the results in the first two trials were very similar, and the last trial became a lot colder a lot faster. To conclude, our hypothesis was correct because when we added more calcium ammonium nitrate to the water, the water became colder.

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

CH

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

PT

Project Number

4007

Title: Wind Energy

Student Name(s): A. Cimmino, J. Dixon

Abstract:

The purpose of our project was to build a wind turbine out of reusable materials and determine the most efficient blade design. To create the wind turbine structure, we secured a 10-inch long water bottle to the top of a 12-inch long cylinder tube. We placed a straw through the water bottle which would spin when the wind turbine was placed in front of a 20-inch electric fan. At the top of the straw, we attached a rotor and blades. At the bottom of the straw, we used a paper clip to secure three 5/6-inch wide washers suspended from a 5-inch string.

Once the wind turbine was created, we constructed 6 pairs of 3-inch blades. We designed square and curved blades made from plastic, paper, and aluminum foil. Our hypothesis was that the curved, aerodynamic blades made of plastic would be the most efficient. To measure efficiency, we recorded the amount of time for the washers to be lifted 5 inches when placed in front of the fan. We tested each blade set 3 times, and took the average of the 3 trials to determine the outcome. Our hypothesis was proven incorrect; the square blades made of paper, not plastic, were the most efficient. We believe this is due to the larger surface area of the square blades, 4 times larger than the surface area of the curved blades, and the lighter weight of the paper blades when compared to those made of plastic.

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

EA ET EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

PT

Project
Number

4008

Title: Raw vs. Industrial; which one is better in removing oil from water?

Student Name(s): A. Kabatilo, Z. Kabatilo

Abstract:

Each year, oil intoxicates many sea animals that are usually never found. We knew that inside raw sheep wool, the cortical is surrounded by the matrix, which contains high sulfur proteins that readily attract and absorb water molecule. We also knew that raw wool is cheap because of its excess products, and we wanted to make wool useful by using wool to absorb oil from water. This made our cause for our project, which is to see which material is better in absorbing oil, raw wool or an industrial-made absorber? To this, we placed two cups in an upward position, and poured exactly a 50/50 ratio of water and oil. We measured the weight before and after putting any liquid in, and afterwards, we put the same amount of wool and Zep Instant Spill Absorber into the cups, and proceeded to wait two minutes. Then, we took out the wool and poured all the liquid into another cup, and we did the same to the Spill Absorber. We weighed the cup, took the results, and compared it to the weight in the beginning. We found out that wool absorbed all the oil cleanly and a bit of water, while the Absorber absorbed all the oil, no water, but the remaining water was very filthy. After obtaining the results of our experiment, we conclude that sheep wool, which is more natural, cheap, and readily available is a better and cleaner solution for oil spills than the synthetic ZEP instant absorber.

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

EM

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

PT

Project Number

4009

Title: The Coral Explorer

Student Name(s): A. Wijesekera, Z. Fleischman

Abstract:

Of the 29 World Heritage reefs, 25 will experience severe bleaching events by 2040. This will kill present coral and slow reproduction, which is necessary for coral recovery. Bleaching of coral occurs when the water around it is too warm, causing the coral to expel the algae from its tissue, turning it completely white. The objective of this project is to create and design a small remotely operated underwater robot capable of visually inspecting coral reefs and measuring temperatures around the coral. To achieve this goal a waterproof water data logger and a Wifi waterproof camera were attached to a modified version of the SeaPerch underwater ROV. The waterproof Wifi camera and temperature data logger were then connected to a device so the user could see up close what's happening within and around the coral. PVC pipes and elbow joints were used to construct a smaller ROV frame so it can fit into the smaller spaces and not harm the coral. Small electrical components were then soldered to a control box and wired to the ROV to allow the user to navigate the ROV. To test the prototype, the ROV was lowered into a trial pool, and the camera and temperature sensor were tested.

The prototype was successful as the user was able to navigate the ROV underwater, measure water temperature throughout the test and stream video from the waterproof camera. This ROV has the potential to help with the detection and prevention of bleaching in coral reefs.

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

EE AT MA

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

175

2019

Fair Category

PT

Project
Number

4010

Title: Milk Magic

Student Name(s): E. Cheung, M. Labbate

Abstract:

In this project, we decided to create casein plastic, which is plastic made from milk. We wanted to find out if simple ingredients, such as milk and vinegar, would create a durable plastic. To accomplish this task, we tested different ratios and different recipes of milk and vinegar to see which would yield the most casein plastic. Since each cup contained 1 cup of milk, the turn out will depend on the amount of vinegar. We thought that 4 tsp. of vinegar with 1 cup of milk seemed to be the right ratio of vinegar to milk. In the two trials, we found that 1 or 2 tsp. wasn't sufficient for the plastic. However, 4 and 8 tsp. yielded a handful of plastic. We discovered that 8 tsp. of vinegar yielded the most durable plastic. As stated in our hypothesis, we thought that 4 tsp. of vinegar would give us the most plastic. According to the results, 8 tsp. of vinegar gave the best reaction by holding its shape well, and by yielding the most.

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

CH

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

234

2019

Fair Category

PT

Project
Number

4011

Title: Do expensive brand name Apple phone chargers faster than a less expensive third party iPhone charger?

Student Name(s): K. Feest, E. Ormsby, N. Murzyn

Abstract:

The purpose of this project was to prove that a \$20 brand name Apple phone charger will charge faster than a \$7 third party Onn generic phone charger. We hypothesized that the Apple charger will charge faster than the cheaper Onn Charger. We believe that the research Apple puts into the development of its products should lead to the production of a better charger than a charger from a lesser known company such as Onn. When speaking to an Apple customer service representative, it was told to us that the components in the Apple charger would be more compatible with the components in the Apple device than the components in a third-party charger making the Apple charger the charger of choice.

The iPhone X was the phone used in the experiment. The phone battery was drained to 0%. The Apple charger was tested first followed by the ONN Charger. We timed how long it took to charge the phone to 100%. We checked the % charged approximately every 15-20 min until it reached 100% charged. The same process was performed using the ONN charger. The experiment was repeated for a total of three times using both chargers and the results were averaged for both chargers to ensure accurate, reliable, consistent data. We found that the third party charger (ONN) charged the iPhone 2 minutes faster than the Apple charger. Unfortunately, this contradicts our hypothesis.

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

AT CS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

PT

Project Number

4012

Title: What is the effect of the frequency of oobleck on its flow?

Student Name(s): C. Chivinski, R. Ramish

Abstract:

Many buildings and structures are destroyed each year during an earthquake. The goal of this work was to see if we could devise a substance to decrease the amount of movement each building felt. It was thought that using oobleck would prevent a structure from moving as much as without oobleck. Oobleck is a substance that falls between a solid and a liquid. When there is a lot of shearing, oobleck acts more like a solid than a liquid. Our research investigates the effects of frequencies on the shear or stiffness of oobleck.

In order to test the oobleck at different frequencies, we needed to design a container to hold the material. A 7"x 7" clear container was mounted to a shaker table. Batches of oobleck were mixed using cornstarch and water. Batch A was in a 2.5:1 ratio and batch B was in a 2:1 ratio. In order to determine how much movement occurred, we placed a metal block in the center of the container and measure how much it moved during 5 seconds of testing. We tested frequencies of seven different frequencies between 0 and 29.5 Hertz. Measurements were made on the displacement from the center. It was found that for Batch A, the metal block moved 0.5 inches from the center while Batch B moved 0.5 inches. Our team felt that oobleck would not be a good materials to prevent movement at different frequencies that might occur during an earthquake.

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

EN CH

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

PT

Project Number

4013

Title: Safer Football Helmets

Student Name(s): T. Martocchio, E. Torrens

Abstract:

According to Time.com, a recent large study conducted in 2017 showed that 110 out of 111 former NFL players died with CTE (Chronic Traumatic Encephalopathy). CTE is a brain disorder connected to repetitive head trauma. Studies show that CTE can lead to loss of memory, suicidal behavior or dementia. The Huffington Post featured a similar study, stating that 21% of football players in the study who played in high school died with CTE.

The objective for this project was to design a prototype helmet for football players that protects their heads from faster and stronger hits, and reduces their chances of having permanent head injuries such as CTE. To achieve this goal, a real football helmet was taken and the padding inside of the helmet will be removed. New padding would be applied in spots that covered the stronger parts of the skull, this way, the direct impact will go to the stronger parts of the skull. The type of padding used will also cushion the head when hit hard, making it not stop suddenly but instead extend the time of impact and reduce the force. To determine if the new helmet prototype was successful, the helmet was tested in the Crash Test Helmet exhibit at the Connecticut Science Center to determine how much force the helmet can take. The initial test results were promising and indicate that with further research and development, these helmets could reduce the amount of football players with CTE.

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

EN AT PH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

220

2019

Fair Category

PT

Project
Number

4014

Title: Off to the Starch Races

Student Name(s): S. Arnaout, A. Robinson

Abstract:

The purpose of this experiment was to test the different ability of different types of starches used as thickening agents, and how thick each one could get. The hypothesis was “if cornstarch is added to a solution with water and is then heated, it will create a thicker substance that that of the other starches. The independent variable that was tested in our experiment was the different type of starch that we used in the testing, and the dependent variable was the amount of time the thickened solution took to reach the bottom of the angled baking sheet. In our procedures, we first stirred water and a few tablespoons of the selected starch, and then put it over high heat for 4 minutes per each starch. We then poured it down a baking sheet angled at about 45 degrees, and timed how long it took to reach the bottom. Overall, the potato starch took the longest time to reach the bottom, making it the thickest starch, and the arrowroot powder took the least time on average to reach the bottom making it the thinnest. Our experiment’s real world connection involves the aspect of using different types of starch to thicken certain culinary dishes and to use in different types of cooking, as starch is an important ingredient in every kitchen.

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

CH

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

244

2019

Fair Category

PT

Project Number

4015

Title: Which Wheels Work?

Student Name(s): T. Kunkel, A. Lee

Abstract:

We choose to do this project because we wanted to be unique and because we were interested in how cars work and how they have evolved since the first ever made car. We choose to build a car out of a plastic bottle and experiment with rubber and plastic wheels. We made a ramp for the car to roll down. If we change the wheels of the car then, then the car with the rubber wheels will roll faster, because the rubber wheels are stronger, can stand wear and tear, and create more friction. Our procedure was, we would let the car go at the top of the ramp, it would roll down and then we would measure the distance each time and average the distance in inches at the end.

After all our trials we found out that our hypothesis was supported by our experiment. The rubber wheels average was 78.2 while the plastic average was 34.11, so therefore the rubber wheels went 44.1 inches farther than the plastic ones. We learned that this is why humans use rubber wheels. Rubber wheels are not only good for the safety of the person but also because the wheels have a tight grip on wet and icy roads. But they can also protect you from a fallen power line or tree. So with this project of ours, we have learned all the reasons why we use rubber and not plastic or other materials for driving.

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

EE

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

PT

Project Number

4016

Title: Soft Robotic Underwater Inspection System

Student Name(s): S. Anastasio, P. Bahel

Abstract:

According to USA Today, a company, BP, spent 62 billion dollars on cleaning up the ocean when its oil rig blew up due to damaged pipes. To reduce this cost and damage done, a need for more effective and efficient methods to inspect underwater pipes is necessary. The objective of this project was to create an underwater, soft robotic pipe inspection system that could be used in a multitude of ways to identify damage in underwater pipes. In order to create this system, the frame was constructed using PVC pipes and connectors. Three DC motors were waterproofed, connected, and later attached to the frame. They were wired to an Arduino Uno, which was programmed to control the navigation system. Finally, a GoPro camera was appended at the top to take images. To test the prototype, it was placed in a body of water and observed to see if it was able to run smoothly and relay the camera's images to the user, from underwater. The underwater system was partially successful because the camera was able to send images, but the motors were not able to receive enough signal to spin. This prototype provided us with insight for enhancing the next iteration of our frame. Some of the future modifications will include a softer and lighter frame material, such as nano-fibers and changing the motors to BLDC motors. BLDC motors are more energy-efficient and powerful than DC motors. This combination of softer material and stronger motors will make a successful prototype.

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

EE 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

249

2019

Fair Category

PT

Project
Number

4017

Title: What Material Creates the Most Static Electricity?

Student Name(s): R. Chacaga, D. LaMonica

Abstract:

The purpose of our experiment is to define and discover what material can create the most static charge to power up an early form of capacitor called a Leyden Jar. In this experiment, we wanted to know what can create the most static electricity out of: pantyhose, fake fur, an elastic and polyester headband, paper towels, and a microfiber cloth towel. The Leyden Jar is an old capacitor that Ben Franklin is known to have used in his experiments with electricity. Research shows that the materials we have chosen to power the Leyden Jar are effective in creating electricity and our project will show what material works the best to generate static. We powered the Leyden Jar by rubbing material against PVC and the top ball of the Leyden jar feeding electrical charges into the inside of the capacitor using the triboelectric effect. We created the Leyden Jar and ran five experiments on each of our materials measuring the D/C voltage with a multimeter after someone charged it. This field of science can apply to real life situations as well as the circumstances created in our experiment. Turbines use friction to create static electricity, similar to the function of the PVC pipe, but on a larger scale. In extreme situations, you could create energy this way to power a flashlight through a homemade battery, and through our research and trials, people will know how to do so in a more effective way to help them with power loss.

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

EE PH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

78

2019

Fair Category

PT

Project
Number

4018

Title: Disappearing Act

Student Name(s): R. Janik, O. Tomas

Abstract:

Our experiment is figuring out if all liquids evaporate at the same rate. We decided to do this experiment because we know evaporation happens to bodies of water all over the world. We wondered if different types of liquid evaporate at about the same rate or if the different ingredients in them will make them evaporate at different rates. We have used carbonated water, coffee, dish soap, tap water, vegetable oil, apple juice, coke cola, and rubbing alcohol.

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

EA EV EM

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

PT

Project Number

4019

Title: Waste Watchers

Student Name(s): E. Sheehe, A. Cummings, A. Acharya

Abstract:

According to the Environmental Protection Agency, in 2013 Americans produced 254 million tons of trash, and only about 87 million pounds of it were recycled. The trash ends up in landfills and bodies of water, and spaces that were once habitats for animals.

The objective of this project was to raise awareness of how much trash is being thrown out over a given period of time and to lessen this amount by designing and creating a prototype that weighs the waste on it and reports the results back to the user. To reach this goal, an Arduino board and sensor weighed the trash, and the Arduino was coded so that the LED would light when the weight exceeded 15 grams. Our original plan was to have the user's phone contain an app that would provide user the data collected. Although we didn't get to this, the idea can be used for future implications. This project required coding skills to create the prototype and program the Arduino to alert the user when there is too much waste through the LED that lit up if the weight went over the threshold. To test the prototype, we put 15 grams on the scale to check that the LED lit up as soon as 15 grams or more was put on the scale.

The prototype was viewed as successful because the LED lit up at 15 grams. This project will help people keep our environment clean.

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

EM EE EV

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

PT

Project Number

4020

Title: Measuring the variability in strength between plexiglass and wood

Student Name(s): L. Amenta, K. Patel

Abstract:

We tested which material wood or plexiglass would make a water wheel capable of lifting more weight. We hypothesized that wood could lift more weight. Wood is the traditional material used to construct water wheels. We choose plexiglass because it is heavier than the wood and will cause increased resistance to the spinning of the wheel causing it to lift less weight.

We constructed a wood and a plexiglass water wheel. We measured which water wheel could lift more weight using water at a pressure of 132 psi. We tested the wooden water wheel first. We began by lifting a 500 gram weight holding the wheel 4 centimeters away from the water faucet. The wooden water wheel successfully lifted the 800 gram weight but with difficulty. We then tried 900 grams, but the water wheel was incapable of lifting it. Then we tested the plexiglass water wheel with the same weights and the same procedure as described above. The results were the same as the wooden water wheel. The plexiglass water wheel also lifted 800 grams maximum. We concluded both wheels lifted the same amount of weight making the strength of both materials the same. Unfortunately, our hypothesis was incorrect as it appears the type of material is not affecting the ability to lift a certain weight. Perhaps the amount of weight able to lift is more dependent on the water pressure than the type of material used. Something we would like to test in the future.

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

EN

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

PT

Project
Number

4021

Title: Garbage Gansterz

Student Name(s): B. Coutant, M. Saviano, N. Psychopaidas

Abstract:

For our science fair project, we constructed a boat that gathers the garbage contaminating the ocean. Our goal with this project is to help reduce the death of marine life due to the ignorance of people. We discovered that a 24-year-old man in the Netherlands (Boyan Slat) took two boats and traveled through the ocean gathering up the trash. We were intrigued by this idea, so we decided to add whatever we thought could help it. We began with a lego conveyor belt and planned on buying an RC boat. Grievously, it didn't look right when we drew it out, so we built our own boat from wood using empty cans to circumvolve the belt. We also constructed our own conveyor belt. Our first design process was to put the conveyor belt in front of the boat, but we settled to put it on the side adding arms to enclose the garbage. It would eventually lead it to the conveyor belt. When we initially thought of the arms, we comprehended that we could only attach one because the conveyor belt was too far back. Throughout the project, we had some minor errors that took quite some time to revise. We had to prevent the wires from getting tangled, as well as attach a clamp to the motor to keep it from spinning. Despite these difficulties, we were able to create our model working just as we planned. With this design, we hope to make a difference for our ocean.

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

EE EM AT

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

PT

Project Number

4022

Title: The Bernoulli Effect

Student Name(s): C. Herr, A. Burnham

Abstract:

We decided to study and research the Bernoulli Effect to understand the principle behind why airplanes are able to fly. We wanted to test how this effect creates lift for an airplane.

Because an airplane must go very fast to lift off the ground, we think that different wind speeds affect the amount of lift created. Our experiment was designed to show that increasing wind speed has an increasing effect on air pressure and can move objects at a faster rate.

We measured the distance between two soda cans and time it took for them to move towards each other after we turned on the hair dryer. We also tested whether the air temperature had any effect on the time it took for the two soda cans to touch.

We conducted twelve tests to see if the speed and temperature of the wind between two objects had a measurable difference on the movement of the objects. We varied the wind speed created by the hair dryer -- low or high, and varied the air temperature of the hair dryer -- cool, warm and hot. The elapsed time for the cans to touch was documented after each trial. We then moved the soda cans farther apart and repeated the tests.

The key impact to our research is that an increasing wind speed does decrease the air pressure where the air is traveling at a faster rate, pushing an object towards the decreasing air pressure. This will impact future air travel efficiencies.

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

PH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

PT

Project Number

4023

Title: Screen Saver

Student Name(s): E. LiVigni, L. Chrostowski, J. Psychopaidas

Abstract:

Our project was to make a design for a locking box to protect students phones. At our school, the teachers collect our electronics at the beginning of the day and the phones are left inside plastic bins that are easy to steal. Our solution is to make a box that can lock students phones and keep them safe. The frames and foundation of our box are made from wood, and there are 9 compartments. Each compartment has a solenoid to allow the students to open and close the hatch when needed. The solenoid is connected to our main Arduino unit where our keypad and LCD are connected. Our goal was surpassed because we had created a functional locking mechanism to protect students phones. To open a compartment, the student has to dial their code to open up their storage, and they would also have to know which box is theirs making two layers of security. As a bonus, we added charger holes so students can charge their phones during and after school. We took a survey of what kind of phone students have, and 100% of the eighth grade had an apple phone. With this data, we decided to use apple chargers only. This is a very secure design that makes it challenging or almost impossible for someone to grab a student's phone or steal a valuable electronic. We hope that our project could one day save student's phones from being stolen and possibly be used for other practical purposes.

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

EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

200

2019

Fair Category

PT

Project
Number

4024

Title: Yogurt Ravioli

Student Name(s): C. Ellis, L. Murphy

Abstract:

Instead of eating yogurt in a bowl, imagine eating it shaped in spheres. We observed raviolis made from yogurt and how they changed over time. We made a solution out of distilled water and sodium alginate and we put it in the fridge for 2 hours. After that we planned out the times that we would weigh the yogurt after we had made it into raviolis. After the solution was done, we took it out of the fridge and poured it into four cups. Three were labeled 1,2,3 and the other was labeled practice cup. Then we took a paper towel and put vegetable oil on it to make it easier for the yogurt to come out of the spoon. After we weigh the spoon and then with yogurt inside it and subtracted the mass of the spoon. Then we put the raviolis in the fridge for a period of 2 hours each. We repeated three times. Our conclusion was that the raviolis grew bigger over time. We noticed that the yogurt on the inside didn't grow bigger but the membrane on the outside. The smallest amount that the yogurt weighed was 31 grams and the heaviest was 41.8.

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

BI CH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

228

2019

Fair Category

PT

Project Number

4025

Title: Artificial Pancreas to Regulate Blood Sugar Levels

Student Name(s): A. Bahel, N. Carmeli

Abstract:

According to the American Diabetes Association, in 2015, 30.3 million Americans, or 9.4% of the population, had diabetes. Additionally, each year, over a million Americans are diagnosed with diabetes. Every day children and adults are at risk of dying, and countless others have the discomfort of pricking their fingers, as well as taking injections and pills several times a day to regulate their diabetic condition.

The objective of this project was to design and create a prototype of an artificial pancreas that will help diabetics regulate blood glucose levels without having to take painful finger pricks numerous times a day. To create the prototype, several components were utilized, including a solderless breadboard which was composed of, resistors, jumper wires, potentiometers, a liquid pump with conductivity sensors, three small baking bowls, vinegar, and baking soda. To test the prototype, a liquid pump with conductivity sensors were wired to detect the basicity of the baking soda, representing high blood glucose levels. The pump ran, and it added an acidic solution (vinegar) that was pumped into the basic solution (baking soda). This neutralized the solution, and when the pump detected that the solution was neutralized, it stopped.

The prototype was successful as it was able to neutralize all solutions. With more time and advanced technology, the development of an artificial pancreas has the potential to improve upon regulating blood sugar levels.

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

EN EE ME

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

185

2019

Fair Category

PT

Project
Number

4027

Title: Ice Melt

Student Name(s): H. Riley, B. Blackwell

Abstract:

We wanted to see how ice melts fastest. Lots of substances help melt ice, but we want to know which ones work best. Research shows that Iodized Salt and sugar lower the freezing point of water, but Salt Sense has not been attempted. In this experiment we explored Salt Sense's effectiveness along with Iodized Salt and sugar. We did a series of experiments to find which was most effective. To test which worked best, we did three tests. We took three cups and froze ice in each at -4 degrees Fahrenheit. First Iodized Salt was sprinkled on one, Salt Sense one another, and sugar on the last one. We used a water dropper to collect all the water on each after 15 minutes. We recorded how many millimeters each collected and then put it back in the same cup. We did this for one hour. We did the process two more times. By doing these tests, we can avoid falling on ice outside on a cold day after a big snowstorm. We think that this is good to know as road salt isn't always available.

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

CH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

245

2019

Fair Category

PT

Project Number

4028

Title: What is the Effect of Construction Site Contaminants on the Compression Strength of Concrete?

Student Name(s): J. Ho, N. Sattan

Abstract:

Concrete is a common construction material that is used to create roads and buildings. Studying this material is especially important because concrete house foundations all across Connecticut are crumbling. Concrete is usually composed of cement and aggregate, mixed with water. The ratio of these three ingredients is important to create a strong material. Contaminants found at construction sites can reduce the strength of concrete. This investigation looks at the effect of construction site contaminants on the ultimate compression strength of concrete.

Cylindrical molds were modeled in Autodesk Inventor and fabricated using a 3D printer. Concrete was mixed and experimental batches were prepared by adding a percentage of contaminants such as dried leaves (0.2%, 0.5% and 1%), plastic (0.25%, 0.5% and 1%), and broken glass (2%, 5% and 10%). Each batch was poured into three cylindrical molds and allowed to set in air for three days followed by submersion in water for 24 days. The samples were tested in compression and results showed that adding only 1% of leaves to the concrete decreased the strength by 72%. Similarly, adding only 1% of plastic decreased the strength by 81%. However, adding up to 10% of glass showed only a decrease of 23%. Additional samples were prepared and tested to examine the effect of the size of the broken glass. These results showed that larger pieces of glass slightly lowered the strength whereas the smallest samples of glass (i.e. glass dust) showed no effect on the compression strength.

**Technical Disciplines Selected by the Student
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EN CH

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

232

2019

Fair Category

PT

Project
Number

4029

Title: The Car-Temp_Bot

Student Name(s): A. Babajanyan, E. Babajanyan

Abstract:

Many children and pets die from heat stroke and similar heat complications every year because of the forgetfulness of parents and pet owners. These occurrences are usually accidental. Every single one of these deaths increases the severity and awareness of this issue.

The objective of this project was to create a prototype that senses a set threshold and activates a fan to cool a car when the surrounding area gets too hot. The prototype will then send a signal when the set threshold is reached to alert the guardian. The Car-Temp-Bot will create a safer car for the baby/pet to be in and to provide the guardian with reassurance if they do accidentally leave a baby/pet in the car on a hot day.

To construct the prototype, an Arduino board (Uno), temperature sensor, fans, case for the Arduino board, glue pads, male and female connectors, breadboard, 9v batteries, and 9v battery connectors were used. This project also required the coding and testing of the arduino. The prototype was tested by raising the temperature to 80°F to simulate a closed up car on a hot day.

The Car-Temp-Bot successfully detected when the temperature reached 80°F and began to cool the environment with its fans and sent an alert to the user. This device has the potential to save the lives of many children and pets.

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

EE CS AT

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

140

2019

Fair Category

PT

Project
Number

4030

Title: Effects of Different Chemicals to Remove Stains on Clothing

Student Name(s): I. Taclawan, A. Krueger

Abstract:

In this experiment we are trying to determine what solution works best as a stain remover. Previous to our experiment, people have tested store bought and homemade stain removers, but they haven't tested a great enough range of stain removers. We tested two homemade stain removers and a store bought one to compare which one worked better. In order to see which chemicals worked the best, we used 100% cotton fabric pieces from the same cloth and stained them. We used three different types of solutions (Shout; Dawn Dish Soap, hydrogen peroxide, and baking soda; borax, vinegar, and water) to remove each of the three stains (coffee, grape juice, and ketchup). Today's society in general has little time to do laundry, so an effective stain remover would benefit everyone by creating a quick and cost-effective way to do laundry.

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

CH

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

177

2019

Fair Category

PT

Project
Number

4031

Title: Juice Balls

Student Name(s): M. Pannone, S. Pershqefa

Abstract:

In this experiment we tested four different formulas that consisted of Calcium Chloride, Sodium Alginate, and Sodium Citrate. In each test we used different amounts of Sodium Citrate and Sodium Alginate but the amount of Calcium Chloride remained the same. The three drinks we tested were Coca-Cola, Gatorade, and Sprite which were dropped into each solution to create the juice balls. We also measured the pH levels of each drink to see if it had any effect with the spherification. We decided to pursue this investigation because we thought that it was an interesting way to "eat" a fluid and we wanted to understand the science behind the spherification of juice balls. We predicted that the juices with higher pH levels would help with the spherification of the juice balls. As we did the experiment we saw that the juice balls were forming but the solution with the least amount of sodium citrate worked the best. The drink with the highest pH level, Sprite, formed the best juice balls with every solution, proving our hypothesis correct.

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

CH

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

4. Is this project a continuation? Yes No

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

224

2019

Fair Category

P7

Project Number

5002

Title: Cabbage Chemistry

Student Name(s): A. Rus

Abstract:

Have you ever wondered if the water that you drink is acidic or not or how high its Ph level is? I thought that all of the liquids will be the same because they are all clear. I used different brands of water and other liquids the other liquids that i used were alcohol, soap, vinegar, softner and windex. I tested each and every liquid with the cabbage juice that put into the liquids and the results came out very interesting. They didnt come out as i thought they would but it was very cool to see how the liquids turned out to be a different color and some even turned out to be very thick. The colors that popped up were green, blue,white and the waters all stayed purple. The white was from the softner that had a lot of acid. After my first day i took it a step further and left my liquids for another day to see if they will change or not and the liquids did change. The waters changed to a lighter purple and the softner turned to be a brownish white. All the other liquids stayed the same. Even though that my experiment didnt come out as i expected it i was very fascinated to learn all of this important information and how the liquids change.

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

CH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

P7

Project Number

5003

Title: Mobility Assistance Device for the Visually Impaired

Student Name(s): C. Ruggiero

Abstract:

The traditional mobility aid for the visually impaired is the white cane, which gives information about the environment. It is used to feel surfaces touched with the tip end, and is limited by its four foot length. The question is whether the use of electronic sensors with sounds will help the visually impaired comprehend their environment more successfully.

This study involved exploring sonar-based technology to improve safety and independence. The hand-held device, the VIAD (Visually Impaired Assistive Device), uses sound cues programmed to an ultrasonic sensor allowing the user to “visualize” broader surroundings. It creates progressively faster beeping sounds as it closes in on an object within its 70-inch field of range. The 69 tests involved blindfolded subjects using the two aids to locate a randomly placed box placed on a small table within a 13 x 20 foot empty space. The baseline time to discovery was determined with the white cane, and then compared to the VIAD alone, and, finally, to a combination of the two. The average timed results indicated if the VIAD helped the user complete the task more rapidly and efficiently.

It was discovered that the use of the white cane compared to the VIAD took approximately the same average time (1% difference) to locate the box. The combination of the aids was most efficient, with a 32% increase in speed. It was concluded that the visually impaired can navigate their environment more efficiently using two senses instead of one with sensor technology.

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

ME EE

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

157

2019

Fair Category

P7

Project
Number

5004

Title: How Much Glucose Is In That?

Student Name(s): A. Faruol

Abstract:

Food companies on television commercials always claim to have less sugar, but which drinks are really telling the truth about that? This project looks at which drinks contain the highest amount of glucose. The eight drinks (independent variables) were tested on a glucose measuring test strip. The amounts of glucose in each drink (dependent variables) took a certain amount of time (constant variables) to develop the true readings of the sugar contained. My hypothesis was that drinks that were more processed, such as soda and juice drinks, would contain the highest amounts of glucose. The experimental results supported the fact that my hypothesis was correct by showing that the ginger-ale contained the most sugar out of all the drinks that were tested. This is how my experimental results proved my hypothesis correct. In addition, the more naturally occurring drinks, such as milk, cranberry juice, chardonnay, and honey green tea, had the least amount of glucose contained.

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

229

2019

Fair Category

P7

Project Number

5005

Title: Good Up High Bad Near By (How the Environment effects the outdoor, groundlevel Particulate Matter)

Student Name(s): A. Jardim

Abstract:

The topic of my project is air pollution, and I chose this because it affects the earth and the living things on the earth including both you and me, if it get out of hand then one day it can kill us along with other forms of air pollutions. The question I am investigation is if the environment impacts the (outdoor) PM. PM is what you get when particles and tiny droplets of water combine, it is a problem because it can do serious damage to lungs, plants, and animals lungs. Before I was able to do my experiment, I had to build a device to measure the PM, I used an arduino PM sensor kit to make the device, I also had to connect wires, and LEDs and a bunch of other things to make the device. For my experiment first I made a machine that had lights on it, and when the PM was higher, the more lights would light up. Then My mom drove me from Danbury, Connecticut, to New York City, New York, the to Courtland, New York and I measured the PM in each of those places. In my project I found that the lights that were on in the farm area and suburbs was none, the lights for the city and beach have 1 light on, and the highway had 2 lights on.

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

EV

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P7

Project Number

5006

Title: LEGO MINDSTORMS EV3 - Can Accuracy Be Improved?

Student Name(s): M. Drago

Abstract:

This year I wondered how to improve the accuracy of the LEGO MINDSTORMS EV3 (EV3) robot's maneuvering. The EV3 is a programmable, autonomously operated, battery powered robot. I wanted to prove that there are methods that can improve the EV3 accuracy in maneuvering. I performed experiments to show variances in consistency depending upon the robot motors, or servos, and the type of turn performed. I hypothesized that a skid steer turn would have less friction than a tank turn, making it turn more accurately and that the most accurate way to turn the robot was to use a skid steer turn with the gyro sensor to guide it.

My methods included programing, testing, and researching. I made four different programs:

1. One tested the paring servos, the robot motors, with similar servos;
2. A tank turn; only one tire moving while the other is stationary;
3. A skid steer; both tires turning in opposite directions; and,
4. A turn controlled by a gyro sensor, that uses a sensor to control how many degrees the robot turns.

My results proved my hypothesis that the skid steer turn had less friction but disproved my hypothesis that the skid steer would be more consistent than the tank turn. The tank turn and the skid steer both had an average variance of 3 degrees. My results also proved that my hypothesis that the skid steer turn with the gyro sensor was the most accurate with only 2 degrees variance in a 360-degree turn.

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

161

2019

Fair Category

P7

Project
Number

5007

Title: Turmeric Indicator

Student Name(s): A. Addepalli

Abstract:

Turmeric is a rich way to add flavor while cooking and is found in most Asian cuisine. It is also an item that is very popular in Asia because it takes a big part in its culture. I thought I could bring that culture into my project and show a different side to turmeric. Even though my experiment was partly right, one part of my hypothesis was disproved. My hypothesis states that turmeric could be used as an indicator for pH levels, and soda, out of 8 household items, would be the most acidic while detergent would be the most basic. But the results show that baking soda was the most basic. I did this by adding rubbing alcohol and turmeric on top of toilet paper to make pH strips to compare to store bought pH strips. While we still are in the age of discovery, why don't we take a look at turmeric, a natural way to indicate pH levels.

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

CH

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

247

2019

Fair Category

P7

Project Number

5008

Title: PediGenerator: Turning Steps Into Energy Using PiezoElectric Generators to harness, convert and store the energy needed to charge a mobile device.

Student Name(s): T. Oshin

Abstract:

The PediGenerator is a device that is useful to people who are on long journeys without electricity and people who live in places where electricity is scarce. It can charge one's phone after one walks, converting mechanical energy from the motion of running to electrical energy - which is then used to either charge one's phone, or charge a battery via USB drive.

Electricity is a basic idea that many take for granted, but it will not last forever. most of the electricity that we use today comes from fossil fuels. The type of energy that I used in my shoe is a source of renewable energy called Piezoelectric energy. It converts mechanical energy into electrical energy using a Piezoelectric element.

To make this device, I used a breadboard, diodes, a capacitor, foam, a turkey cutter, cardstock, a Sharpie, Scissors, a Piezoelectric Element, tape, gel squares, fabric, hot glue, and a LED. I used an online procedure to create the breadboard circuit and then connected it to the element and switch. Then I created the foam shoe, connected both the element and the breadboard to the shoe, and connected it to a multimeter to find out how much energy it would produce.

The results showed that the generator produced a small amount of energy, but I hypothesized for further study that if one placed many elements on the shoe, and if it could produce more motion, then the energy made would be enough to charge a small device.

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

ET EE EN

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

160

2019

Fair Category

P7

Project
Number

5010

Title: Green Insulation?

Student Name(s): T. Fahey

Abstract:

Glass wool insulation can irritate skin and lungs, or even possibly cause cancer or lung disease. The insulations that were used were 100% recycled and are encountered every day. The insulating materials that were used were shredded blue denim, shredded paper and plastic grocery bags. The hypothesis for this lab was "If recycled materials such as shredded blue denim, shredded paper and plastic grocery bags are used as insulating materials, they will be an effective eco-friendlier alternate to other common types of insulation such as glass wool that can be harmful to human health." The results did support the hypothesis. The recycled materials were all effective to different degrees as insulating materials with the plastic grocery bags being the most effective. In comparison to the glass wool insulation, the plastic grocery bags were approximately 23% less effective, but still can be considered a possible effective alternative as it reduced the rate of temperature change with no insulation by almost 60%.

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

PH EV

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

241

2019

Fair Category

P7

Project
Number

5011

Title: Remote Control Ceiling Climber

Student Name(s): S. Brauweiler, D. Phillips

Abstract:

I made a remote control wall and ceiling climber. I found that suction works best for objects that move, such as cars. However, gecko tape, which is designed to stick the same way geckos do, works well for non-moving things, like lights, but does not allow movement. I had tried many things, such as a seal made from a paper plate, which made it too hard to move, and a different fan, which couldn't even carry itself. I measured and compared the weight each could carry without falling off and the final design could carry 280g more than it weighed. I made homemade gecko tape by pouring silicone on filters with five micron sized holes in them. It was supposed to be similar to the hairs on geckos' feet. To test the stickiness of my homemade gecko tape, I attached it to a tile and measured at what angle it would fall off a tilted board, and then did the same for other materials. It didn't do any better than any of the other molds. The final designs of my car were a normal remote control car inside an upside down paper bowl with a mini-desktop vacuum cleaner on top and a painter's plastic skirt to seal the suction to the ceiling. My second design was made from parts of remote control cars and a bit of weather stripping to help make a seal to stick it on the wall.

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

EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

P7

Project Number

5012

Title: A low-cost and efficient way to harvest biomechanical energy: harvest energy from walking on an electricity generating rug

Student Name(s): A. Zhang

Abstract:

Biomechanical energy harvesting from human motion is a promising clean, affordable, and renewable energy source. However, existing biomechanical energy harvesting devices in shoes, clothes and floors are usually expensive and inefficient. An electricity generated floor would take lots of time and money to install. My idea is to harvest energy by walking on an electricity generating rug. It consists of piezo transducers and magnetic spring generators. By combining them, the rug can create energy efficiently. Since the piezo transducers and magnetic spring generators are cheap there are multiple in the rug. Each time a piezo transducer is pressed, it creates energy. There are few ways to put the transducer in the rug. The experiment was conducted by pressing the piezo transducer ten times in different positions with three trials: scaled, stacked, and in a circle. One piezo transducer created 0.11 watts, the stacked average is 0.16 watts, the scaled average is 0.07, and the circle position's average is 0.04 watts. Therefore, the most efficient way is the stacked position. Also, adding three magnetics facing conflicting poles into a tube wrapped with coil creates a magnetic spring generator. It can generate around 2 mW by the vibration of walking. The piezo system is 3-1/2in x 2in x 1/3in. The magnetic generator is 23mm long with a diameter of 1/2 inch. To conclude, my biomechanical energy harvesting device is harmless, easy to create, portable, low-cost. In the future, this device can attach to clothes.

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

ET EN EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P7

Project Number

5013

Title: Lemonade VS Sports Drinks

Student Name(s): A. Henn

Abstract:

The purpose of my experiment was to see which sports drinks have more electrolytes than lemonade. The reason I am conducting this experiment is because I want to know how many electrolytes are in each drink. Keeping your glucose levels at a normal level is very important so that you don't get sick or get dehydrated. For my hypothesis, I predicted that the sports drinks would have more electrolytes than lemonade. After I put together my conductance measuring circuit, I set up my cups with their specific liquids to measure for electrolytes. To clean the tester between each liquid I used Distilled Water to ensure the other liquids were not still in the straw. For each liquid I tested it three times to get an end average for each liquid. My results from my testing were as I originally thought and it proved that sports drinks had more electrolytes than tap water, lemonade, and Vitamin Water.

In conclusion, I found my hypothesis was correct in thinking that sports drinks and their reduced sugar version had more electrolytes than lemonade. In this test, I learned that the tap water at my house has more electrolytes than vitamin water. This is due to the fact that we have a well.. During this experiment to measure electrolytes, I had to measure it in milliamps, then convert the measurement to amps because the current is so small. In this experiment to get my conductance, I measured my amps by voltage for my final result.

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

CH ET ME

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

179

2019

Fair Category

P7

Project Number

5014

Title: Hydraulic Arm

Student Name(s): D. Jenkins

Abstract:

The purpose of the Hydraulic arm is to show how it compares to a real prosthetic arm when it comes to movement. With my Hydraulic arm you will be able to see how the wires, represented by the clear tubes would allow a real prosthetic arm to move. After building both Hydraulic arms from two different types of cardboard, I began testing various objects to determine the amount of weight each arm is able to hold. I tested Empty water bottle, empty soda can, light bulb, tennis ball, "peg" game, box of 24 crayons, PVC pipe, full soda can, and a coffee mug. After testing it turned out my hypothesis was not supported, because after multiple attempts of lifting each item the data showed that the cardboard can lift the same items as the double corrugated cardboard. Both arms were able to lift the empty soda can, empty water bottle, "peg" game, light bulb, and the tennis ball. Neither of the arms could lift the full can of soda, crayons, PVC pipe, full water bottle, or a coffee mug.

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

AT

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

P7

Project Number

5015

Title: Fire and Sharp Things

Student Name(s): L. Reilly

Abstract:

Every child is told not to play with Fire or sharp things. In my experiment I used both. I am a scout and I'll often have to start a fire using bits of wood. So for my experiment I wondered what way of cutting wood will burn fastest? What way will burn longest? I hypothesized that out of a block, chunks, chips, shavings, and sawdust; shavings would burn fastest, because they have the largest surface area to burn while not compromising airflow.

I started by researching the basics of fire. Fire needs fuel, oxygen, and heat to burn. Then, I started seeing how different variables such as humidity, type of wood, and wind affect how wood burns. I then cut up five two centimeter cubes to each specified dimension. I next prepared and fire proofed a box for burning the wood inside. Finally, I burned each of the samples recording how long it took for each to burn.

As I had predicted, the shavings burned the fastest. Unsurprisingly the block took the longest to burn. I originally thought that twenty second under a propane torch would burn up the samples immediately, but each burned longer than I thought they would after being lit.

In the end, My hypothesis was supported. If I do this experiment again, I would see if these results remain consistent over different wood types. For now on, I'll try whittling my twigs down to shavings when lighting a fire.

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

EM

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

187

2019

Fair Category

P7

Project Number

5016

Title: Layered Liquids

Student Name(s): N. Tsai

Abstract:

Layered Liquids

In this experiment, multiple liquids will be tested. The motivation for this experiment is based on household liquids because of their properties of density and behaviors and are commonly chosen when doing liquid experiments. The solution of the project is to see whether or not the liquids will layer neatly based on their properties of density. The liquids tested will be corn syrup, dish soap, dyed water, vegetable oil, and dyed rubbing alcohol as well as a large glass bottle. Corn syrup is the first based on its property of density being higher than the rest of the liquids, and the dyed rubbing alcohol being the last liquid to be poured because of its property of density being the lowest. To begin, the corn syrup must first be poured. Then next is the dish soap, and then the dyed green water. Second to last was vegetable oil, and finally the dyed red rubbing alcohol. As liquids were being poured, they were aligning perfectly from top to bottom. All the liquids were arranged in a rainbow-like layer starting from corn syrup to dyed rubbing alcohol.

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

CH

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

229

2019

Fair Category

P7

Project Number

5017

Title: Extracting Fingerprints From 3D Printed Objects

Student Name(s): J. Porto

Abstract:

For my project I extracted fingerprints from 3D printed objects using two different techniques, then I determined the percentages of how well the fingerprints came out. I did this with both rough surfaces, and smooth. I am doing this project because there are recent studies about fingerprints being harder to remove from 3D printed firearms. The techniques I used were Dusting For Fingerprints, and Fingerprint Fuming. Then I determined which of the two could remove fingerprints from 3D printed objects the best. First I did the dusting, following the steps in my procedure. Then I did the superglue fuming. For this I followed the instructions for Superglue Fuming in my procedure, and taped the finger prints next to the other two. After this I calculated the percentage of fingerprint that came out. The rough Dusting came out as 45% and the smooth Dusting came out as 65%. The rough Fuming came out as 15% and the smooth Fuming came out as 0%. I think that the Fuming calculations came out so low partially because of human error. The Fuming Rough came out as 15%, not because I could see the print exactly, because I couldn't really, but because the lines from the block came out onto the tape afterwards, while the smooth shape showed no effect. The Dusting worked the best, the smooth surface being the easiest to see.

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

CH AT

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

4. Is this project a continuation? Yes No

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

199

2019

Fair Category

P7

Project Number

5018

Title: Projectile Motion

Student Name(s): V. Bordash

Abstract:

My science fair project is on projectile motion, and I want to see what is the best angle to get the farthest jump off a ramp. This is very important to figure out trajectories for rockets carrying satellites and spacecraft so the rocket does not fly out of Earth's orbit or crash back down. But I chose it because I wanted to research what angle is the best to go the farthest distance. The materials I used are plywood, wood, RC car, and tape measure. The RC car is controlled by a remote control and powered by an electric battery. What I did was measure the distance between the car and the ramp then calculate the time for the car to get there to find the speed. Then I will do multiple tests on different angles, which showed that 30 degrees had the farthest distance which I did not expect. So I did the math and it showed that the results should have been very different. At thirty and forty five degrees it should have been around 2.5 to 3 feet but 50 a little less than both. But forty five was the greatest so my hypothesis was right.

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

PH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

244

2019

Fair Category

P7

Project Number

5019

Title: Grow Plant Grow

Student Name(s): P. Kalidasan

Abstract:

In my project I tested which fertilizer affects plant growth the most. I used 3 different fertilizers with different NPK ratios and a control with just water to grow the plants. I think that my project is important because fertilizers are a big part in making a plant grow. If plants grow faster, they may be able to outweigh non-organic and junk food in stores, allowing for easier access to fresh produce. If this happens then it will be beneficial to the environment, our health, and farmers can make more money. Another important factor is world hunger. About 1 out of 7 people are affected by world hunger, which is more than 1 billion people! First I grew 4 boxes of plants, 3 boxes got fertilizers, one got just water. The 3 fertilizers I used were, FloraGro, FloraBloom, and FloraMicro, each plant got the same amount of their respective fertilizer. I thought that the plants grown with FloraBloom would have the most growth because FloraBloom has a lot of nutrients for root growth. I watered all the plants every couple of days and monitored the growth. The final measurement showed that the plants grown with FloraGro had the most growth. FloraBloom, which was my prediction, had the 3rd most growth. FloraGro has the most potassium, so I concluded that potassium helps with a plant's growth the most. Potassium helps the overall function of the plant, which is why the FloraGro was so effective.

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

PS EV CH

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

P7

Project
Number

5020

Title: Stick to it

Student Name(s): N. Radliff

Abstract:

Abstract:

The goal of this experiment is to help consumers find the strongest, most reliable, and safest type of wood glue. It is important to have safe and dependable wood glue. My hypothesis is, if wood is bound together with three types of wood glues, Type A, Type B, and Type C, then Type A will have the strongest bond. I hypothesize this because Type A is PVAC based wood glue. PVAC is found in wood. This might make Type A have a stronger bond on the wood than the other wood glues. Therefore, the experiment was conducted as follows. I chose three popular types of wood glues: a PVAC based adhesive (Type A), a polyvinyl acetate polymer (Type B), and an aliphatic resin wood glue (Type C). I built a wood stand to test my experiment. I assembled the glued Popsicle sticks for testing. I initially conducted a pull test using weights up to 4.53kg. While conducting the pull test, I discovered that the glue was not failing even up to 4.53kg. I decided to conduct a second experiment in sheer. The sheer test showed that the glue was stronger than the wood. The Popsicle sticks broke, but the glue joints never failed. My experiment together with my research supports the recommendation of Type A wood glue as a superior wood glue to Type B and Type C wood glues as the bonds held and the wood did not appear to weaken.

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

EN

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes 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

245

2019

Fair Category

P7

Project Number

5022

Title: Water Quality of the Rippowam River

Student Name(s): A. Pandalai

Abstract:

For eight consecutive weeks, I collected water from the Rippowam River and measured the nitrate, pH and salinity levels in two locations. These two locations were Scalzi and Mill River Park, both of which are highly populated. I tested the pH using a test tube and a pH tablet from the LaMotte kit and then shook the test tube and waited to see its color. After obtaining its color I compared it to the color chart provided in the kit. I then tested the salinity level using a hydrometer. The nitrate levels were tested a little differently, when I took the 5mL sample out of the water, I immediately covered it with a UV protection case. After being secured in the case I added a nitrate tablet into the water and shook it for two minutes and awaited for its color to appear.

After the eight weeks of continuously doing this procedure, I realized that the data was gradually increasing as the weeks passed. The pH had a low of 6 and a high of 10. Through the span of the eight weeks the salinity went from 8 ppt to 58 ppt. The nitrate levels also increased from 15 ppm to 28 ppm.

At one point in my research, my pH and nitrate levels reached a dangerous level for wildlife which is 11 ppm and 28 ppm respectively. I considered that this could have been caused by the salted roads in Stamford during the snow.

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

EV EA

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

Yes No

CSEF Official Abstract and Certification

Word Count

80

2019

Fair Category

P7

Project
Number

5023

Title: Just The Surface

Student Name(s): S. Lawrence

Abstract:

Just the Surface is a project about how the surface area of an object increases or decreases that object's surface tension. This is important because it provides a needed base for future experiments and research on more advanced water vehicle prototypes (jet skis, boats, etc.) I tested how different surface areas altered surface tension. I found that surface area corresponds with surface tension (when one increases, the other increases, etc.) which corresponds with my hypothesis, and therefore proved it right.

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

PH CH 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

248

2019

Fair Category

P7

Project Number

5025

Title: Recovering Renewable Energy From An Air Conditioning Condenser Exhaust Fan

Student Name(s): E. Okoney

Abstract:

This topic demonstrates the ability to produce renewable energy utilizing wasted exhaust air from air conditioning systems. The result converts zero-cost wasted exhaust air from the refrigeration cycle (or other heat removal cycle) commonly used in many buildings.

A prototype frame was designed and constructed to hold a turbine in various positions above the condenser exhaust to determine if the engineering goal was feasible. The wind turbine was wired to a circuit including meters, battery and charging connector to test the output while the turbine was rotating. Once prototype success was confirmed, other testing was completed using variables of position, height and containment walls. The objective was to determine which combination produced the highest and most consistent voltage output. The highest voltages were produced when the turbine was offset 6 inches from center and located at 7 inches from the condenser which was the closest position. In addition, when an enclosure was installed around the frame, the voltage output was most consistent and produced the most stable voltage output results.

Practical applications include using this design on all types of waste air exhaust from many types of air conditioning systems. To maximize the benefit of this energy, this design prototype could be installed on large scale buildings including airports, hospitals, businesses, malls, etc. The above locations have large capacity condensers producing excessive wasted mechanical energy. 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)

EE ET AT

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 vertebrate animals controlled substances

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

161

2019

Fair Category

P7

Project Number

5026

Title: Does a Beam Bridge or a Suspension Bridge hold more weight?

Student Name(s): A. Goodwin

Abstract:

Bridges come in all different sizes and variations. The purpose of this Science experiment is to see which bridge, a Suspension Bridge or a Beam Bridge is able to hold more weight and why. Suspension Bridges are supported by tension cables vs Beam Bridges which are supported by piers. When conducting trials on this experiment, various amounts of pennies were placed in a cup which served as a loader for each of the two types of bridges. After three trial runs on each bridge, the Suspension Bridge proved to be stronger and able to hold more pennies than the Beam Bridge. The three trial runs of the Suspension Bridge had an average of holding 173 pennies. The three trial runs of the Beam Bridge had an average of holding 69.3 pennies. This experiment proved that the tension cables from above on a Suspension Bridge are stronger and able to hold more weight than the two piers/towers on a Beam Bridge.

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

ET

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 vertebrate animals controlled substances

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

225

2019

Fair Category

P7

Project Number

5027

Title: DIY WiFi Booster

Student Name(s): C. Tomaino

Abstract:

My topic was Would adding a parabolic reflector to a router increase the signal strength in a house? Would one design be better than the others? I chose this topic because I was tired of certain rooms in my house having weak internet connection. When I was when I was doing my homework or watching videos in certain rooms of my house such as the kitchen or the dining room, the signal would cause the computer to buffer. This was very frustrating especially when I was trying to do my homework and the site would not load. This took too much time. I built various designs of parabolic reflectors out of household materials and tested them on different days of the week to see which design worked better. During the testing many of the designs showed little change or negative change. Only one design proved to be the best, that was the bottle design. The bottle design was the only experiment that produced positive results for both the upload and the download speeds. One thing that I learned from the experiments was the design that I thought would do the best, which was the wide house design, actually turned out to only be second best. The wide house design had unchanged results in the upload speed but did have positive results in the download speed.

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

AT

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Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

P7

Project
Number

5028

Title: The Vaxinator

Student Name(s): Z. Starr

Abstract:

The problem that will be solved by my project is that many vaccines lose their strength because of adverse temperatures. About 37% of all vaccines that are transported in less wealthy countries lose potency because of this. This makes vaccine effectiveness a very large problem for the world's wellbeing. The goal is to make a machine that monitors the temperature of a capsule containing the vaccine, and then stores the values inside a text file for later use. It is called the Vaxinator. The Vaxinator is made out of an Arduino Uno connected to a Raspberry Pi. The Arduino gets values from a temperature sensor connected to the capsule, which is then computed by the Raspberry Pi in a text file. This file can be used at any time for any purpose, such as creating a graph. There is also a program that tells whether the vaccine is safe to use or not. I tested the Vaxinator by filling the capsule with tap water, measuring the temperature with a laboratory thermometer, and then comparing that with the average temperature the Vaxinator recorded. I recorded eight trials, and found that the Vaxinator recorded lower temperatures than the capsule by one to three degrees Celsius. By the end of creating and testing it, I had successfully created a device that is able to record the temperature of vaccines, as well as easily check their potency. The Vaxinator can help save lives, as well as measure other medications, such as EpiPen®s.

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

AT EE ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

176

2019

Fair Category

P7

Project
Number

5029

Title: HOW DOES THE SHAPE OF AN AIRPLANE AFFECT ITS SPEED AND LIFT?

Student Name(s): R. Carey

Abstract:

When people think of an airplane, they normally think of the regular passenger plane whose shape is slightly curved from the front to the back. But how does the shape of an airplane affect its speed and lift? This experiment tested three different shaped airplanes with three different wing lengths. The length of the plane remained constant at 7.62 meters long. The three airplane shapes tested were circle, oval and square. The wing length for each airplane tested was either 2.74, 5.48, or 10.97 meters long. Each airplane was flown at an altitude of 3505.2 meters above sea level for approximately 5 minutes. It was predicted that the airplane with the most angled features and with the shortest wings would achieve the most speed while the plane with the widest body and the longest wings would achieve the most lift. This experiment proved my hypothesis correct because the most angled plane with the shortest wings achieving a maximum speed of 784.88 kph and the widest plane with the longest wings achieved a lift of 2037.58 kg.

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

EE ET

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CSEF Official Abstract and Certification

Word Count

160

2019

Fair Category

P7

Project
Number

5030

Title: THe Heat is On

Student Name(s): A. Bragg-Phillips, n. na, n. na

Abstract:

My goal was to find out if carbon monoxide and carbon dioxide had a higher temperature than oxygen after being heated up (which heats up faster). I chose this project because I wanted to see which gas had the highest temperature change, so I could know which one is contributing the most to global warming. My hypothesis was, that if carbon monoxide, carbon dioxide, and oxygen are heated up, then carbon monoxide will have the highest temperature change because it is denser than air. I filled 3 bottles with carbon dioxide, carbon monoxide, and oxygen and heated them up under a lamp to see which gas had the highest temperature change. Something I noticed in this experiment is that while heating up, the tops of the bottle caps would always start bubbling in the heat. Of the three gases, carbon monoxide heated up the most. From this project, I learned that carbon monoxide is contributing to global warming the most.

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

EV CH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

103

2019

Fair Category

P7

Project Number

5031

Title: Taper Dome

Student Name(s): R. Coty

Abstract:

Overall, this project was both fun and interesting. I even had fun when I made mistakes. I was able to learn from my mistakes and fix them on the spot. In the beginning I did not think I would be able to use newspaper to construct a dome. I was surprised when the dome shape finally started to form. My favorite part of the geodesic dome project was putting the dome together and watching it take shape. Although, I thought the smaller dome would hold more weight than the larger dome I was really surprised at how much weight the dome actually held.

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

EN AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

P7

Project
Number

5033

Title: Agar vs. Gelatin

Student Name(s): R. Benin

Abstract:

All people need food to survive, but many have dietary and religious requirements for the food they eat. One requirement might be not eating animal products; so many companies are seeking to use animal-free ingredients in their recipes. However, these selective ingredients are not regularly available and can be costly. Finding alternatives is an important part of food science. This experiment compares two ingredients: gelatin (common but made from animal products) and agar (not as common but made from plants). This experiment can help answer the question of whether these two ingredients can be used as a substitute for each other and be equally effective in food preparation. My prediction was that the food dye on gelatin would diffuse faster than food dye on agar. I made this prediction because I thought the creamy texture of gelatin would allow the dye to diffuse faster. To test my hypothesis, I made plates with agar and gelatin. A single drop of food dye was placed on each plate. For three days I observed, measured, and recorded the diffusion of the dye. After the third day, I compared the results which revealed that the food dye on the agar plates had diffused to a greater extent than that on the gelatin plates. Therefore, my hypothesis was disproved because agar (a firmer substance than gelatin) allows food dye to spread the most. This shows that in regard to diffusion, agar and gelatin are not equal substitutes as ingredients in food preparation.

Technical Disciplines Selected by the Student
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CH

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- Yes No

CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

P7

Project
Number

5034

Title: Candy Chromatography

Student Name(s): A. Rotundo

Abstract:

The purpose of this experiment is to test if the dyes within different candies are more soluble than others. To find this out, I am using a process called liquid chromatography. Liquid chromatography is a procedure which uses a liquid, or solvent, to separate these different parts. My hypothesis is that if the candies are more pigmented and complex then they will be less soluble. The experiment was conducted using M&M's candy, filter paper, and salt water solution. The M&M's were placed in water, until the water contained the pigment of the candy. Using the filter paper, the Rf factor was calculated, and compared to a chart which identified the dye. According to my results, I found out that the purple skittles dye was the least soluble candy out of all of the candies that I tested. I got this result because when I tested the purple dye it was made up of two colors, red and blue. Since the purple dye was made of two dyes combined, the dye had larger molecules so it had a harder time migrating through the filter paper. I proved that my hypothesis is correct. My hypothesis stated that if a candy is more pigmented then the dye will be less soluble. My data proved that the purple Skittles were the least soluble dyes out of the three candies that I tested. The purple Skittles' dye had a deeper color than the red Skittles' dye and blue M&M's dye.

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

CH

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

179

2019

Fair Category

P7

Project
Number

5035

Title: Corrosion Breakdown

Student Name(s): T. Joseph

Abstract:

Do you know what makes the chain of your bicycle, a nail or a pipeline gets corroded? What is corrosion and what is its mechanism? Corrosion is the deterioration process of a modified material as a result of a chemical reaction (McCafferty, 13). The most commonly referred to corrosion is the process of rusting. Elements in the periodic table fall into categories of metals, non-metals or metalloids (Green, 23). Metals are the most common type and are defined by certain chemical and physical properties. Most metals rust, but the rate at which they corrode is different. Metals like aluminum seem to resist corrosion, however brass, copper, and steel corrodes rapidly as they come in contact with oxygen and water where an oxidation reaction (gain of atoms bond with oxygen in a substance) occurs to form rust (Wikipedia). This experiment is on corrosion and oxidization of metals when water and oxygen are presented. It will determine how aluminum, brass, copper, and steel reacts as they are introduced to three types of solutions and which metals are resilient to corrosion.

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

EN

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P7

Project Number

5036

Title: Don't Keep Me in Suspense

Student Name(s): B. Owen

Abstract:

This project's purpose is to prove different bridge designs can handle the force of wind better than others, improving stability.

I constructed three bridges and a frame. I attached fans and a power source to the frame, and bridge sections to my model. I recorded the starting point and ending point of each bridge to see how much they moved. I modified two of the sections by cutting slots in them, re-ran the test and gathered information on my modified sections. I graphed the information recorded, to understand results. They showed the medium bridge section was most unstable. My educated guess was due to the fan I used, the frequency of the wind's force best matched that of the medium bridge, causing it to move more than other sections.

The medium and wide bridges became more stable after cutting slots into them. The medium bridge allowed wind to pass through easily after cutting slots into the road, the wide bridge experiment removed most of the rail that caused mini tornadoes. Both slot experiments reduced force pushing on the bridge. When supports were at the ends, it was most stable. When wind moves over sharp edges, it pushes down on the bridge but the supports catch it and keep it stable. When they were at the center it was least stable because no supports caught the wind once it hit the sharp edge.

In conclusion, some designs are effected less by wind, slightly modifying some designs makes them more stable.

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

EE

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

239

2019

Fair Category

P8

Project
Number

5501

Title: What Forces Affect a Sailboat?

Student Name(s): M. Kulick

Abstract:

Have you ever been out sailing and wondered how do boats move through the water or what physics are behind the sport of sailing? There are many components that are very important in the physics of sailing and that is what my project is about. In my project I focused on what forces affect a sailboat? There are many forces that affect a sailboat like push and pull forces, hydrodynamic forces, and many more. I tested my project by taking pieces of cork to be used as the base of the boat and pieces of paper shaped like sails to be the sails on the boat. I had the sails pointing in a close haul which is when the sail is closest to the boat. I put the boats in the water and blew through a straw to create wind. As I did this, I saw that the boats were not maneuvering right, that was because the boats did not have a rudder and centerboard which are the hydrodynamic parts of the boat meaning they are under the water. After doing even more research I found out that when the force of lift is created which is the forward pull on the boat, the boat turns to the side. The hydrodynamics on the boat are the parts that make the boat go straight. In this project I observed how many components and forces really affect how a sailboat moves.

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

EA

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P8

Project Number

5502

Title: Alternative Method of Extinguishing Household Fires

Student Name(s): K. Vijay

Abstract:

The objective of this experiment and prototype was to create a safe, effective and easily accessible product, to extinguish household fires. In the United States, there is above 364,000 residential fires every year causing civilian injuries and death. Cooking is the leading cause of home fires and fire injuries. My hypothesis was if a fire retardant kitchen towel is created using a combination of mineral wool, fiberglass cloth, sodium bicarbonate, coffee grounds and pistachios (acting as ammonium phosphate) it will smother a fire more effectively than a fire extinguisher and cotton kitchen towel. The concept behind this prototype is to eliminate all elements rather than one element of the "Fire Triangle"- Heat, Fuel, Oxygen, therefore, extinguishing the fire effectively. A key part of the investigation was to identify a natural equivalent source for ammonium phosphate. This was accomplished by using a mixture of coffee grounds and pistachios. Multiple small scale tests were done to identify the best natural ingredients and ratio of pistachios to coffee. Finally after perfecting the formula the prototype was created using mineral wool, fiberglass cloth, pistachios, used coffee grounds, and sodium bicarbonate. The experiments were conducted at Wilton, CT fire department. A grease fire was created using one cup citronella and olive oil, and 2 minutes later the fire was smothered using 3 variables- cotton towel, prototype fire retardant towel, and traditional fire extinguisher. The results of my experiment proved that a fire can be more effectively extinguished eliminating all the components of the fire triangle.

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

CH EN BI

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4. Is this project a continuation? Yes No

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

Yes No

CSEF Official Abstract and Certification

Word Count

246

2019

Fair Category

P8

Project Number

5503

Title: Preventing Bicycle Injuries With an Arduino Microcontroller

Student Name(s): A. Sharonov

Abstract:

It may seem impossible to speed on a bike, but according to the American Association of Family Physicians, some injuries are caused by excessive speeding on a bicycle. Millions of new bikes are sold each year, increasing the risk of injury, and causing new riders to be unfamiliar with controlling their bicycles.

The objective of this project was to design a prototype that alarms riders when exceeding a normal speed of 9.6 MPH. If a buzzer were to recognize when a rider is riding too fast, this could remind riders to slow themselves down and prevent them from injuring themselves. An Arduino Uno, hall sensor, magnets, a display, and a 3D printer were used to achieve this objective. The magnet was placed on the bike spokes and the sensor on a 3D printed case, and every time the magnet passed the sensor, the speed was shown on the display. Also, some programming was needed to control the Arduino, which took time to create and a lot of research on various aspects to execute the program. The mathematics used in the code involved the formula for finding the circumference of a circle and converting feet per millisecond to miles per hour.

This project was proven successful after many trials. The display showed the speed of the bike accurately, and the buzzer went off at correct times. This device could be extended by creating more features of safety, such as adding a sensor to prevent collisions with pedestrians.

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

EE CS MA

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

234

2019

Fair Category

P8

Project Number

5504

Title: Erosion in Motion

Student Name(s): P. Pigliucci

Abstract:

I was inspired to attempt this project because of mudslides that hit our pool during a flash flood and forced us to refill the pool with new water. I also chose to experiment with soil erosion because of mudslides that occurred last January near my grandparents' home in Southern California. During my experiment I filled five loaf pans with soil and then added wood chips, spider plants, rocks, sod, and kept one with just soil. I then sprinkled 500ml of water on each of them to simulate rain and measured the amount of soil that came out of each one. After I repeated my procedure with all 5 materials for 10 days, I finally got my results. These results were that the soil without any ground cover performed the worst at preventing soil erosion and the sod prevented soil erosion the best. This means that my hypothesis was proved correct because I believed that the soil would prevent erosion the worst and the sod would prevent it the best because of the roots in the grass. The rocks also prevented erosion very well and was the most consistent performer. I noticed during this experiment that as time progressed many of my materials performed worse at preventing soil erosion. An example of this is that over time the wood chips eroded so much that they had similar measurements to the soil with nothing on it.

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

EA EM

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

P8

Project Number

5505

Title: Conserving Water, One Rinse at a Time

Student Name(s): A. Kopec

Abstract:

Water is a valuable resource in the world, and with only 1% of water available for drinking, we need to conserve it. Since brushing your teeth is something we all do daily, I figured that focusing on how to save water with that would be a good idea, as the water saved could add up. I wanted to create something to help with this problem that was cost-effective, easy to use, and served its purpose. So, I created a device to help save water when you brush your teeth and rinse your mouth. It is a stand that you attach under your faucet and allows you to keep a cup for rinsing on it. So that way, when you brush your teeth, whether you leave the water running by accident, or just want to save water, all the water let out of your faucet will be caught by the rinsing cup so you can just rinse your mouth with water that would have been wasted previously. I also added a small strainer to the cup to prevent anything from getting into the water. My project was successful and fulfilled all the design requirements I had for it. Although it is a basic prototype and concept idea, and therefore not very appealing to look at, it functions and serves its purpose well. With my project, conserving water, even in a small way, is much easier and could really help people preserve the environment, even if they are only brushing their teeth.

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

EM EN

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

P8

Project Number

5507

Title: An Eggs-periment

Student Name(s): R. Schwartz

Abstract:

In this project I wanted to discover how many table spoons of salt it takes for an egg to float completely on water. I thought that it would take ten tablespoons of salt to make the egg float completely on the water. Some of the materials are one store bought raw white egg, one clear glass, cold tap water, iodized salt, measuring cup, measuring spoons, ruler with centimeters, notebook, and pen. First, you fill the glass with eight ounces of cold tap water. Then, measure one tablespoon of iodized salt. Then, you put the salt in the water and thoroughly mix it. Next, put the egg in the water. Then, use a ruler to measure how many centimeters of the egg are above the water line. Then, record your results in the notebook. Last, measure one and a half tablespoons of salt and repeat steps three through seven until the egg doesn't float any higher. In the end my observations showed that an egg cannot float completely above the water line regardless of how many tablespoons of salt I add. I know this because when I added five and a half tablespoons of salt, the egg floated two and a half centimeters above the water surface. Then, when I added another one and a half tablespoons of salt, the egg did not float any higher above the water. In conclusion, an egg cannot float completely on the surface of water no matter how much salt is added to the water.

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

PH

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- Yes No

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179

2019

Fair Category

P8

Project
Number

5508

Title: A Mouthful of Minerals

Student Name(s): C. Underwood

Abstract:

The purpose of my project is to see which toothpaste would clean a coffee stain better not only on the ceramic, but on my teeth. I changed the way people should go about their daily life because I gave them results on what will help them clean their teeth better, especially after drinking coffee because coffee stains your teeth. My hypothesis was that the homemade toothpaste (Squeaky-Clean) would be the best at cleaning the coffee stain, the natural toothpaste (Hello) would be second best, Colgate Total would be third, and Aim would be last. My hypothesis was not supported because the toothpaste that cleaned best was Hello, then Colgate, Squeaky-Clean, and last, Aim. My project contributes to the area I worked in because now my family and I are going to use Hello toothpaste from now on at home. It's very important that you put the best things on your teeth and in your mouth because it helps prevent tooth decay, gum disease, and bad breath all in one. Also, so you can have a brighter smile.

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

CH 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

231

2019

Fair Category

P8

Project
Number

5509

Title: The Study of Effectiveness of Different Methods in Removing Suspended Microplastics from Water

Student Name(s): S. Ramakrishnan

Abstract:

Microplastics, which are hazardous to our health and the environment, have become more widespread in the world in the last decade, and are not completely removed in the wastewater treatment plant due to their size. In this project, the effectiveness of environmentally friendly approaches such as the use of natural coagulants and a sandbed filter in removing suspended powders of different plastic types were investigated. Also, the amount of microplastics in lake waters and treated wastewater was examined. Initially, it was hypothesized that if coagulants were added to the plastics, they would help the plastics become hydrophilic, agglomerate and settle. The convoluted channels in the sandbed was expected to be able to trap suspended microplastics. The amount of microplastics in lake water and treated water samples was assessed using turbidity measurements and through visual examination of the filtered particulates stained using the Nile Blue Dye. Extracts from Moringa seeds (*Moringa oleifera*) and chickpeas (*Cicer arietinum*) were used as coagulants. Both coagulants were more effective in settling denser plastics like PET than lighter plastics like PP. The *Cicer arietinum* coagulant was able to settle more plastics than the *Moringa oleifera* coagulant, but it increased the overall turbidity of the water significantly. The filtrate after sandbed filtration measured 100% transmittance. The initial hypothesis was partly supported, as the sandbed was able to trap all the plastics, and the coagulants were not as effective.

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

EM 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

248

2019

Fair Category

P8

Project Number

5510

Title: Fighting Wildfires with Data from Satellite Remote Sensors

Student Name(s): G. Kaimal

Abstract:

Every year, devastating wildfires burn millions of acres of land, cost many lives and result in billions of dollars in damage. I investigated the following: 1) Can we use remote sensor data from satellites to predict and detect wildfires? 2) Is soil moisture a suitable indicator of wildfire risk, exploiting the correlation between soil moisture and vegetation moisture content?

I studied multiple California wildfires and collected the meteorological data (temperature, humidity, precipitation, etc) influencing wildfire risk. I calculated three drought indices (Angstrom, Nesterov and Keetch-Byram) that are commonly used as indicators of wildfire risk. To test my hypothesis that soil moisture was an effective indicator of wildfire risk, I collected data from NASA's SMAP (Soil Moisture Active Passive) remote sensing satellite. I wrote programs in the python language, and used a time-series database (InfluxDB) and a graphing software (Grafana) for my analysis. I benchmarked soil moisture data against calculated drought indices and mapped these over a period of time leading up to a wildfire. In my analysis, I found a correlation between soil moisture levels and the start of these fires.

The second part of my project was to enhance early detection of wildfires using data from NASA's Visible Infrared Imaging Radiometer (VIIRS) remote sensing satellite. VIIRS satellites scan areas for thermal anomalies on ground.

Data from SMAP and VIIRS is more practical than in-situ sensors in every acre of forest, thus making wildfire prediction and detection using this novel approach superior to existing solutions.

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

EA AT EM

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

181

2019

Fair Category

P8

Project
Number

5511

Title: How do boats Hydrofoil?

Student Name(s): D. Flack

Abstract:

Have you ever wondered how hydrofoiling boats appear to defy the laws of physics? Well, for my science fair project, I decided to attempt and answer that question. My original hypothesis was that these boats hydrofoil at different points of pressure on different points on the foils of the boat. My hypothesis was mainly correct, with some minor flaws. How I solved my hypothesis was by researching my topic critically and thoroughly.

The results I obtained was that when the boat increases in speed, the boat creates upward pressures lifting the boat out of the water. This decreases wetted surface and drag causing the boat to speed up. The results I was able to obtain contributes to the area of people being able to understand this seemingly unnatural phenomenon. I was also able to achieve a personal goal of constructing an accurate model of a foiling boat. Based o my results obtained by an expert, I believe that my project will help people not very experienced in the field of sailing better understand the incredible science that sailing has to offer.

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

AT

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

P8

Project Number

5512

Title: The Effects of Dry Ice

Student Name(s): S. Farooq

Abstract:

Abstract

Dry ice was always something that intrigued me as a young boy. I loved seeing people conduct cool experiments using dry ice. This substance is extremely cold and reacts very aggressively towards warm substances by creating fog, however, I have realized that stores are not selling dry ice anymore. People have told me they haven't heard of dry ice in a while, and that people stopped selling it. So I made a science fair topic all about dry ice.

I decided to conduct three experiments using dry ice. The first one was to make tiny bubbles using some dry ice and bubble solution. Next, is to make a balloon pop by putting some dry ice inside a bottle along with some hot water and a balloon on top. The last experiment is making a bubble inside a bowl. It required: dry ice, hot water, and some bubble solution inside a bowl, along with some dishwashing liquid on the rim of the bowl to create the huge bubble.

In the end, I met my objectives. I created the experiments and they worked out. When I did the tiny bubbles experiment, bubbles started to appear. When I did the balloon experiment, it became bigger due to the fog created when dry ice and hot water mix together, and it popped. Lastly, when I made the bubble, I slid the dishrag around the rim of the bowl filled with hot water and dry ice, with dishwashing liquid, and created a bubble.

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

238

2019

Fair Category

P8

Project Number

5513

Title: Friction Frenzy

Student Name(s): S. Herard

Abstract:

In conducting this experiment I was trying to find out the best conditions that would result in the best traction and efficiency when it came to different road conditions. The problem or question that I was investigating is, Does the surface an Erector Set Car drives on impact the distance it can travel up a ramp? My hypothesis is If the surface the car is driving on is sandpaper then the car will move the farthest and if the surface is dampened tin foil then the car will travel the least amount of the ramp. To begin the experiment I ran a control experiment where the surface of the ramp was just the plain wood. The next was the sandpaper to represent rougher roads and the dampened aluminum which would represent a wet or icy road. I measured how far the car traveled up the ramp and marked it on the wood with a marker. My hypothesis was if the surface the car is driving on is sandpaper then it will make it the farthest up the ramp and if the surface is wet aluminum foil then it will travel the least up the ramp. My data reveals that I was correct. When on sandpaper the car traveled 80cm which is 21cm more than the control which was 59cm and when on the wet aluminum foil the car traveled 50cm up the ramp which is the least distance.

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

ET

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

P8

Project Number

5514

Title: MediBox

Student Name(s): V. Vadhera

Abstract:

In 2017 approximately 72,000 people died related to drug overdose in the United States and this number is on the rise. Drug manufacturers are actively looking for a solution to resolve this epidemic. My solution is Medibox, a unique medicine box that can help minimize drug overdose and under dose using Arduino. When you get a prescription, you place it inside the box and the programming monitors the usage. Let's say your doctor prescribes you one pill every 24 hours. This will be programmed into the Arduino by simply changing the delay function. The box will remain locked until it is time to take your medicine. When the time has come to take your medicine a buzzer and LED will go off. The box will remain locked until the person who needs to take their medicine puts their fingerprint on the fingerprint sensor. When biometric is verified, the box will open. In the box there is an HX711 weight sensor and load cell and the pills are placed on top of them. When you take one pill the Arduino knows that and records that on a graph. The weight on the graph should fall equal to the weight of one pill. This graph can be accessed by the doctor to monitor drug usage daily. Let's say you accidentally took two pills; the graph would go down a lot. This would be a red flag for the doctor to act which will help reduce drug overdose and under dose.

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

2019

Word Count

228

Fair Category

P8

Project Number

5516

Title: The Effects of Different Types of Filters on Landscape Runoff

Student Name(s): L. TeeKing

Abstract:

26 February 2019

Abstract

The Effects of Different Types of Filters on Landscape Runoff

As the main component in many commercial fertilizers, phosphorus is beneficial in helping to grow healthy plants and crops. But when there is too much phosphorus, it is dangerous to the waterways and can lead to eutrophication. In this experiment, a design was used to collect and filter landscape runoff. Two different natural filters were used and compared to determine their effectiveness at filtering phosphorus from the runoff: biochar and acid mine drainage iron ochre. A common phosphorus test strip was used to determine the amount of phosphorus present in the runoff and in each of the filtered water. It was predicted that the iron ochre would be best at removing the phosphorus, but the data proved otherwise. Biochar actually proved to be the most effective at removing phosphorus from the landscape runoff with an average of 8 ppm left in the water. While the Iron Ochre was unable to be determined how much it filtered. The beneficial side of using natural filters such as biochar and iron ochre is that once they become saturated with the phosphorus, they can be reused as an additive to next year's plantings. This will reduce the need for additional fertilizer next season. The waterways will benefit and the demands for a limited natural resource will be reduced.

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

EM

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

254

2019

Fair Category

P8

Project Number

5517

Title: Testing Different Nano-Particle Inks as Electrodes in Printed Bio-Photovoltaic Systems

Student Name(s): M. Coisman

Abstract:

The Rockefeller Foundation estimates that more than 1 billion people have little or no access to electricity. These people are deprived of the most fundamental benefits of modern society. Our current practice of burning fossil fuels is not environmentally sustainable and, unfortunately, many of the green energy technologies such as silicon-based solar, wind, and nuclear power generation are out of reach for this poor and geographically remote segment of the population. In this project, I tested another, far cheaper variant of harnessing the sun's energy – bio-photovoltaic (BPV) systems.

BPV systems are similar to the silicon-based solar panels that can be seen on roofs all over the developed world; except, instead of using semi-conductive materials to capture free electrons in a chemical reaction, they use algae to harness the sun's energy during the biological process of photosynthesis. The technique I used – printing BPV systems onto pieces of cardstock was first pioneered at the Imperial College of London only 18 months ago. While they focused on the type of algae used, I took the concept to the next level and tested different nano-particle inks as electrodes in these BPV systems. My winning BPV system - which used a graphene-base ink - generated 21% more electricity per square inch. I was not content with this increase in maximum power output, so I also programmed a raspberry-pi-based controller to allow my BPV cells to follow the sun like a sunflower and capture its strongest rays which increased the output by another 6%.

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

ET EN CS

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

129

2019

Fair Category

P8

Project
Number

5518

Title: #Save the sip

Student Name(s): K. Tuccinardi

Abstract:

For my project I created (two) biodegradable versions of the plastic straw and tested them to see if they could replace the common but harmful item. My research showed how harmful plastic is to the environment, so I wanted to create an alternative solution, rather than just placing a ban or restriction on plastic bags, straws, bottles, etc. To test my hypothesis I first created the straws, the first by using milk protein and vinegar, and the second by using cornstarch, glycerin, and vinegar. After observing the straws, I came to the conclusion that using milk protein, called casein, can help you create an effective and efficient biodegradable straw, while using cornstarch, water, vinegar and glycerin doesn't hold its shape so is not as effective when making biodegradable straws.

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

EN EM

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P8

Project Number

5519

Title: Integrating Intelligence Systems into Humanoid Robot Using Raspberry Pi

Student Name(s): N. Lee

Abstract:

The Robotis Mini is a humanoid robot that is capable of several human-like motions. However, its main controller, the OpenCM 9.04, is limited to programming for servomotors. The Raspberry Pi Zero W is a small (2.6" x 1.2" x 0.2"), general purpose computer that is more flexible in its functions, having more interfaces and high-level programming. The objective of this project is to integrate the Raspberry Pi into the Robotis Mini in order to enhance its capabilities and give it a high level of intelligence. This is addressed by connecting the Pi to the OpenCM 9.04 and communicating between each other via Bluetooth and serial communications. Python is used for the programming of the Raspberry Pi, and then the program is executed to control the Robotis Mini's motion. This enables the Robotis to have more capabilities, becoming increasingly more intelligent, attaining functions such as vision sense, controlling motion, and object tracking. To assess this notion, three tasks are implemented: (1) testing Pi-camera for visual systems, (2) controlling motion kinematics of the Robotis Mini, and (3) object tracking with visual and motion systems. The successes of these assessments lead to many new possibilities. Because of how much more versatile Python is compared to the OpenCM default programming, new projects such as computer vision, audio sensory, and even more complex attributes such as Artificial Intelligence, which gives the Robotis a mind of its own, become possible. This project is the framework for implementing more intelligent systems into humanoid robots.

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

CS AT EE

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

93

2019

Fair Category

P8

Project
Number

5521

Title: Watch Out!

Student Name(s): M. Lopez

Abstract:

My experiment, titled "Watch Out!" tested whether the chemical reaction caused by Mentos in Diet Coke would change in height depending on the type of Mentos dropped inside the Coke. To test this I put white Mentos in the Coke and separately put colored Mentos in the Coke as well, testing to see how tall the explosion would be for each. I found that the reaction from the colored Mentos averaged 2 inches higher than the white ones. This is probably because of the added chemicals to produce the different colors and flavors.

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

CH PH

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

100

2019

Fair Category

P8

Project
Number

5522

Title: Bio Bottle

Student Name(s): C. Bruce

Abstract:

The point of my project this year was too try and find a solution to plastic. The reason I wanted to do this was because even if we don't realize, plastic is in everything and we use it everyday. We are basically attached to it so I wanted to try and help. I made a biodegradable water bottle made up of agar powder, which is algae and seaweed based. So you mix the water in the powder, boil it, pour it into a mold and put it in ice water. Then you fill it up with water, drink and enjoy!

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

EM EN

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

224

2019

Fair Category

P8

Project Number

5523

Title: Building A Better Hearing Aid Using Noise Cancellation

Student Name(s): P. Noe

Abstract:

Hearing aids have been helping people hear since the ear trumpet was invented in the 18th century, yet despite hundreds of years of technological advances the modern hearing aid still has several limitations. One major limitation is that hearing aids amplify both sound and ambient noise. Noise cancellation and directional microphones were used to solve this issue. In this project, a noise cancelling circuit was designed and built based on similar circuits used in active noise cancelling headphones. In order to test the prototype, two audio oscillators of different frequencies were set up. One was placed in front of the microphones to simulate signal and the other was placed at a comparable distance behind the microphones to act as background noise. Six configurations of the signal and noise microphones were set up and tested to see which one cancelled the most noise. When the signal microphone was embedded in sponge, 27 dB of noise were cancelled. These results are a significant improvement from the 5 to 16 dB of noise reduction allowed for by a Digital Noise Reduction (DNR) hearing aid. Digital Noise Reduction hearing aids use pattern recognition to cancel noise. This means that human speech will not be cancelled, even if it is distracting. However, adding a DNR circuit to this prototype could improve noise reduction further by better cancelling environmental noise.

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

AT EE ME

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P8

Project
Number

5524

Title: Wind Turbine Tree

Student Name(s): M. Zha

Abstract:

Wind Turbine Tree

Pollution is a problem that has plagued humanity for generations. It deteriorates lung tissues, increases heart pressure, and leads to strokes. Pollution also causes the greenhouse effect.

The objective of this research project was to design and create a product that resembles a tree but functions as a system of wind turbines. The goal was to make wind turbine systems more charming so more people are willing to utilize them near homes, thus stemming the use of fossil fuels, the main root of pollution.

The branches of the Wind Turbine Tree were sporadically placed to show the unpredictability of nature and designed so none of them overlap. The first step of construction was to build the turbines by attaching blades to a hub and the hub to a motor. The structure of the tree was made of PVC pipes, and each turbine was put on an individual branch. To test the prototype, it was placed in front of a high-velocity fan with a multimeter connected to one of its wind turbines. The amount of energy one wind turbine could produce was 1.5 volts. Altogether, ten turbines could produce 15 volts. This establishes that on a larger scale this type of system has the potential to produce significant renewable energy.

Although the Wind Turbine Tree was successful, it could be improved. The structure could be made taller to obtain energy more efficiently, and vertical wind turbines could replace the current ones to capture wind from any direction.

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

ET AT EE

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

246

2019

Fair Category

P8

Project Number

5525

Title: Aerodynamic Under Construction

Student Name(s): N. Rosales

Abstract:

Roofs have protected humans from severe wind for centuries, three types of roofs are designed explicitly against the wind. The three types of roof designs are the Gable roof, Hip roof, and Lean-to roof. The use of the gable roof was to keep out water from the walls and ceilings. Predominantly used in hurricanes and windy areas, the hip roof excels in harsh conditions. If three different known to be wind resistance roofs are to test, then the Hip roof will have the best results compared to the remaining two. The hypothesis is based on prior knowledge that the four inward slopes allow the Hip roof to be more durable than the Gable and lean to roof. The houses were built out of light wood, glue, and tape. They are measured 12 feet from the house to the leaf blower. The houses are placed on the marker, and when it is let go, the stopwatch begins. Step 4 was repeated for two more times at the same house. Then repeat steps 4 and 5 for the remaining houses. While timing the intel is logged and averaged. The data showed that the hip roof was more wind resistant than the other two roofs lasting 15.04 seconds while the lean-to roof lasted 8.82 seconds and the gable roof 8.59 seconds. By blowing the three different roofs, it was discovered that the Hip roof has the most wind resistance from a controlled distance, proving the hypothesis correct.

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

EM PH

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

P8

Project Number

5526

Title: Piezo Energy Collection from Quake Vibrations

Student Name(s): A. Brady

Abstract:

Piezoelectricity is a pressure sensitive method to capture energy, that provides an alternative to fossil fuels. Movement from quake vibrations or man-made vibrations (ex. cars on a bridge) could trigger sensors. Buildings have natural sway or movement from weather (wind or precipitation) that could trigger sensors.

This experiment explored variables that affect energy collected by a piezo sensor including building size, shape, base area, height, length, and building material as well as number of sensors applied to the building. Energy collected from structures in the community was also measured. The hypothesis predicted that taller buildings with smaller base areas, heavier masses, and consistent movement patterns would produce more energy.

LEGO® earthquake simulators, several scale LEGO® buildings and cardboard buildings were constructed for testing. LEGO® NXT was programmed to move the LEGO® simulators with different scenarios. A battery-powered shake table with quake design bars was also used for testing. Data was collected using an Arduino kit, and piezoelectric sensors. A simple circuit was created with a breadboard, resistor, and modified Arduino knock coding to measure volts from the sensors to compare variables.

Several phases were conducted as modifications were made to improve quake tables, building design and performance. Over 5,000 data points were analyzed. Results supported the hypothesis that a single sensor at the building base, taller buildings, heavier buildings, and smaller base areas generated more energy. Consistent wave patterns generated higher voltage than random patterns. Several of the real world data trials showed potential for energy collection.

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

EE ET AT

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

83

2019

Fair Category

P8

Project
Number

5527

Title: Testing Airfoils in a Wind Tunnel

Student Name(s): B. DeMartino

Abstract:

In this experiment, I tested two (vastly) different airfoils in a wind tunnel in order to see which one was the most aerodynamic. My two tested objects are a laminar flow airfoil, and a ping-pong ball. While testing, I found that the laminar flow airfoil was shown to be the most aerodynamic out of the two objects. This conclusion makes sense, as it is already used in real-world applications (such as for aircraft wings and rotors), and the sphere is not.

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

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

169

2019

Fair Category

P8

Project Number

5529

Title: Blown Away

Student Name(s): H. Jordan

Abstract:

An experiment was conducted to see how the material of a pinwheel affects its speed. The reason for this experiment is to see if wind turbines could be made more efficient. The hypothesis was that a pinwheel made with lighter materials would spin faster. The experiment supported the hypothesis. Four pinwheels were made, each constructed out of a different material. These materials were newspaper, printer paper, construction paper, and cardboard. The pinwheels were held up to an electric fan for 10 seconds from two different lengths away. the spinning pinwheels were recorded using a phone, then the video was analyzed in slow motion to count the number of spins. The pinwheels made with lighter materials spun faster than the pinwheels made with heavier materials. The application for this experiment is applying it to a similar tool, a wind turbine. Because the faster s wind turbine spins, the more energy it will generate, so making a wind turbine out of a lighter material would make a wind turbine more efficient.

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

P8

Project Number

5530

Title: Facial Detection using Raspberry Pi and Python

Student Name(s): L. Manke

Abstract:

Facial recognition is an important factor in technology with endless possibilities for future uses. This project investigates this technology from beginning programming to analysis of images collected.

This project used a Raspberry Pi with a camera and Python programs, to take pictures, detect faces and investigate variables that affect facial detection performance. The researcher had no prior experience with coding or a Raspberry Pi. Time was spent learning how to setup and use the Raspberry Pi to write simple programs in Python. These included finding the slope of a line from user input and finding birth year based on questions answered by a user. After attaching a camera to the Raspberry Pi, programs were written to take pictures. Updates, upgrades, and libraries were added for use with a facial detection program. Many difficulties were encountered before the program was working and usable for data collection. Python Imaging Library (PIL) was used to explore characteristics of images to determine next steps and help with troubleshooting. Fifty pictures were taken for Phase I testing to measure facial detection performance. Settings in the program were modified to improve performance. Hundreds more pictures were taken for testing to analyze effect of other variables. Images were taken with white, green, and black backgrounds, at 5, 10, and 15 feet, and with different facial expressions.

Phase one testing detected all actual faces in all images, but falsely identified some areas as faces. Phase II showed distance, program settings and backgrounds could degrade and/or improve performance.

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

CS AT BE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

195

2019

Fair Category

P8

Project
Number

5531

Title: The Vision Assist 2.0

Student Name(s): S. Bhardwaj

Abstract:

The Vision Assist 2.0 is an enhanced prototype of the Vision Assist 1.0, showcased at the Cheshire Public Schools Discovery Expo and the Westport Maker Faire in 2018. The Vision Assist 2.0 is a device, powered by the Raspberry Pi prototyping board, built to assist the visually impaired move around safely, alerting the wearer about the obstacles ahead by providing 5 alerting methods. The Vision Assist 2.0 is using a hat, glove and carrying case for easy mobility. The hat has four ultrasonic sensors that are front, back, left, and right for 360 coverage. The sensors determine how far away an object is. With that data, the Raspberry Pi processes the information and produces a sound, or sets off a vibration, based on the direction of the closest object. The glove has four vibration motors, which is also front, back, left, and right. There are five modes, the wearer can choose any of offered 5 modes as they desire per their comfort level. The first one being vibration only, the second being buzzer only, the third one being audio only, the fourth being buzzer and vibration, and the last one is vibration and audio mode.

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

AT CS EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

175

2019

Fair Category

P8

Project Number

5532

Title: Tracking Geomagnetic Storms in the Ionosphere

Student Name(s): Y. Oukassi

Abstract:

The title of the project that I was conducting is "Tracking Geomagnetic Storms In The Ionosphere". The question for this experiment was can GPS error signals be used to detect geomagnetic storms. This experiment was done to find efficient ways to detect geomagnetic storms and how to use the information for preparation. In this experiment, a chart was made and divided into sections for each type of measurement (longitude, latitude, altitude, whether the WAAS was on or off, and the level of error). WAAS is a type of GPS system that gives more accurate GPS readings compared to an ordinary GPS system. In the project, measurements were found in both system and the difference between the two were calculated. The greater the difference, the stronger the storm is supposed to be. The strength level of the storm is measured in Kp Index in scale from 1 to 9, 1 being the lowest. The difference and Kp Index numbers were compared for data. In the conclusion, GPS error levels can be used to track geomagnetic storms.

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

AT 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

252

2019

Fair Category

P8

Project Number

5533

Title: Temperature vs. Time

Student Name(s): K. Wilkos

Abstract:

The purpose of the project I performed was to see which material out of wood, metal, plastic, and glass would hold a low temperature for the shortest amount of time. To complete this experiment, I used the wood, metal, plastic, glass, a temperature gun, and a stopwatch. I thought that this experiment would prove that plastic would stay cold for the shortest amount of time, followed by wood, glass, then metal. To perform this experiment, I left each material outside in 6-degree (Fahrenheit) weather. When I was sure that the temperature of my materials would not change any more, I started the experiment. I laid out my stopwatch, table (to record my results), temperature gun and brought in my first material, glass. Once the glass was inside I laid it on a 68-degree (Fahrenheit) counter and started my stopwatch. After one minute, I checked the temperature with my temperature gun to see how much it rose. Letting my stopwatch run, I marked down the temperature each minute for 5 consecutive minutes. I did this same experiment for the plastic, wood, and metal. Once I had my results, I put them into a neater table so I could read them more clearly. Contrary to my hypothesis, metal held a low temperature for the shortest amount of time, followed by plastic, then glass, and finally, wood. These results surprised me because I thought that metal was a good temperature conductor and it would have stayed cold for a longer amount of time.

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

ET EV EM

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

208

2019

Fair Category

P8

Project Number

5535

Title: The Internal Hearing Processor

Student Name(s): E. Novak

Abstract:

The World Health Organization states that over 446 million people are disabled with hearing loss - that is over five percent of the world's total population! One of those people is me! At this point in time, hearing processors or the computer to hear is on the outside of the ear.

The objective of this project was to create a hearing processor prototype in which the processor is barely visible, and with limited exposed wiring on the outside of the head. The materials used were a speaker, two cell phones, and a foam mannequin head. One of the cell phones released the signal of the sound. The speaker was used to act as the brain. Lastly, the other cell phone was used to take in the sound waves that are produced. All of this was done with Bluetooth.

This project was a success as it was able to represent a processor that is barely visible, and with limited exposed wiring on the outside of the head. With further development a processor like this has the potential to eliminate the hassle of putting the battery onto the computer processor, putting it on your ear, and then taking them off to charge when you go to sleep would be decreased tremendously.

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

EN AT EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

129

2019

Fair Category

P8

Project Number

5536

Title: The Effects of Different Cleaning Agents of the Levels of Pesticides in Fruit

Student Name(s): J. Williams

Abstract:

This project was designed to test the effectiveness of different cleaning agents to remove pesticides from lemons. Which cleaning agent is the most effective at removing pesticides from lemons? The hypothesis predicted that all cleaning agents will remove some of the pesticides from the lemons, but the baking soda solution will remove the most pesticides from the fruit. However, the salt water mixture proved to be the best at removing the most of one pesticide from the lemons. Thiabendazole was found in all the lemons and the amounts decreased the most after being soaked in a salt water mixture. Overall, none of the lemons reached levels to cause serious health effects, but this shows that the safest method to soak fruits is by soaking in a salt water mixture.

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

EV PS EM

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

P8

Project Number

5537

Title: Freezing Substances

Student Name(s): M. Sponzo

Abstract:

Freezing Substances

I was curious to find the results of this experiment. I will determine what substance will freeze the fastest at room temperature 21°C versus boiling temperature 90°C. My hypothesis is that the substances that are at room temperature 21°C will freeze faster than the substances that are boiled to 90°C. I predict that the water will freeze the fastest.

I created a data table to record my results. I measured ½ cup of four different substances and poured each into 4 clean cups. The cups sat until they reached room temperature 21°C. I placed the 4 cups in the freezer and started a stopwatch. I checked each substance every 15 minutes until they were all frozen. I recorded the results.

I measured ½ cup of each substance again and poured each one individually into a pot. I boiled until each substance reached 90°C. Once all the substances were boiled, I put them into the freezer and started the stopwatch. I checked each substance every 15 minutes until they were all frozen. I recorded the results.

Water was the fastest to freeze in both the room temperature and boiling temperature experiments. The substances that are boiled to 90°C froze faster than the substances at room temperature 21°C. I learned that this is called the “Mpemba Effect” named after Erasto Mpemba, a Tanzanian high school student who first observed it in 1963. Evaporation is the strongest process to explain the Mpemba Effect.

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

CH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

108

2019

Fair Category

P8

Project
Number

5538

Title: Solar Powered Tesla Coil

Student Name(s): K. O'Marra

Abstract:

For my science fair project, I tested out whether or not solar energy could power a Tesla coil. I bought a solar panel and then measured the output of energy from it using a voltmeter. I then made tin-foil magnifiers to increase the sun's power and measured it again. After that, attached the solar panel to a Tesla coil to see if it would power the Tesla coil. I found out that with the magnifiers, the solar panel did not produce enough energy to power the Tesla coil. This was because the Tesla coil needed a high amount of energy to force energy through the electromagnetic field.

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

ET EE

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

184

2019

Fair Category

P8

Project Number

5539

Title: Recycled Plastics As Insulators For Energy Efficient Homes

Student Name(s): G. Chirayil

Abstract:

Insulation can help keep buildings warm during the winter and cool during the summer without needing to switch up the thermostat and use fossil fuels. In this experiment, different insulators such as fiberglass insulation, and styrofoam insulation were used to see which is most effective. Recycled plastics such as plastic straws, recycled plastic water bottles, a plastic T-shirt, recycled styrofoam, and recycled styrofoam with a sheet of aluminum were tested to see if recycled plastics can be used effectively as insulators as compared to common insulators. For the control experiment only air was used. Recycled plastics were tested because plastic is thrown away a lot, and insulation could be a place for plastics to go instead of landfills. The best insulator was determined by measuring the amount of heat that was transferred from the heated side of a box to the other side with the insulator inside. The best insulator was the recycled water bottles. The side that was exposed to heat was 236.5°F, and the side that was not exposed to heat was 75.1°F. The difference between the two temperatures was 161.4°F.

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

EM ET

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

209

2019

Fair Category

P8

Project
Number

5540

Title: Saving the Ocean: 700,000 Microplastics at a Time

Student Name(s): A. Brown

Abstract:

My experiment is testing different types of filters on microplastics in the water to build a filter to be used in washing machines. Microplastics are bits of plastic that are 5mm or less that come from many different things such as being broken down from bigger pieces of plastics. They are incredibly bad for the environment hurting animals and are found almost everywhere. My hypothesis is that the 50 micron wire filter will perform the best because it is one of the strongest filters, as well as the smallest micron. It does not give off its own microplastics either because it is made of metal wire. For the prototype I predict that the first layer should be the 150 micron wire filter because it will catch the bigger particles, then the 100 nylon filter, then the 70 micron nylon filter then the 50 micron wire filter, so the smaller filters won't be overwhelmed. The coffee and Whatman paper filter main filter microplastics but will not withstand the force or pressure of the water, and filter very slowly. My experiments found that for maximum filtration effectiveness and efficiency to layer the filter largest micron to smallest spaced apart. It will not affect flow rate and will filter 99% of microplastics.

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

EM AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

226

2019

Fair Category

P8

Project Number

5541

Title: The Crane, One of The Most Useful Compound Machines

Student Name(s): N. Bruce, N. N/A, N. N/A

Abstract:

Introduction: My project was to build a working crane able to lift fifteen pounds. To accomplish this, I made a simple crane using an electric motor and block and tackle.

Methods/Results: I made three designs for my crane because of difficulties that arose working on the project. Each design used the same frame, but different motors. The frame was built by creating a simple base made of a wooden platform, four legs, and arm. The block and tackle was hooked on a screw with the pulley above to lessen the friction of the rope against the arm. The first design used a small electric motor. This design did not work because the motor was not powerful enough. The second design used a drill's motor attached to a nail embedded into a piece of wood that served as a spool for the rope. The nail failed, so I tried the same model with a screw. It worked initially but failed too, so I made a third and final design. The third design also used a drill, but it used a hook connected to the drill. The final design was able to lift fifty pounds.

Conclusion: Cranes are an integral part of many industries including shipping, building, automotive manufacturing, and others. The third design was the most successful; it lifted fifty pounds and exceeded my design goal.

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

EE AT

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

P8

Project Number

5542

Title: Surf's Up

Student Name(s): T. Baldini

Abstract:

The purpose of my experiment was to examine the effect of thermal expansion on certain types of water. Thermal expansion is the process in which matter changes its shape, area and volume due to a change in temperature. Temperature is a monotonic function of the average molecular kinetic energy of a substance. A monotonic function of a substance is a change (an increase or decrease) in one of its qualities such as temperature. When a substance like water is heated, the kinetic energy of its molecules increases and causes the substance to expand.

I chose this experiment because thermal expansion has a significant impact on our environment. When water is heated, its volume and temperature expand. Over many decades, the temperature of the Earth's water has increased due to such things as industrialization, the burning of fossil fuels, an increase in the world's population and the emission of greenhouse gases such as carbon dioxide, methane and nitrous oxide. The rising water temperatures and increase in water levels has caused sea levels to rise which has negatively affected our environment.

In this experiment, the process of thermal expansion was tested using tap water and salt water. The tap water and salt water were the independent variables. The positive control was the heat source. The negative control was the unheated salt water and tap water.

I predicted that the volume of tap water would increase more than the volume of salt water. My results showed that my hypothesis was correct.

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

PH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

229

2019

Fair Category

P8

Project Number

5544

Title: The Battle of The Fabrics

Student Name(s): K. Rowland

Abstract:

I wanted to conduct an experiment where I tested the thermophysiological comfort in polyester and cotton shirts. Thermophysiological comfort is how well fabrics can transport heat and moisture away from your body. I wanted to see if I had put both a polyester shirt and a cotton shirt over a cup of water and then the water under a heating lamp which fabric will cause the temperature of the water to increase the most. I had predicted that the cotton shirts would cause the least amount of increase to the temperature of the water because cotton conducts heat away from your body while polyester traps in heat and moisture. To test this I used four different blends of fabric. Using a rubber band I secured the shirts on top of a cup of water. I checked the original temperature of the water before adding any sort of heat with the lamp. Next, I turned on the lamp and recorded the temperature of the water every two minutes for twenty minutes. After conducting my experiment I saw that the shirt with the highest percentage of cotton, had the lowest increase in temperature going up by only 2.1 degrees F. My hypothesis for the cotton was correct. However, my hypothesis was incorrect for the polyester shirt because the shirt had the second lowest increase. Only going up by 2.4 degrees F.

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

EN AT

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

P8

Project Number

5545

Title: "Is It Really Childproof"

Student Name(s): M. Lindsey

Abstract:

The title of my project is "Is It REALLY Childproof?" The purpose of this project was to test different childproof products. The products I chose to test were a door knob cover, a cabinet lock, and a pill bottle. I had three test subjects the ages of 4-7 and three trials were conducted for each one. The background information is that childproof locks were around for thousands of years and Ancient Mayans were given the credit of creating the first ones. Did you know that the first known childproof lock was made to protect a vat of chocolate? It's surprising but true.

The reason I chose this project is because of my love for younger children. I have a ton of younger children in my family and I am one of the older ones. When I go out to my aunts and uncles homes, their children can easily open the childproof locks that could be found around the house. What was the point of them being there and claiming to be child-proof if young children were able to open them with ease. This led me to question the safety of future generations. These kids are our future and will carry on our legacies. The fact that it deals with the safety leads on to why it is so important. This experiment I have conducted should be regularly tested because of the fact that it deals with the safety of younger children. This should be something we make a priority.

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

PH

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

229

2019

Fair Category

P8

Project
Number

5546

Title: Ultraviolet Radiation
Studying the Reaction Rates in Ultraviolet Beads

Student Name(s): C. Jeffers

Abstract:

Most of the ultraviolet (UV) light produced by the Sun is blocked by the atmosphere, but some UV light does still reach the Earth. The light can be detected by using UV beads. UV beads contain a pigment that changes color when exposed to ultraviolet radiation from the Sun. In this experiment, UV beads were used to study how temperature can affect the rate at which UV beads lose their color.

During the procedure, four cups with 10 UV beads in each of them were placed outside for one minute so that they could react to the ultraviolet radiation being produced by the sun.

When the minute was over, each cup was brought back inside and timed to see how long it took for all of the UV beads in each up to return to its original color.

During each of the three trials, cup #4's beads took the quickest amount of time to return to their original state, cup #3's beads were next to return to their original color, and cup #2's beads took the longest amount of time.

My hypothesis stated that the beads in cup #4 would take the least amount of time to change back their original color, then the beads in cup #3, and the beads in #2 would take the longest. The results of the experiment proved my hypothesis incorrect.

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

EV ET

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

P8

Project Number

5547

Title: What local town is the best for stargazing?

Student Name(s): G. Gogliettino

Abstract:

Less than a hundred years ago, anyone who looked up at the sky, would see a spectacular starry night sky. Nowadays, most citizens can only see a few stars and nothing near the spectacular sight that once was. For three billion years, Earth had a pattern of light and dark which was created by the illumination of the Sun, Moon, and stars. Currently, artificial lights overpower the darkness and disrupt nature's balance between light and darkness.

For this experiment, the procedure was somewhat easy. The first step, like in any experiment, was to collect all materials. The next step was to get to the first location. Upon arriving at the first location, set up a tripod and camera and take all pictures for the data needed. After doing this, the same process needs to be repeated for each and every location selected. After the data is collected, the photographs from all locations must be compared.

The purpose of this experiment was to test light pollution levels in different locations. The locations were New Haven, East Haven, Branford, Guilford, and Madison. The results showed that Madison had the least skyglow and New Haven had the most. The original hypothesis turned out correct in guessing that when in an area with low light pollution levels, more stars would be visible. Since Madison has a population of about 18,000 which is less than the other towns experimented on, it makes sense that Madison would have the least light pollution out of all locations.

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

PH EV

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification
2019

Word Count

157

Fair Category

P8

Project
Number

5548

Title: The Effect of Synthetic Dyes on Natural and Synthetic Fabrics

Student Name(s): A. Hoyt

Abstract:

February 25, 2019

Abstract

The Effect Of Synthetic Dyes On Natural And Synthetic Fabrics

The objective of this experiment was to see whether synthetic dyes lasted longer on synthetic fabric after exposure to Connecticut weather. It was predicted that the synthetic dye would last longer on the natural fabric. After sitting in a dyebath for twenty minutes, each piece of fabric was left undisturbed for forty-eight hours to dry. After drying, each piece of fabric was nailed to a wooden board and left out in Connecticut weather for twenty-one days. It was concluded that at the end of the twenty-one days the natural fabrics showed to be better dye-holders, proving to have a darker color. The averages were close, but because some fabrics absorbed close to no dye at all, while others showed the darkest color on the color scale. So, my hypothesis was proven correct, synthetic dye lasts longer on natural fabrics.

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

87

2019

Fair Category

P8

Project
Number

5550

Title: Breaking the Ice

Student Name(s): C. Dainiak

Abstract:

The purpose of this project was to test if Diet Pepsi or sugar could melt ice faster than salt. I put $\frac{1}{4}$ teaspoon of each substance in a container with $\frac{1}{2}$ teaspoon of ice. The control was no melting agent. The variables were adding salt, adding sugar, or adding Diet Pepsi to the ice. In the experiments it was discovered that salt was the fastest melting agent and Diet Pepsi took longer than the control. Any melting agent helps besides Diet Pepsi, but salt was the best.

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

CH

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- Yes No

CSEF Official Abstract and Certification

Word Count

232

2019

Fair Category

P8

Project
Number

5551

Title: Cool Cups

Student Name(s): J. Palas Garcia

Abstract:

Cool Cups is about how the design and type of material of a cup affect how well it will insulate a liquid. This problem is important because you want your beverage or liquid to remain the same temperature as you go on with your day. You also want to make sure your cup is worth buying. This experiment can be useful to bigger things like freezers or your house in the winter, so it won't get that cold. I measured the temperature over a period of 90 minutes for cold, hot and room temperature water for each cup. I found that the best cup for keeping water hot is Yeti because its overall change in temperature was less than the other thermal mugs compared to their original hot temperature. The worst cup for keeping water hot is the ceramic Mug. I found that the best cup for keeping water cold is Yeti because it's overall change in temperature is less than the other thermal mugs compared to their initial cold temperatures. The worst cups for keeping water cold are Tervis and Aladdin. I found that the best cup for keeping the room temperature water the same is the ceramic Mug because its overall change in temperature is less than the change of the other cups compared to their starting temperatures. The worst cup for keeping room temperature water the same is Aladdin.

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

EN

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CSEF Official Abstract and Certification

Word Count

117

2019

Fair Category

P8

Project
Number

5552

Title: Testing of the Efficiency of CO2-Style Air Engines

Student Name(s): J. Gerlach

Abstract:

Many model airplanes run on carbon dioxide engines. These engines deliver power to propel the aircraft. Currently there is little scientific research concerning the most efficient carbon dioxide style engine. The objective of this science project is to find what kind of CO2 engine is the most efficient. In this research a 3d printed carbon dioxide style air engine was made. The engine was made out of PLA and was designed in a CAD software program. The engine was designed for easy customization in order to simplify the testing and building of the engine. Rotations per minute, the torque, the flow rate into the engine, and the pressure into the engine will be tested and efficiency calculated.

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

EE AT ET

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4. Is this project a continuation? Yes No

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CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

P8

Project Number

5553

Title: Tracking Plastic Bottles on Blockchain - Better Environmental Policies and Accountability through Economic and Accurate, Real-Time Management

Student Name(s): C. Harris

Abstract:

The purpose of my project is to design a system to track plastic bottles with RFIDs on blockchain to reduce pollution. Tracking bottles allows you to charge manufacturers for the pollution they create and raise funds for the clean-up. It also allows you to monitor policy changes to find the best ways to reduce plastic waste.

The best way to track bottles is to use RFID chips. RFIDs are better than regular tags such as QR codes and barcodes because those tags cannot be scanned when bottles are mixed with other trash. The main problem with RFIDs is they very expensive to inject into the plastics. We can reduce the cost through sampling, which is only putting RFIDs on some of the bottles instead of all of them. Because many bottles are produced, sampling can give an accurate accounting of all the bottles. Blockchain would be used because it allows us to secure the data, make the system easily accessible to people throughout the country, and let people track the effect of new policies on the number of bottles ending up in the environment.

My simulation shows that even 1 RFID device per one thousand bottles still gives good tracking accuracy, and the entire system is affordable. I use a simulation to show how charging manufacturers for bottles raises money to offset some of that pollution. My simulation also shows how feedback can optimize the deposit charged on bottles as well as the impact of investing in education and clean-up.

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

CS EM MA

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CSEF Official Abstract and Certification

Word Count

218

2019

Fair Category

PS

Project
Number

6001

Title: Enhancing Dye Sensitized Solar Cell Efficiency Through the Application of a Silica Structure Microfilm Layer

Student Name(s): C. Mazerolle

Abstract:

Skeletonema costatum is a diatom made up of a silica structure. The pores found on the frustules of the structure are at an optimal angle for refracting and focusing the incoming sunlight. The method in which the silica is applied to the dye sensitized solar cell is through a microfilm layer. This microfilm layer is constructed out of a UV treated polygel containing fumed silica particles. A piece of glass is coated in the polygel and is placed on top of the solar cell so that the microfilm layer can be removed and reapplied effortlessly. On average, the control solar cell (no microfilm layer) produces .03 milliwatts (10 millivolts and .003 milliamps) during a five minute trial. Alternatively, the experimental solar cell (has a microfilm layer) produces an average of .06 milliwatts (12 millivolts and .005 milliamps) during a five minute trial. Therefore, the application of the silica layer doubles the productivity of the solar cell. The improvement of renewable energy sources, such as solar energy, is a necessary step towards a greener planet. This experimental breakthrough provides hope for the next generation of economically effective solar panels. In the future, the method used in this experiment of adding a microfilm layer of silica to a solar cell could potentially be applied on a larger, more practical scale.

**Technical Disciplines Selected by the Student
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ET EE AT

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CSEF Official Abstract and Certification

Word Count

268

2019

Fair Category

PS

Project
Number

6002

Title: Simple Creation of Portable Renewable Energy using a Recycled/Repurposed Water Bottle – *C. reinhardtii* Biophotovoltaic System

Student Name(s): Z. Wang

Abstract:

Climate change remains at the fore of current research initiatives, as the depletion of our natural resources continues. Biophotovoltaics (BPVs) has come into focus as a promising renewable energy resource. Unlike solar, which require expensive materials for their fabrication, BPVs are constructed with recycled materials and are particularly useful in remote, underdeveloped areas. The output of BPVs, however, remains poor; improvement is needed to increase its viability. This research details the design of an optimized, multichannel BPV, composed of used water bottles, aluminum cans, and *Chlamydomonas reinhardtii* (in simulated pond water; 500 μ S/cm conductivity). For each BPV, a 500ml recycled water bottle is used as the “cell” housing. The cathode consists of a 2.5x10cm Pt-loaded carbon cloth that is inserted into an 18cm (11mm OD) plastic straw; 6mm holes were punched into the straw, to optimize water flow. The anode is comprised of an aluminum can (4.6g), which is cut into a single 2.5x68cm strip. BPV performance was optimized for algae concentration and cathode content. With 2.3x10⁻³ nmolChl/ml equivalent *C. reinhardtii*, and a 2.5x10cm 0.5mg/cm² 20%Pt-load-on-carbon, a BPV output of 235mW/m² was realized. To increase BPV viability for remote regions, a floatable, 3D bottle holder was designed with side-clips, so that holders can be joined in an open pond, creating a multichannel BPV grid, with open-cell bottoms. In a 6-channel, optimized-BPV tandem, grid output reached 171mW/m² using typical pond water (~200 μ S/cm conductivity). To facilitate adoption of the BPV-grid, the 3D holder-design will be crowdsourced, to allow for simple construction, at ~\$2/cell.

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

ET EN AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

PS

Project Number

6004

Title: Diagnosing Parkinson's Disease with Artificial Intelligence

Student Name(s): A. Agarwal

Abstract:

Parkinson's Disease (PD) is one of the most common neurological disorders, affecting more than ten million people globally. The hallmark symptoms of PD are tremors, limb rigidity, and imbalance. PD shares many of these symptoms with other disorders, making it difficult to diagnose. Furthermore, due to the lack of definitive laboratory tests, PD is poorly diagnosed with subjective examinations such as family history evaluations, thereby resulting in high misdiagnosis rates. Recent research shows that an additional symptom, dysphonia, is present in over 80% of PD patients. Dysphonia is a speaking disorder caused by involuntary muscle movement and other neurological factors in PD. In this project, that unique symptom was taken advantage of in designing a machine learning algorithm. A cross-validated neural network was programmed to deliver rapid and accurate diagnoses using biomedical voice data from 195 patients of varying statuses. This automated, machine-learning based PD diagnostic tool was successfully created and functions with over 95% accuracy. This rate includes nearly zero false negatives and few false positives, showing significant improvement over previous attempts which had misdiagnosis rates of nearly 20%. A low probability of false negatives is favorable. The neural network was designed such that overfitting is avoided, and more features/data would further improve the algorithm's accuracy. The algorithm is currently being implemented such that patients can submit their voice recordings through an application for an accurate remote diagnosis. An early and accurate diagnosis is critical for treating PD patients, and this project proposes a way to achieve that.

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

CS AT BI

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

PS

Project
Number

6005

Title: Real-Time Sinkhole Detection Using Civil Engineering Techniques, the Internet of Things (IoT), and Artificial Intelligence

Student Name(s): S. Wang

Abstract:

In the United States, 20% of land is susceptible to sinkholes. Designs derived from civil engineering (structural health monitoring system (SHMS) and wireless sensor network (WSN)) and computer science (the Internet of Things (IoT) and Artificial Intelligence/Machine Learning (ML)) were used to more accurately and efficiently detect sinkholes compared to current methods, which are inapplicable to the most dangerous sinkhole type (cover collapse) and are not practiced in real-time. SHMS and WSN were used to create a sensor network that could diagnosis underground structural state in real time. A sensing device which modeled the limestone dissolution process was used to encapsulate the sensor network. IoT was applied to create a user friendly interface, and ML algorithms were developed to analyze data in realtime. ML allowed for system automation. To test the system, a cover collapse sinkhole was physically modeled using karst geology. The sensing devices were placed in set locations prior to simulation. The sensor data was recorded during simulation and ML analyzed in real-time. The ML Algorithms (Neural Network, Naive Bayes, K-Nearest Neighbor, Random Forest, SVM) had high testing accuracy, with Random Forest obtaining a 93% testing accuracy after training. The Algorithms provided for a significant detection period prior to the collapse and served as a prediction model. The detection system accurately and efficiently detected future sinkhole occurrences in real time, and when advanced, these designs have the potential to not only reduce property damage, but more importantly, reduce the massive public health threat that sinkholes pose.

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

EA AT CS

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

PS

Project
Number

6006

Title: Influence of Ionic Strength on the Cleavage Rate of DNAzyme Tethered Nanocapsules

Student Name(s): D. Allam

Abstract:

In cancer research, the current understanding is that the concentration of RNA may diagnose and determine the severity of cancer. The focus of this study is to find a rapid and accurate diagnosis technique. DNAzymes are engineered to mimic functions of naturally occurring protein-based enzymes. Recent studies have discussed "RNA-cleaving DNAzymes," which have been derived so that their activity is dependent on a given chemical or biological stimulus.

Another goal is to identify the influence of the ionic strength on the rate of cleavage of RNA using DNAzyme tethered nanocapsules. Once the RNAs are available in the cell the DNAzymes will bond with RNAs. DNAzyme will then cleave causing the dye to be released from the nanocapsule and will result in fluorescence. The more RNA that bind, the stronger the fluorescence response. Therefore, it is expected to indicate the correlation between ionic influence and cleavage rate. The concentration of RNA is expected to be directly proportional to the level of fluorescence. If the fluorescence is higher than average it would suggest that cancer has reached a more advanced stage and may be difficult to eliminate. However, the sooner this is done on a patient the more likely they can check how aggressive their cancer is, and hopefully catch it an early stage.

Currently, we have created the nanocapsule and the DNAzyme. The DNAzyme will be tethered to the nanocapsule and the ionic influence will be tested. Results are pending but will be complete in time for the competition.

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

CH BI ME

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

217

2019

Fair Category

PS

Project Number

6008

Title: Measuring the Effects of Gravity on Planck's Constant using a Watt Balance

Student Name(s): J. Trahanas

Abstract:

Planck's constant was originally formulated in 1900 by Max Planck as a means of calculating the light emitted from a blackbody at any given temperature. This led to the expression $E_n = nhf$, in which n can only be an integer, which accurately predicted the distribution of blackbody radiation. It has since become the backbone of modern physics. In order to acquire an accurate measurement of Planck's constant, the National Institute of Standards and Technology uses a watt balance - a device that, as opposed to traditional balances which use two weights to balance each other, uses electromagnetic forces to balance one weight. Using this method, they have been able to define Planck's constant as $6.626069934 \times 10^{-34} \text{ kg}\cdot\text{m}^2/\text{s}$ with an uncertainty of 13 parts per billion in 2017. However, NIST's measurement was taken in an environment with a constant gravitational field. This research focuses on the effects of varying gravitational fields during the measurement of Planck's constant, which could possibly explain the uncertainty of the value. In order to detect a difference in the constant, a watt balance was constructed and certain components of the balance were encased in lead to create a microgravity field without disturbing the physical weight. The results of these measurements were then compared with a control group to detect the differences.

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

PH

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

PS

Project
Number

6009

Title: How can the technology in commercially available consumer-level modern wearable devices be applied to help reduce risk of coronary heart disease?

Student Name(s): R. Annadurai

Abstract:

The world's number one killer is heart disease. The most common form of heart disease is coronary heart disease, where plaque builds up inside the arteries and blocks the delivery of vital oxygen. Heart disease affects all ethnicities and, more commonly, those ages 65 or older. The major risk factors for coronary heart disease are smoking, poor diet, and lack of exercise. My project aims to answer the question, "How can the technology in commercially available consumer-level modern wearable devices be applied to help reduce risk of coronary heart disease?" Given the recent rise in wearable technology devices in the mainstream market and their assortment of biometric sensors, my research experiment aims to look at further applications of these specific mechanisms to aid in lowering risk of heart disease for users. This involves looking at the different methods of usage and the specific medical capabilities of the products (i.e. what metrics they measure, treatments they can administer, cost efficiency, and unintended side effects). A recent research article, "Wearable Sensors/ Systems and Their Impact on Biomedical Engineering", by Paolo Bonato, analyzed the applications of wearable sensors and systems, such as the immersion of wireless technologies such as IEEE 802.11b, Bluetooth, and cell phone technology. Furthermore, the article inspected the prospect of advancements in ambulatory electroencephalography to increase efficiency in the diagnosis of epilepsy and seizure treatment. The findings and results of Bonato's study indicate that novel utilization of wearable technologies in the biomedical field can produce life changing results.

**Technical Disciplines Selected by the Student
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EN ME EE

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- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

PS

Project
Number

6010

Title: Harnessing Machine Learning and Sentiment Analysis to Predict Future Prices of Individual Stocks

Student Name(s): L. Tang

Abstract:

This research project aims to develop a novel stock forecasting model through the synthesis of machine learning and sentiment analysis algorithms. In particular, I hope to quantitatively categorize and measure public opinions (e.g. optimism, anxiety, doubt, positivity, neutrality, etc.) pertaining to individual stocks through the sentiment analysis of social media content (e.g. Tweets, Facebook comments, etc.). This analysis, then coupled with a traditional machine learning algorithm, such as a Neural Network, Multivariate Linear Regression, or Support Vector Machine, will hypothetically yield a novel, more precise predictive model.

To accomplish this task, I executed four broad steps. First, I scraped the web for time-series company-specific stock price data from Quandl (a platform for financial and economic information, akin to the now-inaccessible Yahoo Finance API), as well as company-specific Twitter mentions. Then, I constructed a Long Short-Term Memory Recurrent Neural Network based solely off the collected stock price data. Afterwards, I utilized BeautifulSoup, a Python library for sentiment analysis, to categorize and assign weight values to each Tweet mentioning the company. Ultimately, I incorporated the sentiment analysis values for the Tweets back into my original Neural Network.

As of now, my conclusions are still pending. However, in the near future, I plan on comparing the accuracy of the novel predictive model with previous algorithms. The primary metric of accuracy I intend on utilizing is the Mean Absolute Percentage Error (MAPE), which measures the difference between predicted and actual stock prices.

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

CS BE MA

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

PS

Project Number

6011

Title: Quasar Near-Infrared Magnitude Variability over Right Ascension and Declination

Student Name(s): J. Paulin

Abstract:

Quasars are the most distant and luminous objects detectable in the universe. They are so distant that they offer a look into the history and development of early astronomical objects and the universe as a whole. Typical characteristics of quasars include an accretion disk, large amounts of radio emissions, variability, high redshifts, and broad emission lines. Although it is known that quasars vary over time, this study is meant to track patterns related to variability with respect to their location in the sky, primarily right ascension and declination. To track these patterns, the Sloan Digital Sky Survey (SDSS) Data Release 7 was used, specifically the Quasar Time Variability from Large Data Sets, compiled by MacLeod et al. The data used in this study was the northern sample for which three or more observations of each quasar were made. The data was converted into a CSV file using Excel, sorted by either right ascension or declination, and read into R to create a scatter plot and track patterns. Specific attention was paid to near-infrared wavelengths, represented by the "I" band described by the SDSS. Running tests showed little correlation in variability with respect to either right ascension or declination. However, as an extension, the same data was sorted with respect to redshift, another type of location indicator. The data showed oscillating levels of variance, similar to a sinusoidal function. Although this study did not fulfill its original intention, the results apply to quasar evolution, since redshift correlates with distance.

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

PH

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- Yes No

CSEF Official Abstract and Certification
2019

Word Count

249

Fair Category

PS

Project
Number

6012

Title: Developing Age Detection Software Based on Touch Behavior

Student Name(s): K. Yuan

Abstract:

In an increasingly technologically based world, children are beginning to gain exposure to the internet at a very young age. This creates the possibility of several dangerous consequences. Children may unknowingly access a website that is inappropriate for their age. Current mechanisms that exist to prevent this from happening do not account for all situations. The objective of this project was to investigate the relationship between touch behavior and age. First, a data collection program was developed. This program recorded several features over time intervals. The features were hold time (milliseconds), force (newtons), and touch area (pixels). Then, data was collected in order to create profiles ranging from kindergarten to twelfth grade. Participants completed a series of activities on Nexus 9 tablets and Google Pixel 3 phones including tapping, swiping in various directions, and zooming in and out with two fingers. Participants completed each activity three times. After data was collected, features were extracted, those being hold time, force, and touch area. For each age group, the mean value for each feature was calculated. Then, results were plotted and trends for each feature were observed. As age increased, both force used by participants and their touch area increased. As age increased, hold time decreased. These trends indicate that there are changes in touch behavior on touchscreen devices as age increases, which has never been investigated before. Implications include developing a support vector machine learning program that is able to identify age based upon profiles in order to improve cybersecurity.

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

CS AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

PS

Project
Number

6013

Title: The effect of growth temperature and annealing on the degradation rate of newberyite coated AZ31 magnesium alloy for biomedical engineering applications

Student Name(s): E. Zhang

Abstract:

This research aims to slow down the degradation rate of AZ31 magnesium alloy by fabricating a non-toxic magnesium-based newberyite ($MgHPO_4 \cdot 3H_2O$) coating. The magnesium alloy with corrosion-resistant coating could be used to provide self-dissolving structural support for broken bones and torn ligaments, eliminating secondary operations for removal of implants. AZ31 magnesium alloy substrates were etched in a mixed aqueous solution containing phosphoric acid and calcium phosphate, then placed in an oven with the precursor solution and growth temperatures from 50°C to 85°C. The coatings adhered well to the wafers as no coating was removed in the scotch tape test. Substrates were massed before and after the growth experiment and morphology and thickness were ascertained using SEM. EMPA gauged the chemical composition which corresponded to the percent composition of newberyite. Greater mass gain and film thickness (40 m - 60 m) occurred at higher growing temperatures, albeit a grainy deposit. Degradation rates of these samples were slower (0.6 mg/cm²/day) as determined by SBF testing. Annealing experiments of coatings deposited at lower temperatures were conducted. SBF testing of annealed samples had more salt deposit on the surface and reduced the degradation rate significantly by becoming a barrier between the wafer and SBF. Depositions on curved objects showed excellent adherence and thickness uniformity, making it suitable for body implants. I conclude that the magnesium-based newberyite coating decreased the degradation rate efficiently, and far superior to calcium-based coatings because of the cohesiveness between the magnesium coating and the alloy substrate.

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

EN CH EE

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

130

2019

Fair Category

PS

Project
Number

6015

Title: The Effectiveness of an Inline Sodium Hydroxide (NaOH) Scrubber to Remove CO₂ From Car Emissions

Student Name(s): D. Raymond

Abstract:

The world is going through many changes in today's society. One of the most pressing matters is climate change. CO₂ is a large contributor to this change by trapping heat in the atmosphere, and warming up the earth as a result. This is a proof of concept test to prove that sodium hydroxide (NaOH) was placed inside a simulated tailpipe to try and alleviate the amount of CO₂ that automobiles exhaust. NaOH reacts with CO₂ to create NaHCO₃, or baking soda. The CO₂ was produced by an alka seltzer tablet in water. It was found that the tests with NaOH had shown results as a potentially effective CO₂ scrubber. This helps global efforts to reduce CO₂ in the atmosphere, and help alleviate the amount of trapped heat in the atmosphere.

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

AT EM

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

149

2019

Fair Category

PS

Project
Number

6016

Title: Single Stage to Orbit Spaceplane Utilizing Hybrid Propulsion Design Study

Student Name(s): J. Burns

Abstract:

The single stage to orbit spaceplane is a spacecraft that is designed to take off from a runway conventionally, reach orbit without dropping any stages, return to a runway, and get reused with little to no maintenance in between flights. The spaceplane outlined in this paper utilizes three modes of propulsion to reach orbit. Two of these modes are in-atmosphere jet engines, which carry the craft from ground to 70,000 meters, and mach 0 to mach 17. The third mode is a traditional vacuum optimized rocket, which brings the craft into and out of orbit. The reusability is enhanced from a focus on using off the shelf technology to minimize issues with integration and reliability. Targeted payload capacity is 5,000 kg to orbit. The basic design of the spaceplane follows the design and dimensions of the SR-71/YF-12/A-12 family of high speed reconnaissance aircraft.

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

ET EN 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

229

2019

Fair Category

PS

Project Number

6017

Title: Development of Novel, Highly-Efficient, Earth-Abundant Crystalline Perovskite Solar Cell

Student Name(s): A. Rouffiac

Abstract:

The United Nations' 2018 Intergovernmental Climate Change Report reenergized efforts to avoid the drastic consequences of global warming through the improvement of renewable photovoltaic energies. While the electricity output of silicon solar panels has increased, their manufacture is energy-intensive and costly. Therefore, researchers have investigated a promising alternative: perovskite crystals. Many of them contain lead though, posing risks of toxicity. Therefore, efficient, cheaper, lead-free perovskites with a simpler fabrication would power more with less energy, less monetary input, and greater safety. A lead-free perovskite composed of Cs₂BiAgBr₆ was studied. To produce the solar cell, an FTO glass substrate was washed in ethanol, and ozone-treated. Layers of titanium diisopropoxide, TiO₂, and TiCl₄ were deposited atop the FTO layer, and annealed (500oC). Cs₂BiAgBr₆ perovskite crystals, formed via mixing of 1:1:2 molar ratios of BiBr₃, AgBr, and CsBr in 6M HBr, were then spin-coated, and annealed to the FTO-TiO₂. Conductive carbon-paste and aluminum electrodes were tested; the aluminum outperformed the carbon. Performance of the Cs₂BiAgBr₆ perovskite cell was completed on a custom optical bench that included a calibrated tungsten source. The open-circuit voltage was measured as a function of solar intensity; a maximum VOC of 0.309V was achieved, with a maximum power of 3.5mW, and 1357mW/m² power density. Results for this cell, while preliminary, exceeds that of silicon cells of the same size.

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

EN EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

246

2019

Fair Category

PS

Project Number

6018

Title: Fabrication and Analysis of a Biosensor using Carboxyl MWCNTs and PTPN22 Antibodies to Detect Antigen Levels Through Resistivity Changes

Student Name(s): L. Wells

Abstract:

Approximately one in five Americans suffers from an autoimmune disease. A common diagnostic option for this is a blood test; however, the propensity for misdiagnosis and inconclusive results is endemic. Biosensors are devices used to detect substances by combining a physicochemical detector with a biological agent. In this study, a biosensor was synthesized using carboxyl-functionalized, multi-walled carbon nanotubes (MWCNTs)—due to their high conductivity and low resistivity levels—and PTPN22 antibodies, as their dysregulation often leads to autoimmune diseases. This project aimed to determine if the biosensor could be used to detect antigen irregularities. The phases of this project were as follows: synthesizing the biosensor, testing in solution with PTPN22 antigen, analyzing results and completing these steps again with 6% functionalized plasma MWCNTs (pMWCNTs). A general trend observed in pMWCNT trials: as the amount of PTP antigen increased in solution, the pMWCNT sensor's resistivity decreased. The most dramatic results were illustrated in the biosensor with 4 μ L antibody and .3000 g of pMWCNTs with 10-20 nm diameters: its resistivity decreased from 1.78 to - 1.91 k Ω when placed in 2% and 3% PTP solutions, respectively. When antigen levels in solution were increased, the biosensor's resistivity decreased, indicating that the conductivity of the MWCNT-antibody complex increased as it interacted with the antigen, as conductivity is inversely tied to resistivity. This sensor can potentially be implemented as a diagnostic tool for patients with a family history of autoimmune diseases or those who currently struggle with them.

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

EN BI ME

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

PS

Project Number

6019

Title: Split Streams as a Novel Determinant of Extreme Severe Thunderstorm Potential in the Northeastern US

Student Name(s): J. Feuerstein

Abstract:

While Banacos et al discussed the role of elevated mixed layers (EMLs) in significant severe weather across the Northeast in a 2010 paper, the list of EML associated events includes such outbreaks as occurred on May 31, 1985, which killed 75 and injured 851, alongside outbreaks such as July 22, 2005, which had 0 casualties. It is apparent that, while EMLs can distinguish significance in Northeastern severe weather, they are not sufficient in identifying the truly extreme outbreaks. It is hypothesized that the thermodynamic advantages of an EML air mass can be combined with the kinematic support of strong midlevel impulses only when a southern stream transports the EML while a northern stream transports kinematic support. Therefore, the purpose of this study will be to determine if split stream flow can differentiate extreme Northeast severe weather among EML-related significant events. Split streams will be measured subjectively via composite analysis alongside an objective measure of winds longitudinally to determine if there is a bimodal spread, and to what extent. If a relationship can be found in which split streams occur in composite analyses of the former, an attempt at disregarding extraneous variables will be carried out by analyzing other factors such as temperature and lifted index. Analysis demonstrates much stronger split stream presence in extreme than significant EML-related outbreaks, suggesting that split streams can be used as a predictor of extreme severe weather potential in New England several days in advance, when more mesoscale model output is impossible to come by.

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

EA MA

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

229

2019

Fair Category

PS

Project Number

6021

Title: Clean Screen

Student Name(s): K. Young

Abstract:

With today's technology becoming more interactive, touch screens have become a part of daily life for many. These screens can be found in many places, including, but not limited to restaurants, kiosks, ATM machines, and store checkouts. These screens have become popular breeding grounds for germs and bacteria that can easily spread from user to user. The most logical solution to this problem would entail an employee to wipe down the screens with an antibacterial wipe on a regular basis. However, this does not eliminate the germs and bacteria left behind after each transaction. With the use of technology, a device can be created to clean the surface after the use of each customer. UV light has been proven to kill the most common types of bacteria found on touchscreens, such as enterococcus faecalis (E. faecalis), staphylococcus, and listeria, when exposed for a period of time. After each transaction a revolving screen protector will rotate and clean the surface with UV light, while a new sterile screen is put into place for the next customer. In addition, antibacterial resistance is a major concern for the world and by introducing this cleaning solution, it can limit customer exposure to these harmful bacteria. The system will run off an Audrino Uno microcontroller with an ultrasonic distance sensor to detect customers. This device will function on its own, therefore requiring minimal maintenance.

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

AT EE MI

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

254

2019

Fair Category

PS

Project Number

6022

Title: Analysis of Ulva Seaweed While Utilizing and Comparing the X-Ray and Atomic Absorbance Spectrometers

Student Name(s): J. Federico

Abstract:

In this research there is a comparison of the X-ray Spectrometer (X-ray Spec) and the Atomic Absorption spectrometer (AA) while testing Ulva seaweed for copper absorption. Copper is the target element due to Ulva's sequestration efficiency. Sample preparation for the AA takes a lot of time and requires Microwave Digestion. The X-ray Spec is an easier instrument to use because it can be used in the field and scans take about five minutes. Determining a relationship between the two methods allows a prediction of the concentration of copper in the sample recorded on the AA by based on the X-ray Spec. For example if the sample sets showed a high correlation value and had a relationship where the X-ray Spec recorded concentration was three times higher than the AA value. Then instead of going through the excessive sample prep process the sample can be tested in the X-ray spec and then the concentration divided by three for an accurate concentration value. When comparing the X-ray Spec concentrations to those of the AA the correlation found was 0.3048. This correlation means that the X-ray spec recorded concentration values that are inconsistent with those of the AA for copper analysis. This means X-ray Spec needs a correction factor, the next step is to find that correction factor if it can be found. This same comparison should be looked into for other metals as well as other applications in order to determine if the results are the same.

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

AT EV CH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

118

2019

Fair Category

PS

Project
Number

6023

Title: The Link Between Electromagnetic Radiation Exposure from Electronic Devices and Mental Health and How to Protect yourself from Electromagnetic Radiation from Electronic Devices.

Student Name(s): Z. Moore

Abstract:

I've conducted an experiment to find the relationships between electromagnetic radiation exposure and psychological and mental health variables. The purpose of this research is to provide information on radiation in relation to mental health conditions. The topics which it covers are what radiation is, where it comes from, the different types of radiation, the effects on human mental health and how to prevent its harmful effects. In this experiment, I measure the amount of low-frequency radiation a cell phone emits and how many hours each person spends on their phone. using that information and the information I've gathered from my research, I will provide information on the effects of radiation as it pertains to mental health conditions.

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

BE EV EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

260

2019

Fair Category

PS

Project Number

6024

Title: Open-source, In-field Android and iOS Detection and Mapping of Waterborne Diseases via Time-Based Spectroscopic Sensing and RGB Luminance with a New 3D Printable Optical Interface

Student Name(s): N. Liu

Abstract:

Recent studies point to an increase in smartphone usage across the world, even in underdeveloped nations. The need to measure and remediate water-borne pathogens is immediate; smartphone technology may offer an opportunity for rapid point-shoot detection of bacteria in drinking water, so location-specific water quality data may be shared for improved remediation. Herein, a smartphone-based spectrometer was developed, for rapid, in-field detection of pathogenic E.coli (O157-H7) in water. Using inexpensive optical parts, basic household materials, and open-source 3D-models, a smartphone accessory and accompanying app were developed to transform a smartphone to a spectrophotometric bacteria-in-water detector. In the accessory, the phone's flashlight transmits light through an optical fiber to the front of the phone, where it is filtered to 598nm, passed through two plano-convex lenses, a glass diffuser, and through the measured water sample, where it is measured by the phone's ambient light sensor. A similar technology has been developed for iOS. Instead of using the ambient light sensor, the phone's front facing camera is used, with RGB to luminance algorithm that convert RGB values to relative light intensity on each pixel. A continuous video shot off the phone's rear-facing camera is automatically fed into a Python script, and using the OpenCV library, individual frames are extracted and analyzed with the Pillow image library. The iOS colorimeter similarly falls within 5% error of the Lambda 2 and Android spectrometer. Both Android and iOS data can be crowdsourced and uploaded to a public server which creates a public water quality map.

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

EV AT CS

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 vertebrate animals controlled substances

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

246

2019

Fair Category

PS

Project Number

6025

Title: Beam Dynamics as a Function of Scraping Parameter Studies For the Muon g-2 Experiment at Fermilab, Chicago

Student Name(s): A. Mangla

Abstract:

The Standard Model of particle physics is the theory that describes three of the four known fundamental forces in the universe and classifies all known elementary particles. The muon g -2 experiment at Fermilab is set up for precise determination of the muon's magnetic dipole moment in an attempt to challenge the Standard Model, probing beyond the energy of 1 TeV. This study was a part of the systematic error studies to try to minimize muon loss when going into storage in the ring. Its aim was to simulate the muon conditions in the storage ring and visualize what happens when the muons go over a strong resonance at $n = 0.148$. Using a high precision beam and spin dynamics simulation coded in Fortran, we tested this by modeling the change in the field focusing index $n = 0.135$ to $n = 0.160$, going over a strong resonance at $n = 0.148$. We also tested the effects of changing the time constant and run time to see how the muon oscillations were affected. We observed the maximum oscillation amplitude of the muons to see where muon loss occurs and hypothesize why it occurs. We discovered that the oscillation amplitude of the muons may be smaller or larger when crossing a resonance depending on the initial conditions of the particles as well as the timing of the transition from a low to a high field index. This effect was not observed when a resonance driver was not included in the simulation.

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

PH

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

PS

Project Number

6026

Title: Development of Self Adjusting Slip Clutch Vertical Axis Wind Turbine to Eliminate Torque Damage in High Wind Speeds

Student Name(s): G. Krois

Abstract:

Conventional energy sources propose sustainability problems for the near future. Vertical axis wind turbines (VAWTS) provide an eco-friendly, alternative for power generation. They are easier to maintain and can be mounted on rooftops. Unfortunately, current models of VAWTS tend to fail in high-speed wind conditions. The generated centrifugal force causes fatigue on the system, breaking the turbine and hindering its ability to generate power.

A slip clutch system could be implemented to mitigate wind damage. The design for the clutch system consists of rotating blades resting on ball catches. As the force exerted by the wind increases, the blades push over the ball catch, readjusting their angle of attack, resulting in a lower rotational speed. By using a system of ball catches, the turbine could maintain power generation in most winds.

Current experimentation has proven that with a wind speed of 61 m/s^2 the first ball catch is engaged and the second in the system at 67 m/s^2 . To find the acceleration, find your K value ($F = KX$), the mass of air in the blade ($A_m = (\pi r^2 h) / 2$), the force exerted ($F = A_m x a^2$) and finally, acceleration ($a = \sqrt{F / A_m x}$)

Future research consists of implementing the clutch system into a complete turbine since it works in a single blade system. Other future experimentation would be to replace springs and use lighter materials to generate an ideal power output and of the turbine to result in a lower force to engage the system.

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

AT EE ET

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

198

2019

Fair Category

PS

Project
Number

6028

Title: Impact of Sugarcane on the Demineralization of Teeth

Student Name(s): M. Lembree

Abstract:

In some indigenous cultures in South America, people chew on sugarcane instead of brushing their teeth. This strategy has been said to be as effective as brushing their teeth in these countries. The purpose of this experiment was to test if this sugarcane juice actually helps stop demineralization to be a cheaper option in these areas. In this experiment, four eggs were cracked and dried until only the outer shell remained. The shells were weighed, then the four eggs were submerged in sugarcane juice, ACT mouthwash, coca-cola and distilled water to test if sugarcane juice was just as effective as mouthwash to fighting demineralization of the teeth. After they were submerged they were set out to dry. When this was done, it was found that the eggs lost the least amount of material after being submerged in the sugarcane juice rather than the ACT mouthwash, showing that sugarcane juice does not promote demineralization and can be effective if people use sugarcane instead of dental products. This is believed to have happened because the eggs that lost the most material were in the most acidic climates and the eggs that didn't lose material were in more alkaline liquids.

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

BI

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

239

2019

Fair Category

PS

Project
Number

6029

Title: Analyzing Particulate Matter Atmospheric Pollution Trends in New England

Student Name(s): E. Marin

Abstract:

PM_{2.5} is an atmospheric pollutant that is extremely detrimental to both the environment and human health. The National Ambient Air Quality Standards (NAAQS) were implemented in 1990 to help reduce levels of PM_{2.5} in the United States. However, since then many other countries have cited data showing that PM_{2.5} levels are rising. The purpose of this study is to determine whether the NAAQS have been effective at decreasing PM_{2.5} levels in various New England states. For this study, all PM_{2.5} concentrations were obtained directly from the EPA repository dating from 2000-2017. Trends were determined over the given time period in Connecticut, New Hampshire, Vermont and Massachusetts. These trends were compared to the current standard for PM_{2.5} levels, and the significance of the trends was evaluated. The average R² value for all of the states was 0.88 proving the strength of the linear relationship between concentrations and time. Further, in all states the PM_{2.5} values were significantly below the standard by 2017. Brief analysis was done to examine the sources of PM_{2.5} pollution in an attempt to understand where the decrease was coming from. It was found that in many man-made sectors, such as industrial processes, levels have substantially decreased, thus explaining the overall downward trend of PM_{2.5} pollution. In The NAAQS were concluded to be effective at lowering PM_{2.5}. The future goals of this project are to provide feedback on the NAAQS in other regions of the US.

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

EV EM

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

PS

Project
Number

6030

Title: Atmospheric Modeling of the Albedo Effect of Sulfur Aerosols from Volcanic Eruptions in the Stratosphere

Student Name(s): M. Sun

Abstract:

Sulfuric aerosols react with atmospheric particles in the stratosphere to create a strong albedo effect, reflection of radiation from the sun. Volcanic degassing has been evidenced to push sulfur particles into the stratosphere. Given both of these properties, the sulfur emissions from volcanic degassing should affect the temperature of the local environment enough to the point of being able to mathematically model the effect. This model would be used to predict future changes in temperature if given the rate of sulfuric emissions occurring. Information about sulfuric emissions from active degassing and weak volcanic eruption sites was collected, such as emission concentration and duration of the emissions, and then compared to temperatures in the area, both upwind and downwind of the emissions site, to determine a long-term correlation between the two. However, there was little correlation between the sulfuric emissions and the local temperatures. The temperatures did not show significant enough change to show that the sulfur emissions from degassing are causing a localized temperature shift that could be easily modeled. There are more complex factors that should be included to detect an effect of the like, such as human influences like traffic, whether or not the volcano is landlocked, and the weather experienced by the area beside temperature. This study does show that the sulfur emissions from weak eruptions and degassing from volcanoes either does not have a high enough concentration or too little of an albedo effect to change the local temperature significantly.

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

EV CH EA

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

4. Is this project a continuation? Yes No

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

254

2019

Fair Category

PS

Project
Number

6031

Title: Pi NAS

Student Name(s): R. Vaddiraju

Abstract:

Network attached storage devices are gaining traction in the home as more people find it frustrating to dig through all their devices to find that one wedding picture or resume. This device is essentially a hard drive connected to your router, giving your network-connected devices access to it, but it comes at a cost, ranging anywhere from \$150-500. The solution is a simple, economical, do-it-yourself device using a Raspberry Pi, storage device, 3D printer, and a software called OpenMediaVault. By connecting the Pi to the storage device via USB, installing OMV, and 3D printing an exterior casing, I created a \$90 NAS. This device functions exactly the same as a retail model, connecting to your router using an ethernet cable and can be accessed through an app on your tablet/smartphone or on PC/Mac. With the gigabit connection on the Raspberry Pi, file transfers are quick and storage can be upgraded effortlessly, while on many retail-NAS systems you have to buy a new device for more storage. In the future, I plan to add wifi and a rechargeable battery to this device, making it wireless and portable. Many people may be wondering how difficult it is to build this device, and perhaps even considering having to build it a drawback, but this is not the case. With a few wires plugged in, a simple download and install, and a print at your local library's 3d printer, you saved \$60+ and have a hub to store your home's data.

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

CS

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

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4. Is this project a continuation? Yes No

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

249

2019

Fair Category

PS

Project
Number

6032

Title: Biofiltration of Ferric Iron Utilizing Citrus Biowaste to Mitigate Freshwater Harmful Algal Blooms.

Student Name(s): M. Katz

Abstract:

Harmful algal blooms are a result of not only excess nitrogen and phosphorus in fresh waters, but also iron. All U.S. coastal and great lakes states experience harmful algal blooms, which, due to the noxious cyanotoxins, cause serious impacts on the health of the surrounding people and marine ecosystems. In order to prevent the growth of harmful algae, the biowaste of grapefruit, orange and lemon were extracted and tested for their capacity to absorb iron. The sample with the highest absorbance (orange biowaste) was utilized to sequester iron and deter growth of *Arthrospira platensis*, a blue-green cyanobacteria.

The biowaste was dried using a drying oven and minced to a uniform particle size using a pestle and mortar. A stock solution with iron content of 2853 PPM was formed utilizing ferric nitrate nonahydrate and distilled water. Each type of citrus biowaste was submerged in the solution and centrifuged for extraction. Post exposure, the solution and biowaste were then tested for iron content utilizing the Bruker S1 Titan XRF in order to determine the sequestration potential of the biowaste. Three cultures of *Arthrospira platensis* were grown, the first tank with enhanced phosphorus and nitrogen. The second was grown with phosphorus, nitrogen and iron, displaying the effect of iron itself on algal blooms. And the third grown with all three previously mentioned nutrients along with orange biowaste.

The lemon, grapefruit and orange facilitated a decrease in iron content by 2.7%, 8.2% and 31.2% respectively, proving their viability in iron mitigation techniques.

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

EM EN BI

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

217

2019

Fair Category

PS

Project
Number

6033

Title: The Medicine Box

Student Name(s): M. Coyne

Abstract:

For people that are in need of medication or a life saving drug like an epipen it is essential for certain medications to be kept at a critical temperature. There is no device on the market that is capable of regulating the strict control of temperature, the devices available to the public are not capable of keeping it at a constant temperature and the temperature range is to wide.

The objective of this research project was to create a package that is capable of regulating the temperature inside an insulated container, so that the medication will not be spoiled and consequently discarded. This was accomplished when a thermoelectric(peltier) heat pump was used to heat or cool as required an insulated container and a dual digital thermostat controller. The controller senses the temperature in the container, compares it with the set point values, and decides whether to heating or cooling is necessary by operating output relays. The system will run off of 12 volts with 4 lithium ion batteries. To test this prototype, the student researcher will put it in two different scenarios one in heat and one in cold in a controlled classroom environment.

The Medicine Box was a successful because the demonstration showed that the temperature could be controlled inside a cold and hot environment.

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

175

2019

Fair Category

PS

Project
Number

6034

Title: Correlations Between Home Insulator Composition and Heat Retention

Student Name(s): J. Callender

Abstract:

Fossil fuels, such as oil, are quickly becoming consumed. The world is going to run out of fossil fuels sooner than later. This experiment is to see different types of insulation that will retain heat in homes, so they do not need to use as much oil to heat. In this experiment, the insulators that are tested are cellulose, fiberglass, and spray foam. The experiment was conducted by using a box, having the insulator in the box, and measuring the temperature inside to get the average temperature. Spray foam was able to retain the most temperature because of the air not being able to escape. Spray foam was the best because the box started at 15.6 degrees Celsius and only changed on an average of 16.7 degrees Celsius, which was the smallest change of temperature of all the insulators. Also, the data showed that fiberglass was the second best and showed that cellulose was the worst. Spray foam might have been the best insulator because of the thickness and the heat retention of the material.

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

ET EM EV

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

172

2019

Fair Category

PS

Project
Number

6035

Title: A Comparative Analysis of R and SPSS on Panel and Cross-sectional Data for Labor Cost Over Thirty Years

Student Name(s): S. Jain

Abstract:

Analyzing labor costs is critical to understand what components of businesses affect the amount of resources spent on workers. Interpreting this will help make managerial decisions in adjusting costs of production and develop new strategies in regards to investing in workers. Labor costs vary due to many factors such as employees, assets, liabilities, sales, and debt. In this study, labor costs is studied using a panel data set over a span of thirty years using R and SPSS and the results are compared. Currently, there is not much literature regarding the matter. After running analyses using both statistical softwares, results show that they both give the same output when running a multivariate regression. They both are powerful enough to analyze large datasets. However, with the simple language like instructions in R, the dataset can be easily manipulated to work with the analysis. Managers and practitioners can use the softwares to draw conclusions and make important managerial decisions with the results. Future study includes comparing the two softwares using more complex analytical techniques.

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

CS AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

PS

Project
Number

6036

Title: Portable, Simple Filtration of *V. cholerae* Infected Water using Electrified, Silver-SWCNT Nanostructures within a Sari-Cloth Textile

Student Name(s): S. Sakai

Abstract:

Cholera is an acute illness caused by *Vibrio cholerae* (Vc) intestinal infection. If left untreated, cholera can lead to death within a few hours, due to rapid dehydration and shock. Since it is transmitted through water sources by fecal contamination, the spread of cholera is easily prevented with advanced water filtration systems in developed regions. For at-risk, underdeveloped regions, however, a simple, portable, and effective water filtration device is highly desirable. In this research, such a device was created, using a sari-cloth textile filtration medium, with embedded antibacterial silver nanoparticles (AgNPs). To construct the filter, 500nm AgNPs were first synthesized and verified with SEM and EDS. Silk-polyester sari cloth textiles were then coated with 4mg/ml SWCNT ink, to provide 200 Ω /cm² conductivity. Previously synthesized AgNP's were dispersed in solution and evenly loaded onto the conductive textiles (as supported by SEM). A 2.5cm² AgNP-SWCNT-Sari filtration textile was loaded into a custom funnel-holder, so that 0, 5, 9, & 12 V could be applied across the conductive filter, as known concentrations of *V. porteresiae* (BSL1 model-bacteria) were filtered. Organism filtering capacity was determined via filtrate OD_{600nm}; the treated textile exhibited 97% inactivation at 12V, with 95% being inactivated using a typical 9V battery. SEM images of the post-run filtration textile confirm the stability of the AgNP/SWCNT/Sari matrix. Additionally, traces of dead *V. porteresiae* atop the textile suggest that bacteria inactivation occurs at the point of contact between the organism and the electrified textile.

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

EM EN AT

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

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- Yes No

CSEF Official Abstract and Certification

2019

Word Count

230

Fair Category

PS

Project
Number

6038

Title: Using Motion Sensors to Help Reduce Collisions on the Ski Hill

Student Name(s): J. Shanks

Abstract:

Today skiing is not as safe as it could be. In a study conducted in Niigata, Japan 19% of all ski injuries were from collisions. By optimizing passive infrared sensor technology, the goal of this helmet design is to allow skiers of all skill levels a longer time to react to possible incoming dangers. Thus reducing collisions on ski hills.

For testing, a bike was ridden near a small ladder with the helmet on a rung at a constant speed of ten and seven miles per hour recorded on a bike computer. A person standing on the side started a stopwatch when the light went on and stopped it when the bike passed the helmet. I also recorded a control group of human reaction time tested by riding a bike at seven and ten miles per hour by a person who started a stopwatch when they first realized the bike was coming and stopped it once the bike passed.

Results showed that the average human time to react was 0.302 seconds with a bike passing them at ten miles per hour. The average time to react for a skier with the motion sensor helmet was 1.07 seconds when the bike was passing at the same speed. So this helmet increases a skiers time to react by 0.768 seconds. This extra time to react can help prevent collisions on ski hills.

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

EE AT ET

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

2019

Word Count

140

Fair Category

PS

Project
Number

6039

Title: Synthesis of Novel Mesoporous Mixed Metal Oxides

Student Name(s): S. Channa

Abstract:

In this study, a mesoporous material was synthesized and characterized in order to find its future application. This study was aimed toward creating a material that is environmentally benign, recyclable, and highly reproducible. We have created a novel, mesoporous mixed metal oxide containing a high surface area for it to be able to display its activity on different reactions. The synthesized material has been identified with the ideal conditions to be classified as a novel and mesoporous material, as it had a pore diameter of 3.8 nm and a surface area of 101 m²/g. This catalyst was composed of CuWO₄ and was created through a surfactant-assisted synthesis route. In order to find the catalyst's application, various coupling reactions were performed to analyze its conversion to different products. The created catalyst has showed excellent activity toward alkyne coupling.

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

CH

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

PS

Project
Number

6040

Title: Degree Centrality and Betweenness Centrality: Predicting Viral Videos Based on Social Connectedness

Student Name(s): K. Morgan

Abstract:

Networks are interaction structures among sets of connected units and include online social networks. Such networks have become increasingly complicated, making their analysis challenging but of potentially high importance. The social connectedness of persons who share their thoughts within an online social network may be, for example, an important predictor of which ideas become widely known and which do not. In this study, the connectedness of persons who comment on selected youtube videos was analyzed as a predictor of which videos “go viral” (the independent variable). The connectedness variables that were measured were degree centrality (a measure of total connections) and betweenness centrality (a measure of connectedness to a variety of social groups). It was predicted that betweenness centrality would be greater compared to degree centrality in persons commenting on videos that went viral than in persons commenting on videos that did not go viral. To test this hypothesis, 12 pairs of viral videos and non-viral videos were studied in a case-control design. Betweenness centrality and degree centrality (dependent variables) were measured using the social network analysis tool Condor. Results from the study show that the ratio of betweenness centrality to degree centrality in persons who commented on viral videos is significantly and dramatically higher than in persons who commented on videos that did not go viral. These findings provide the first evidence that betweenness and degree centrality may be useful in predicting which internet memes become universal and so has potential social, political, and economic implications.

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

AT BE CS

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

PS

Project Number

6041

Title: Mitigating the Waste of Single-Use Plastic Water Bottles Through a Simple Identification System

Student Name(s): M. Gadomski

Abstract:

Keeping track of water bottles during functions and events is less convenient than opening a new one, and the leftover water bottles are thrown away. The addition of a simple ID system to the tops of caps of disposable water bottles solves this problem. A material created using a ratio of non-toxic dish soap and non-toxic pigmented liquid is applied to a water bottle cap with a layer of tape beneath it. A fingernail is used to scratch off some of the material, letting the person write an identifying marker. By having this specific symbol, everyone can easily determine which disposable water bottle belongs to which person. I ran an experiment to confirm the effectiveness of the system. Out of a 40 pack of 16.9 oz (499.8 mL) Poland Spring disposable water bottles, half were modified to have prototype caps with the scratch off material and the other half were left alone. They were randomly placed in a cooler and were used as drinks for a party with 32 people. The ID system water bottles were more popular with 8 being fully empty and 6 leftover with an average 90.0 mL of water left in them. There were 3 fully empty of the plain water bottles, with 7 leftover and an average of 237.5 mL of water in them. The amount of plastic being introduced into the environment will be reduced, as well as less water and money being wasted.

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

EM EA

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

251

2019

Fair Category

PS

Project
Number

6044

Title: Candidate Evaluation Of A Replacement Catalyst In A Hydrogen Fuel Cell Oxygen-Reduction Reaction.

Student Name(s): S. Chastanet

Abstract:

The dependency on expensive Platinum or Pt-based electrocatalysts in hydrogen fuel cells persists as a significant obstruction for extensive use of the technology. Finding a cheaper alternative through non-precious metal is the next logical step. Candidate of Iron and Copper based catalyst in a hydrogen fuel cell oxygen-reduction reaction is the proposed step. By combining metal bases in different ratios that dissolve in water and combining the NH compound with an immigration metal, will yield higher Catalyst performance was measured in a vacuum chamber with a solution of hydrogen peroxide with the gases output volume/rate measured and analyzed. While the metal bases have little impact on the amount of gases produced, they do have a palpable impact on the rate at which the gases are produced. Glucose is used as carbon additive to provide structure/durability. Using $P V = n R T$ the number of gases can be observed to produce around 0.266L of gases generated from 25ml of hydrogen peroxide. The rate at which the gassed is produced is 2.60L /min. Consequently, with a high flow rate, this catalyst has proven that Iron and Copper based catalyst is a viable candidate to replace platinum in the hydrogen fuel cell industry. Successful development of this catalyst allows for widespread use of hydrogen fuel cell machines in commercial and industrial use. The price of platinum is inhibiting the uses of this technology. This cheaper alternative of Iron and Copper based catalyst allows further progression into the energy field.

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

EN EE EV

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

199

2019

Fair Category

PS

Project
Number

6045

Title: Water Vehicle Stabilizers Using Weight Adjusting to Wind and Water Currents.

Student Name(s): A. Mehta

Abstract:

How can a Water Vehicle Stabilizer (Gimbal) be modified to sync with wind and water currents to improve the prevention of boats tipping over in bodies of water? As gimbals are used to stabilize mainly cameras, they can be used on boats to. You first construct the gimbal on a simple bearing mechanism and put saran wrap below the water level that can trap the water currents. After, you would test the mechanism in a bathtub with and without the device. Put a compass or a degree measure inside the plastic container of the device and record the starting and ending tilt of the boat. Find the difference of the two and observe if the device was more effective then without it. Based on the data, the device was effective. Without the device, the degree of the tilt would normally range from 2-4, meaning more rocking motion. With the device, the degree of tilt would normally range from 1-2, meaning there would be less rocking motion in the device. Overall, the gimbal was sustainable and effective in creating less motion of the container. With further investigation, the device can be created in a less complex way and possibly cheaper.

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

AT EN EE

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

188

2019

Fair Category

PS

Project
Number

6046

Title: Oil Containment following an Accidental Spill: Temporarily preventing the spread of crude oil in Aquatic Environments

Student Name(s): L. Delgado

Abstract:

The objective of this project was to construct an apparatus that would temporarily contain and prevent thicker crude oils and surface oils from spreading and damaging the environment during oil spills. This apparatus would be built around oil rigs and platforms and act as a safety net when oil rig and/or pipes burst. The system was designed to be engaged at the time of a spill rather than simply floating around the rig. It is critical to have a secure and reliable system that immediately addresses oil spreading quickly due to waves, wind, and tides. The apparatus was designed and several prototypes constructed using a variety of materials to serve as absorbers. Seawater degradation rates of the materials were considered. Next an experimental environment was created to simulate an oil spill using a perforated pipe within a small tank. Prototypes were tested and data collected by measuring rate of seepage from the barrier as well as total amount of seepage. Results indicate that the most efficient absorbers are not as resistant to seawater degradation, yet an effective inflatable system is well within the realm of feasibility.

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

EM EN

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- Yes No

CSEF Official Abstract and Certification

Word Count

264

2019

Fair Category

PS

Project
Number

6047

Title: A Green Nanotechnological Approach for Energy Efficiency and Conservation:
Tungsten-doped Vanadium Dioxide Thermochromic Smart Windows

Student Name(s): C. Chen

Abstract:

Vanadium dioxide is a "functional material" that has gained notoriety in fundamental research and smart-window applications. It responds to environmental temperatures, making reversible structural changes from an infrared-transparent semiconducting state to an infrared-translucent metallic state when heated beyond its transition temperature (T_c). Application of VO₂-thermochromic smart windows has been limited, however, due to their T_c values being higher than desired ambient temperature. In this research, tungsten-doped VO₂-windows were synthesized, to lower the transition temperature to $<30^\circ\text{C}$, and improve the transmission properties. The temperature-dependent optical properties of windows were studied from 400-4000nm via visible, near-infrared, and mid-infrared spectroscopies. Their ability to control infrared light transmission as a function of outside temperature was also determined, via thermal imaging. Results for the 17%W-VO₂ window highlight %Transmission decreases of 25.3% and 42.8% through the near-infrared and mid-infrared regions, respectively, with heating from 29-60°C. Decreased transmission of W-VO₂ windows is evident via a decreased thermal footprint; as the sample temperature was raised from 20-60°C, the VO₂ window reached 58.1°C, determined by radiation, while the 17% W-VO₂ windows reached only 37.9°C. Finally, modeling of overall increase in room heating efficiency was performed using 8in3 model-wooden homes, with W-VO₂ (and control) windows, and constant infrared illumination. With an increase in the external window temperature from 29-60°C, the home temperature of the VO₂-window house rose from ambient to 29.5°C; the house with the 17% W-VO₂ window rose to 28.8°C, for a 16% improvement in heating efficiency vs VO₂, and 37% vs normal windows.

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EN EM ET

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- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

PS

Project Number

6048

Title: Intuitive Control Algorithm Development of 4WIS/4WID Using A SpaceMouse

Student Name(s): T. Kim

Abstract:

4WIS/4WIS(4 Wheel Independent Steering/Driving) is a steering system of guiding a four-wheeled vehicle that allows for a separate speed and direction control for each wheel. These controls can result in a very versatile motion for those who need to navigate tight spaces such as using a wheelchair in subway cars. However, controlling two parameters (direction and speed) for each wheel results in eight parameters in need of simultaneous control. This research sought to find an intuitive control with a SpaceMouse that abstracts away the complexity, allowing for a full realization of the vehicle's capabilities without any special training on the operator's part. In the procedures, a Mathematica simulation was created to have a 4WID/4WIS vehicle respond to the input from the SpaceMouse. SpaceMouse's inputs were integrated coherently by modeling the vehicle's movement as a motion along a circular path, where a straight line motion is calculated as a motion along a circle of very large radius. Each wheel's direction was pointed to the tangential direction of that circle, and each wheel's speed was set to be proportional to their distance from the center, allowing it to have no slip/skid. The eight parameters calculated with this algorithm was then tested on a 4WIS/4WID prototype to determine the algorithm's accuracy. Modeling every motion, including a straight line motion, as a travel along a concentric circular path was successful, greatly simplifying the complexity of the algorithm by having one routine determine all parameters coherently.

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

CS EE ET

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

PS

Project
Number

6049

Title: Utilizing the thermal energy released from the human body as a result of exothermic reactions in combination with cooler ambient air to power a hearing aid.

Student Name(s): S. Abbineni

Abstract:

Although the hearing aid is widespread, a glaring issue that it has is its constant need for replacement batteries. This need can expose one's disability, potentially placing them in danger. In order to remove this hindrance with the hearing aid, thermal energy from the body will be converted into electricity with peltier tiles and the Seebeck effect.

The device was fabricated with a few basic parts: peltier tiles, wires, resistors, and an adhesive plastic strip. A peltier tile is made of ceramic and silicone. When heat is applied to one side of the tile, a current is created and transferred by metal leads. Two cables were soldered to each of the peltier tiles. The negative wires had resistors soldered to them, which would connect to the hearing aid. Whenever there is a temperature difference between the two sides of the tile, electricity forms and is conducted to the hearing aid.

To be functional, a hearing aid must receive a current that has a voltage which is 1V or greater. While testing, the device was able to produce a current that had a voltage of 2V when the temperature difference was 2°C. If the difference increases, the voltage of the electricity and efficiency of the device will increase.

We can conclude that the device is functional since it is able to produce a voltage without being connected to a battery. By connecting this device to hearing aids, it will be able to eliminate the problem of the constant replacement of batteries.

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

EE AT EN

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

PS

Project
Number

6050

Title: Relation Between Distance from Cluster Center and Mass of Protostellar Cores in Infrared Dark Cloud G28.37+0.07

Student Name(s): C. Glasgow

Abstract:

It has been observed that in mature star clusters, star mass is inversely correlated to the distance from the center of said clusters. However, it is unknown if this mass segregation occurs thanks to greater mass accretion in cores at the center of clusters during the protostellar stage or thanks to gravitational forces acting on the most massive stars after initial formation. Here, an ALMA survey of dense gas and cores in a massive infrared dark cloud G28.37+0.07 is used to analyze the relation between the distance from group center and density of young core groups. 4 groups containing significant data were chosen, and measurements of the flux of each core within these groups allowed for the derivation of their mass, and therefore regional surface level density. As a result, it was found that there is no significant relation between core mass and distance from group center during the protostellar stage, indicating that the mass segregation found in fully formed star clusters is due to gravity forcing the most massive stars towards the center of their clusters over time. This has implications for the stellar initial mass function, as observations of stars in their early stages tell us about its distribution. In addition, the fact that stars in clusters cannot be traced back to their initial distance from cluster center based on their current mass means that density profiles of these mature clusters upon their birth cannot be derived from current observations.

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

PH CS MA

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

260

2019

Fair Category

PS

Project Number

6052

Title: A Novel Activation Function for a Convolutional Neural Network Implemented Without Machine Learning Libraries

Student Name(s): A. Pourkavoos

Abstract:

Artificial neural networks apply a nonlinear activation function to all numbers in a given layer of neurons, represented by a tensor, before the affine transformation in the next layer. By alternating nonlinear and linear functions, they introduce nonlinearity into what otherwise would be only a linear regression model. This project proposes a new activation function for convolutional neural networks (CNNs) to better balance training speed and classification accuracy than three of the currently-used functions. The new function was tested to classify images of handwritten digits in the MNIST dataset. The general structure of the CNN emulates that of Karpathy's ConvNetJS demo. I coded this entire convolutional neural network in Python using only NumPy's array functionality without the aid of machine learning libraries. Four different activation functions were compared. The rectified linear unit (ReLU), $\max(0, x)$, computes quickly but has derivative zero over negative numbers. The softplus function, $\ln(1+\exp(x))$, approximates ReLU and, although less efficient, has a positive gradient everywhere. The logistic function, $1/(1+\exp(-x))$, produces less accurate results than ReLU and was mainly included to test the validity of this experiment. I hypothesized that the new function, $(x+\sqrt{1+x^2})/2$, which resembles softplus, would have a comparable accuracy to the same while computing more quickly. Twelve CNNs, three using each activation function, were trained on MNIST for 50 epochs using the ADADELTA adaptive rate method. This took 25.9 hours of IGPU time. Although slightly less accurate than the others, the new function, as hypothesized, ran faster than all but ReLU.

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

MA CS AT

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

4. Is this project a continuation? Yes No

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

233

2019

Fair Category

PS

Project
Number

6053

Title: Designing an Efficient Roof-Mounted Wind Turbine System

Student Name(s): M. Chandy

Abstract:

The purpose of this investigation was to find the effect of putting a wind-turbine on a roof. The hypothesis was that the airflow into the wind turbine would be improved because wind would be directed along the surface of the roof into the turbine. The variable being manipulated was the angle of an inclined plane, which simulated the roof of a house. To simulate the other components of the system, a homemade pinwheel, which simulated the turbine, was placed in front of a fan, which simulated the wind. The rotational speed of the pinwheel was measured by having a sensor receive a light shone through the spinning pinwheel. The rate at which the intervals of light were received was related to the rotational speed using a computer program. After recording data for using a plane with angle 0° , 10° , 20° , 30° , 40° , 50° , and 60° , the rotational speed was found to be greatest when the plane had an angle of 10° , only slightly greater than 0° . The rotational speed was found to be least as the angle of the plane approached 45° from both sides, with the 50° trial yielding the least rotational speed. This investigation is important as it presents a possible future for the use of home wind turbines, and it demonstrates which angle would most effectively increase the speed of the wind turbine and therefore create the most energy.

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
2019

Word Count

250

Fair Category

PS

Project
Number

6054

Title: Designing an Integrated System for Biofeedback Measurement

Student Name(s): C. Eswarakumar

Abstract:

I'm producing three biofeedback devices - electroencephalogram (EEG), electrocardiogram (EKG), and electrodermograph (EDG) - and creating one integrated system.

Last year, I investigated how rewards affect biofeedback. This year, I am investigating the biofeedback machine. I started by exploring the essential component of the biofeedback device, a black box called AD620. Diving deeper into this instrumentation amplifier, I found the powerhouse: the differential amplifier. I rebuilt this to further my understanding of the machine. By doing so, I was also able to see the limitations of a basic differential amplifier, and added more filters to help clean the signal.

To combine the three devices, I decided to use a microcontroller. I learned coding and wrote a program that allows me to take measurements similar to those I would take with the biofeedback devices. You can see data coming in through the serial monitor and that data can be manipulated by changing the resistance with a potentiometer much like neural activity in the brain will alter an EEG, the way heart rate would alter an EKG, or the way sweat level alters the EDG. However, it was difficult to correctly place the amplifiers and receive a consistent read-out from the devices.

Thus, a new oscilloscope was introduced, the Siglent 200Mhz. This is a higher-performing oscilloscope compared to the software program on a laptop from last year. This has two channels instead of one. This isn't perfect, as three would be ideal, but that's why the arduino is continually being worked on.

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

ME 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

249

2019

Fair Category

PS

Project Number

6055

Title: Modeling a Variable Helmholtz Resonator for Use in Reducing Automobile Exhaust Noise

Student Name(s): J. Sung

Abstract:

Objective: To test the feasibility of a variable Helmholtz resonator in reducing automobile noise.

Background: Exhaust systems account for over 20% of the noise pollution caused by automobiles. Currently, most mufflers are composed of either porous materials that dampen the sound, or materials that can redirect the exhaust gas to reduce noise. Helmholtz resonators can effectively dampen soundwaves at specific frequencies. However, most Helmholtz resonators are fixed at certain frequencies and cannot easily be tuned. Variable Helmholtz resonators may solve this problem.

Methods: I used a series of acrylic boxes and adjustable lids to model a variable Helmholtz resonator. Using these lids, the size of the hollow chamber that comprises the resonators could be adjusted. From one end of the boxes, I emitted soundwaves at different frequencies, while I recorded the resulting noise from the other end. The two sound waves were saved and compared.

Results: Although the model was not perfect due to the inability of acrylic boxes to fully simulate Helmholtz resonators, I was able to derive the resonance equation for this system. Overall, I was able to demonstrate an approximately 45-75% reduction in noise (average 60.67%) across a wide range of soundwave frequencies.

Conclusion: My experiment demonstrates that a variable Helmholtz resonator is a feasible and effective method of reducing noise across a wide range of frequencies. This lays the foundation for future work in applying this design using sturdier and more adaptable materials

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

EE CS

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

119

2019

Fair Category

PS

Project
Number

6056

Title: Unmanned Remote Controlled Gliders as Cargo Transport

Student Name(s): C. Chugh

Abstract:

Many companies are trying to do delivery services, mostly using variations of quadcopters, for things such as mail/parcel delivery and even medical supplies. Why are gliders (otherwise known as sailplanes) not being used for this use case? Gliders seem as if they are perfect delivery vehicles for long range, around low volume transport, as they are extremely efficient and can travel at a fair speed if they have a small motor attached to them. This project looks at the flight time of the aircraft when given the same cargo payload, given the same motors and battery. My hypothesis was that the glider would have a longer flight time, thus being more efficient in a test against a quadcopter.

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

PH 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

234

2019

Fair Category

PS

Project
Number

6058

Title: The Effect of Design Parameters and Operating Conditions on Optimal Energy Conversion and Force Generation in a Magnetohydrodynamic Drive

Student Name(s): V. Talanki

Abstract:

A magnetohydrodynamic drive is a device that uses only electromagnetic fields to induce a flow in a fluid. Magnetohydrodynamic drives have the advantage of not having moving parts and thus experience no mechanical wear. This project focuses on increasing the drive efficiency, so that this approach to fluid propulsion can be feasibly used for more varied applications.

The housing for the device was modeled using a CAD/CAM system with sections for electrodes, magnets, a cavity for the fluid to flow through, and cutouts to increase electrical conductivity between the plates through the fluid. It was subsequently fabricated using an FDM 3D printer. The direction of the magnetic field was verified with a compass, and the electrodes were wired in series with a safety shut-off switch.

The first test involved varying the salinity of the water with a constant 20 volts across the electrodes. The second test involved varying the voltage across the electrodes from zero to 30 volts, while the salinity of the water was held constant. In both tests, the velocity was calculated by analyzing the video feed of dye being transported through the drive. Results show that increasing the salinity while holding the voltage constant increased the speed of the dye. Likewise, increasing the voltage while holding the salinity constant also increased the speed of the dye. Analysis of energy conversion efficiency (electrical to kinetic) and force generation is ongoing.

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

EE ET AT

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

82

2019

Fair Category

PS

Project Number

6059

Title: Auto-Attendance

Student Name(s): J. Brown, J. Brown

Abstract:

Attendance for the students is an important task in class. When done manually it generally wastes a lot of productive time of the class. This proposed solution for the current problem is through automation of the attendance system using face recognition. A face is a primary identification for any human. This project describes the method of detecting and recognizing the face in real-time using Raspberry Pi. This project describes an efficient algorithm using open source image processing framework known as OpenCV.

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

AT CS EV

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

PS

Project
Number

6060

Title: How Can Solar Power be Streamlined so it is More Cost Effective and Utilized Efficiently?

Student Name(s): H. Young

Abstract:

I was motivated to investigate into solar energy efficiency because of the ongoing energy crisis in the US. The goal of my research was to determine which type of solar panel is the most energy and cost efficient by comparing multiple models. In order to formulate my conclusion, I visited numerous websites, questioned two current owners of solar panels, and looked into a number of different solar panel companies. In my research, I was focused on the quality, cost, and lifetime of the solar panels. I have found that solar panels are generally classified into three categories; Economy, Standard, and Premium panels. There are also other types, such as solar tiles and thin film solar panels that have some benefits, however they are very costly and not as efficient. Economy solar panels are lower in quality, however they are the cheapest option. The middle region in terms of cost and quality corresponds with the standard panels, and the premium solar panels have the longest lifetime and are the most durable. I have determined that the most efficient and cost effective panels in the US are the Premium Solar Panels. Even though these panels are the most expensive option, they can be streamlined by using Solar Renewable Energy Credits, which will be collected at a faster rate due to higher efficiency. As a result, there is a higher investment return. Therefore, consumers should be educated in the future about the use of SRECs to encourage purchase of Premium Solar Panels.

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

EV ET EA

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

243

2019

Fair Category

PS

Project Number

6061

Title: The Clean Water Project

Student Name(s): M. DeLeo

Abstract:

The Clean Water Project is all about more accessible drinking water using inexpensive methods. In the world there isn't much clean water, only 2.5% is fresh and only 1% is accessible. The reason this project is so important is because it is an invention that can give people unlimited clean drinking water. The reason this invention is life changing is because it costs a set amount for all the materials and then is powered by solar electricity. Many MEDs, or multiple effective distillers, are 10,000 dollars and more and then the cost of electricity on top of it.

For, The Clean Water Project the problem is finding a more effective way to clean contaminated water using solar energy. The hypothesis was, If you use a solar panel to collect enough energy to heat and distill water, then you would be able to clean large amounts of water inexpensively because, a solar heater would be able to heat a vat of water and separate it from the contaminants in it. The results of the repeating the engineering process was being able to get $\frac{3}{4}$ cups of clean water out of $3\frac{1}{2}$ cups in a half an hour. In other terms within a half an hour 1:7 units of water was collected as clean.

In experimentation, The Clean Water Project met its objectives. It was able to distill water using only solar power stored in a battery. As well as costing less 50 dollars.

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

ET EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

PS

Project Number

6063

Title: Engineering a Polylectic Biomimetic Unmanned Aerial Vehicle to Pollinate Drones

Student Name(s): K. Parikh

Abstract:

Colony Collapse Disorder (CCD) causes 80-100% population losses in *A. Mellifera* (western honeybee) colonies. CCD is an exaggerated occurrence of an ongoing centurial pattern whose symptoms cannot be traced to a direct source. Mitigating all potential mortality factors, such as monoculture and cross-country transportation, results in agricultural inefficacy. Instead, *A. Mellifera* should be withdrawn from agricultural practices. To pollinate enough crops to meet the rising food demand, biomimetic drone pollinators were engineered for exposure to cross-country transportation and nutritional deficiency of monoculture pollination.

A component was created using hollow carbon fibre rod, tipped with a curved brush of plastic fibres. The component performs as the mechanical equivalent to corbiculae in *A. Mellifera*. The component could be downscaled and attached to low-cost smaller drones. However, the larger DJI Mavic X drone was used for experimentation to evade flight stability issues.

The efficacy of the component was qualitatively measured by its ability to deposit and retain pollen during a pollination simulation. Four artificial flowers were populated with 1 gram of dyed chenopodium quinoa, which substituted pollen. To augment pollen retention capability, the brush was coated in solutions of varying viscosity during each trial. The trials revealed a solution of water and olive oil best augmented pollination rates because every flower was cross-pollinated.

Verification of consistent functionality of the component accounts for the conclusion that drone swarms are prepared for agricultural pollination. However widespread use of drone pollinators proposes floral evolution patterns which, if undeterred, reduces symbiosis between honeybees and flowers.

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

EE CS AS

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

222

2019

Fair Category

PS

Project
Number

6064

Title: Designing and Testing a Aid for the Visually Impaired

Student Name(s): S. Viswanathan

Abstract:

The "Vision Shoe" is a wearable device that assists the visually impaired to move around unfamiliar environments with greater confidence. The design utilizes a custom programmed microprocessor which detects topography using 5 ultrasonic sensors. Strategically placed 3 vibration motors indicate the location of obstacles. The setup is powered by a 9 volt battery and the whole system is embedded in a standard shoe. When an object is detected by one or more of the ultrasonic sensors, the vibration motor placed in the direction of the object will provide a tactile cue. The wearer will know the direction and the distance to the obstacle and can take measures to avoid it. This device was tested by a blindfolded user whose task was to successfully walk through a 30x30 ft room with obstacles of different shapes and sizes placed strategically between the entrance and exit. This test was performed three times with the position of the obstacles changed each time. The device aided the person to successfully traverse the room avoiding any contact with the obstructions. This device has a great potential in not only helping visually and sensorily impaired but also be useful for people who could be subjected to be active in low to no light situations like in the mine shafts for miners and in combat zones for military personnel.

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

AT CS EN

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

PS

Project
Number

6066

Title: USING A CONFORMAL PIEZOELECTRIC PLLA-BASED MICROPHONE FOR IMPROVED HUMAN SOUND DETECTION

Student Name(s): A. Mohnani

Abstract:

Biological sounds can be used as a health indicator. Heart murmurs sometimes signify underlying issues such as a leaking or dysfunctional heart valve. Bowel sounds have been used to assess and evaluate the activity of the gastrointestinal tract. Current microphones use rigid materials to detect sound, which means that the sound can only contact naturally curved skin over a small area. This study focused on creating a flexible and conformal microphone, making it possible for the microphone to adhere to the skin and stretch across a large surface area. We used the piezoelectric (a property by which a material converts mechanical energy into electricity) material PLLA (Poly-L-Lactic Acid) as the active element. The piezoelectric film was produced by electrospinning PLLA solution in a 14 kV field. The fibrous mat was annealed at 105°C and 160°C to increase and stabilize the material crystallinity. The PLLA film was cut at a 45° angle in order to maximize the measured signal and then sandwiched between two flexible aluminum electrodes to accurately detect the voltage generated by the film. To complete the microphone, we encapsulated it in polyimide tape, which is both flexible and safe for contact with human skin. We were able to test the ability of the microphone to detect sound by both using short bursts and sustained bursts of sound, both of which the microphone was able to detect. Overall, this project presents a conformal, flexible microphone that can be used to detect sounds from inside the human body.

**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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

196

2019

Fair Category

PS

Project
Number

6068

Title: Measuring Convexities of Electoral Districts Using Graph Theory to Flag Potentially Gerrymandered Districts

Student Name(s): S. Florin

Abstract:

Gerrymandering, the creation of unfair voting districts for political gain, has recently become a major issue because, during the past several election cycles, the number of seats received by a party did not align with the percentage of the popular vote received. Voting districts are required to be compact; however, current measures of compactness are inaccurate for reasons including differing results based on choices of coordinates or resolution, inability to adjust for the coastlines, and not addressing the fact that many sections of the country are uninhabited. This research addresses these issues by discretizing one of the most common formulas for compactness: the convex hull. By treating a district not as a geometric figure but as a graph of small regions, such as census tracts, with an edge drawn between vertices if they are geometrically adjacent, one can improve on this traditional measure. This discretization avoids the issues caused by coastlines, resolution, and coordinates, and by computing the ratio of the population of the original district and that of its convex hull, one can avoid issues caused by empty spaces as well. Thus, this metric can act as an improved mathematical signal for potentially gerrymandered districts.

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

MA CS

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

PS

Project
Number

6069

Title: ALTERNATIVE ACOUSTIC ABSORBING MATERIALS AND THEIR EFFICIENCY OF DECREASING ACOUSTIC VOLUME

Student Name(s): E. Kadambaya

Abstract:

In the 21st Century, noise complaints are becoming more frequent in America. The New York City article states, “about 420,000 noise complaints were filed citywide with the city’s 311 hotline in 2016, more than doubling the number of complaints made in 2011,”(Gannon, 2018). The source of the problem are the close proximity of buildings. Also, the increase of home workers such as streamers, musicians, workshop workers, micro-bloggers, etc... are causes of noise complaint cases. Environmental Noise Control says that noise issues are a type of pollution (Kinetics Noise Control, 2017). The solutions to decrease noise complaints are soundboard barriers and acoustic foam. The problem is that the solutions are very expensive. For example, it can cost at least \$500 to cover a normal 12 by 12 room. The experiment is designed to test alternate materials, to see if people can save money and do what they want without disturbing someone else. After testing all of the materials, it was concluded that all-purpose foam was the best alternative material at soundproofing compared to the soundboard barrier. This is because the data shows that the Sound Proof Board reduced the volume by about 13.54 dB, while the Foam reduced the volume by 11.9 dB. Although the Sound Proof Board reduced 1.64 dB more than the foam, humans can not tell the difference. The foam did well because of how dense and soft it is. The best part about the foam is it’s cost; At Home Depot it cost about \$6 for 3ft².

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

EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

224

2019

Fair Category

PS

Project
Number

6070

Title: Quantification of Cancer Cell Response to Squeezing Effect in 3D

Student Name(s): R. Du

Abstract:

To understand how cancer cells metastasize in vivo, it is important to understand how cells mechanically communicate with the environment. Optogenetic tools were used to switch RhoA activity on and off in 3D. Cell behaviors were quantified and characterized in the stimulating process. We were interested in answering the research questions: How can we change cell shapes in vitro, and to what extent can they be squeezed? Is there a difference between different cell types' response time to squeezing, and what factors can influence response time? Independent variables were the cell types. Dependent variables include response time and cell curvature. It was hypothesized that the extent to which the same type of cells can be squeezed would be the same, but the response time between different types of cells would differ. Images and data were collected with a confocal microscope. 3D videos and images were processed in Fiji and Matlab, and around 40 samples were run. Data was compiled and statistically analyzed. We found that the extent of the morphological change differs in different cell types while the response time is similar. In the near future, cell movement could be better controlled to investigate cell mechanics with optogenetics. This research project was conducted under the mentorship of PhD student Chang Liu at the Mak Lab in the Yale School of Engineering and Applied Sciences.

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

CB EN

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

173

2019

Fair Category

PS

Project Number

6071

Title: Utterly Surprising

Student Name(s): G. Rivera

Abstract:

In my “Utterly Surprising” science fair project, my goal is to figure out if glue made from whole milk would work better than glue made from low-fat and almond milk. Before starting the experiment, I expect that whole milk would work the best by far because I am thinking that because whole milk had the most fat out of almond and low-fat milk which I thought it would create the thickest and strongest glue. Since I didn’t do the experiment yet, I think almond milk will be the second strongest glue because it wasn’t labeled as low-fat milk. I think lastly that low-fat milk would be last because the name is low-fat and I was thinking that the less fat a milk has the less stronger the glue would be because it would not be as thick. I expect that each milk would at least be able to hold about 70+ pennies and that whole milk would be able to hold at least 85+ pennies per 3 trials.

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

CH

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

253

2019

Fair Category

PS

Project Number

6072

Title: Calculating the Best American Launch Vehicle for the Boeing CST-100 Starliner

Student Name(s): R. Lemone

Abstract:

The purpose of this project was to determine which American launch vehicle compatible with the Boeing CST-100 Starliner crew module would be most efficient in propelling the capsule to low Earth orbit (LEO). This is a concern as the development, building, and launching of spacecraft can surpass billions of dollars, so payloads need rockets that are streamlined and cost-effective. The Atlas V N22, Falcon 9, and Delta IV Heavy were chosen as launch vehicles for the research as the Starliner is being designed to launch with them, and the Atlas V 512 was chosen as it requires one less solid rocket booster (srb) than the N22. Information on the mass, dimensions, thrust, burn times, fuel costs, and specific impulse were researched on the four different rockets in order to make the calculations needed. These included: finding the thrust-to-weight ratio of the the different rocket/Starliner combinations to see how efficient the launches would be, determining whether the Atlas V 512 could angle its engine nozzles enough to counteract the torque of the offset center of thrust to mass due to having one srb, calculating the potential change in velocities of the rockets to ensure they could reach LEO and finding how much fuel could be taken from the rockets while still reaching LEO to save money, and comparing the costs of launching each rocket with the Starliner. The calculations show that the Falcon 9 would be best for the Starliner as it consistently proved more efficient on every step.

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):

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

156

2019

Fair Category

PS

Project
Number

6073

Title: Enhanced Photocatalytic Activity of Carbon Dots Grafted TiO₂ Nanorods

Student Name(s): S. Cai

Abstract:

TiO₂, one of the most promising photocatalysts, is widely used in air purification, sewage treatment, water splitting, carbon dioxide reduction and solar cells. However, TiO₂ can only absorb ultraviolet light, which makes up only a small fraction (< 4%) of the total solar spectrum. Therefore, we successfully prepared carbon dots (CDs) by low-voltage electrolysis of ethanol/sodium hydroxide/water mixture. TEM image shows that the prepared CDs are monodispersed spherical particles with a diameter of 3-5 nm. CDs grafted TiO₂ nanorods (CDs-TiO₂ nanorods) were prepared by hydrothermal treatment of CDs and TiO₂ nanorods solution at 200 °C. TGA shows that the content of CDs in CDs-TiO₂ nanorods was about 0.8%. UV-Dis shows that CDs could significantly improve the visible light absorption property of TiO₂ nanorods. Methyl orange was used as a model pollutant, the photocatalytic activity of CDs-TiO₂ nanorods was 2.17 times higher than that of TiO₂ nanorods under visible light irradiation.

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

CH 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

240

2019

Fair Category

PS

Project
Number

6074

Title: Sorption of Hydrogen Sulfide Contaminants Through Methyl Diethanolamine Doped Ceramic Beads Coupled with a Piperazine Catalyst

Student Name(s): E. Carpenter

Abstract:

Hydrogen sulfide (H₂S) is a toxic gas which is a by-product from industries such as mining, wastewater treatment and textile mills. The current mitigation technique for eliminating H₂S, car catalytic converters, use platinum, palladium, and rhodium, which are expensive metals. An alternate mitigation method is methyl diethanolamine (MDEA) and piperazine (PZ), a solvent blend, is inexpensive and easy to obtain. This experiment was conducted to remove H₂S using MDEA + PZ coated ceramic beads. MDEA was chosen due to its high absorption potential when introduced to H₂S. PZ was used to accelerate the process of MDEA absorbing H₂S. To test the efficacy of this proposal, the beads were soaked in a mixture of H₂S and water for 24 or 48 hours. To determine the levels of H₂S bonded to MDEA and PZ catalyst, the beads were analyzed with a Bruker S1 Titan X-Ray Fluorescence analyzer post exposure. Pre exposure to the H₂S water, there was 0 ppm of H₂S in the bead. Pre exposure to the MDEA + PZ, there was 4000 ppm of H₂S in H₂S water. The beads that were soaked for 24 hours absorbed an average of 3320.5 ppm H₂S. The beads that were soaked for 48 hours absorbed an average of 6252.5 ppm H₂S. This demonstrated a 100% absorption of H₂S. In both trials post exposure, H₂S water contained 0 ppm H₂S. In the future, this experiment would use H₂S gas in place of H₂S water.

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

EM AT 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

235

2019

Fair Category

PS

Project
Number

6076

Title: Extending the Life Expectancy of Fruits

Student Name(s): J. Corniello

Abstract:

In this experiment, two different types of coatings were created. These coatings were put on three different types of fruits in hopes of extending the fruit's shelf life. There is a lot of food going to waste and by extending the shelf life of fruits; it gives people more time to eat the fruits so food does not go to waste. A chitosan based coating and collagen based coating were created and dip coated on apples, bananas, and grapes. The moisture in the fruits was measured as time went on. The hypothesis was that as the fruit spoiled, the moisture in the fruit would increase. For the collagen coated grapes, the coated grapes lasted a week longer than the uncoated grapes. Also, as they spoiled, the moisture increased from about 45% to about 80%. The collagen coated apples, chitosan coated apples, and chitosan coated grapes are still being analyzed and so the results of those fruits cannot be summarized at this time. After 9 weeks for the collagen coated apples, the uncoated apple has gone bad while the coated apples are still usable. After 5 weeks of studying the chitosan coating grapes, the control and one of the coated grapes have been determined unusable. This study is ongoing until the other two samples fail. With observing the chitosan coated apples for 6 weeks, all of the apples (coated and uncoated) are still acceptable and ongoing.

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

CH EN

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- Yes No

CSEF Official Abstract and Certification

Word Count

218

2019

Fair Category

PS

Project
Number

6077

Title: The Design and Utilization of a Miniaturized Wind Turbine to Charge An Electronic Device

Student Name(s): N. Levi

Abstract:

The purpose of this project was to produce a hand-held device that could use wind to charge an iPhone by converting kinetic energy into electrical energy. The device was designed to create electricity using a miniaturized wind turbine, along with steel shielded bearings that powered a DC Project Motor Generator when it was turned. The initial prototypes consisted of a 3D printed, bladed fan attached to a generator, but the PLA filament proved too heavy to spin efficiently and the generator required too much torque to function. The next set of prototypes sought to decrease mass by constructing the generator from scratch. These prototypes were tested by attaching the fan and steel shielded bearings to a metal shaft and connecting the copper wires to a voltmeter. When the fan was blown and the steel shielded bearings spun, voltage was produced, but not at a sufficient level. Construction of the third group of prototypes utilized components from prototypes 1 and 2. The design remained relatively the same, but the prototype was fully insulated and included a motor generator attached directly to the steel shielded bearings. Results were collected with a voltmeter and analyzed for statistical relevance. Ultimately, it was concluded that the circuit and prototype created were not sufficient to charge an iPhone within a reasonable time interval.

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

EE ET AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

PS

Project
Number

6078

Title: EFFECT OF LENGTHENING TUNGSTEN-BASED β -SHEET MODELS ON HYDROGEN BONDING BEHAVIOR

Student Name(s): R. Lee

Abstract:

In biology, proteins play a major role in cellular processes, facilitating everything from the synthesis of molecules to the transmission of genetic information. The importance of these protein-protein interactions has led to a heightened interest in predicting the behavior of proteins via model systems of α -helices and β -sheets, or protein secondary structures. While most research has focused on purely organic models, some studies, notably those conducted by Curran and his group, have documented the use of metallic ions in synthesizing organometallic β -sheet models (Curran, Boynton, Berk, & Pedro, 2015; Curran et al., 2016; Curran et al., 2017). Such organometallic models are more promising than their purely organic counterparts because they are not only easier to synthesize and analyze but also offer novel information in a relatively understudied field. This study builds off a recent unpublished work by Curran and his group describing the addition of single amino acid chains to a rigid cyclic tungsten complex, addressing the unexpected presence of both static and equilibrating hydrogen bonds within the molecule by studying whether adding a second amino acid chain will stabilize the equilibrating hydrogen bonds. Through a series of chemical reactions, two glycine chains have been coordinated to a cyclic tungsten complex and purity of the final sample has been determined via thin layer chromatography and high performance liquid chromatography. A DMSO titration will then be performed to study the location and number of stable hydrogen bonds in the molecule.

Technical Disciplines Selected by the Student
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CH BI

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- Yes No

CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

PS

Project Number

6079

Title: Maximizing Photodynamic Therapy Through a Highly Focused (200-400nm) Beam to Promote Tumor Cell Apoptosis

Student Name(s): J. Garskof

Abstract:

Current surgical techniques for cancer treatment are limited due to proximity constraints of nerve tissue and arteries. In scenarios where cancer tissue cannot fully be removed, surgery is often accompanied by chemotherapy which is occasionally ineffective. To avoid this, it is proposed that photodynamic therapy can be used as a supplemental cancer treatment. In addition to surgery, photodynamic therapy will promote cellular apoptosis on the cancerous tissue that was not excised through surgical methods. A highly focused beam is critical to protect healthy cells from ultraviolet exposure. Focal length and magnification were determined for each series of lens. The value for focal length of lens A was 1.82mm, and lens B was 7.19mm. Yeast samples were exposed to ultraviolet beam determine the most effective lens combination to promote apoptosis. UVA, at low exposure times, induces beneficial mutations in yeast causing them to accelerate metabolic activity. While UVB promotes cellular death. Data provides an inverse relationship with yeast exposure to UVA and apoptosis. Since UVB will be used surgical scenarios, yeast samples with highest metabolic activity rate after UVA exposure will apply more damage to cancer cells. Metabolic rate was determined through the amount of carbon dioxide yeast sample emitted. The range of CO₂ ppm for one test was 2258ppm (control) and 4492ppm (lens A followed by lens B). The average 5 year survival rate in adults treated with cytotoxic chemotherapy was 2.1% (Morgan, 2004); this project will reduce chemotherapy protocol requirements, saving patients time, money, and pain.

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

AT EE PH

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

252

2019

Fair Category

PS

Project
Number

6080

Title: Textiles and Heat Reaction: How Likely to Burn if left Under Iron Heat?

Student Name(s): D. Hernandez

Abstract:

Fires caused by careless ironing is not one of the most common types of fires in the US, however everyone should be educated about, given the fact that nine out of ten people own an iron at home. As a cadet at a military high school ironing your uniform is mandatory. Therefore, it is used at least 2-5 days a week. If the material our uniforms is not very fire retardant then the risks of burning our houses down are higher during busy morning, or when in a rush.

The purpose of this lab is to find out which textile material will be the least flammable when exposed to prolonged time by an iron. My hypothesis is that if more polyester was used in clothing then it would be less likely to ignite. This would result from the chemical materials polyester is made of; coal, water, petroleum and water. To confirm this idea an experiment was performed, and each different textile was tested for its heat reaction when exposed to iron heat for a certain amount of time. And then observing any possible changes that might have occurred during the lab, such as discoloration, ignition/burning, smoke, cloth deterioration and any chemical release. The textiles that contained higher percentages of polyester had lower reactions to the heat while the ones that contained less polyester had higher levels of reaction to the heat. In conclusion the hypothesis was determined to be proven based on the results of the lab and all observations made.

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

CH AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

241

2019

Fair Category

PS

Project
Number

6081

Title: Comparing Functional Connectivity Scan Reliability Between the Prisma and TimTrio Scanners

Student Name(s): T. Lu

Abstract:

Functional magnetic resonance imaging (fMRI) brain scans have a variety of uses, such as being a tool for diagnosis and treatment plans. Where images for an individual patient are consistent throughout various scanning sessions, the data can be considered reliable. Having this reliability is essential to fMRI data being used effectively. Past studies have shown that scanner resolution and test site impact reliability of scans. However, there lacks research on how the reliability of two different scanners compares, which is what this project aims to investigate. In this study, the reliability of the TimTrio scanner will be compared to the newer Prisma scanner. It is hypothesized that between the two scanners, the spatial distribution of reliability will remain similar, but Prisma will have higher reliability. The independent variable is the type of scanner and the dependent variable is the comparison of reliability between the scans. This will be measured by the intraclass correlation coefficient (ICC), which ranges from 0-1 (0=no reliability, 1=complete reliability). Previously collected data on both scanners was used. Each set had the same participant and scanning procedures. The sets were prepared using Linux shell and fMRI Software Library, then uploaded to Matlab so ICC values could be generated. The average ICC for the Prisma scanners was 0.5012, with a standard deviation of 0.2264. The reliability and distribution is similar to that of the TimTrio scanner, but is lower than reliability measured in other studies using TimTrio.

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

ME

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- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

250

2019

Fair Category

PS

Project
Number

6082

Title: The Effect Of Continuous External Stimuli on Human Time Perception

Student Name(s): A. Anuar

Abstract:

This project studies how changing the rate of a continuous repetitive motion, such as a clock's movement, affects a human's innate sense of time. The intrinsic idea of the experiment is that all humans have a certain, subjective awareness of time, and that this perception is often affected by environmental factors. In the experiment, the subjects' accuracy in counting to 60 seconds mentally was tested while they focused on various different speed clocks. Meanwhile, various other factors were kept constant. The procedure itself was fairly simple and safe; it was determined that there was little to no risk of long lasting impact on the mind. The hypothesis was that if the clock speed were to increase, then the subjective time measurement for each subject would consequently slow down, which would be explained by the mind compensating for the change of pace by slowing down the mental clock. Major findings during the analysis of the results included the likelihood of trends; however, there seemed to be distinct trends, which differed from case to case- the relationship between clock speed and subjective time measurement had a proportional relationship in some cases, while some had a curved trend, where a difference in clock speed caused greater inaccuracy in each subject's time measurement. Essentially, the conclusion drawn from the experiment was that although different subjects had different types of trend patterns, most, if not all, subjects showed regular trends in the change of mental time perception as a result of the clock speed changing.

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

PH ME

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

246

2019

Fair Category

PS

Project Number

6083

Title: Computational Fluid Dynamics Study of Turbulence

Student Name(s): B. Ingwersen

Abstract:

Fluid turbulence is an area of physics that is still not well understood, but new techniques have the potential to better quantify its formation. Fluids are known to transition to turbulence as the Reynolds number of the flow is increased, but estimates of the critical point where this occurs are very imprecise. Current investigation into this problem has been carried out through physical experiments which face challenges of maintaining extreme precision. This research explored the use of computer simulations to more effectively approach the problem. A computer simulation of a fluid-filled duct was created for conducting trials, and the behavior of disturbances introduced into the flow were observed over a long time span. Many trials were conducted to establish the tendency of these disturbances to either decay or propagate into more disturbances at different Reynolds numbers. The critical Reynolds number can theoretically be identified by finding where the probabilities of these two actions equalize. The data collected show that for lower Reynolds numbers, the simulation can model the decay of turbulent structures in the fluid flow, while trials conducted at higher Reynolds numbers showed less consistent results. Therefore, the current simulation techniques lack the precision required to establish a full mathematical relationship, but an approximation can be made by extrapolating the data according to findings of other research. If the precision can be increased, future experimentation could provide insight for engineering applications that encounter turbulence such as the design of pipelines, cooling systems, or airfoils.

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

PH CS

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

243

2019

Fair Category

PS

Project
Number

6084

Title: Utilizing an Electrical Charge to Stimulate Osteogenesis

Student Name(s): P. Hall

Abstract:

A bone break generally takes about 6-12 weeks to heal enough to a significant degree. As the body ages, bones take significantly longer to heal which means bone breaks may render an elderly person incapacitated for a noteworthy amount of time. It is proposed that a micro mesh made out of titanium when placed over the break will provide stability and increase the speed of the bone healing process. The proposed titanium micro mesh is to be placed into a solution consisting of Calcium and Sodium Phosphate then exposed to varying electrical voltages from a power source to test if a calcium matrix would form onto the micro mesh proving that the experiment would be a success inside the human body. Using the X-Ray Spectrometer, multiple scans were taken at the voltages of, 6 volts, 7.2 volts, 9 volts, 10 volts, and 11 volts. In order to test if there was an adequate amount of calcium present. The scans demonstrated that calcium was in fact taking over the material and its exposure in the solution showed plating on the micromesh. The plating was so successful that Calcium was showing up as the most dominant element in every scan prevailing over the base elements of the grid by tens of thousands parts per million. The micromesh when exposed to an electrical charge, plates with the calcium solution which is exactly what would happen inside the body utilizing the properties of electrical bone stimulation.

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

AT

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

232

2019

Fair Category

PS

Project Number

6085

Title: Green, Clean, Solar Machine: An Efficient and Natural Way to Clean Solar Panels

Student Name(s): J. DiAngelo

Abstract:

In this experiment, different natural cleaning agents were explored to observe if they performed better than a chemically-based solution. The solutions cleaned solar panels and allowed them to absorb the most UV rays, and convert them into potential energy. The solutions explored were decyl glucoside, eucalyptus oil, and distilled white vinegar, which were compared to each other, as well as Windex©. This experiment was conducted to explore different solutions and how they cleaned the solar panels of dust and dirt. The natural solutions were compared to a chemical solution, to note whether a natural cleaning agent would clean the panels more of their dirt and dust, in addition to being better for the environment. It was hypothesized that decyl glucoside would clean its solar panel the best because it is known for its cleaning properties and is often found in shampoos and soaps that are safe to for skin. Eucalyptus oil had the greatest improvement in voltage after being cleaned; its average delta was 0.89 volts. The average delta of Decyl Glucoside was 0.62 volts, vinegar was 0.56, and Windex© was 0.72 volts. The experiment proved which solution performed best at its task, and when experimented further, could change the performance of all solar panels. Incorporating eucalyptus oil in cleaners could allow solar panels to absorb their maximum amount of UV rays, and convert them to their maximum amount of energy.

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):

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

224

2019

Fair Category

PS

Project Number

6087

Title: Sky Sugar: Engineering Biodegradable Balloons

Student Name(s): D. Ferrara

Abstract:

Whether released for a display or inadvertently, latex and foil balloons have the potential to harm and kill organisms in both terrestrial and aquatic ecosystems. As a result, organized balloon releases in the United States have been banned in five states and regulated in several municipalities. With the intention of creating a helium balloon that is environmentally friendly, Sky Sugar came into fruition.

Sky Sugar is a biodegradable and digestible balloon made out of simple household baking ingredients. The original idea for the Sky Sugar balloon came from Alinea, a Chicago-based restaurant who makes a dessert item out of an edible, helium balloon. Building off of that concept and enhancing recreations of the recipe to focus on durability over flavor, Sky Sugar introduced itself as a potential alternative to latex and foil balloons. In its trials, the Sky Sugar balloon lasted more than 50 minutes — long enough for any public balloon release. When deflated, all that remained were sugar crystals, which melt in contact with water and are digestible, and jute twine, a natural and biodegradable material. Sky Sugar uses common household baking ingredients that are mixed and boiled together, including sugar, corn starch, corn syrup, and water.

With continued development to enhance the durability, color, and production capabilities, the Sky Sugar balloon could prove to be a viable alternative to conventional balloons.

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

EN

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- Yes No

CSEF Official Abstract and Certification

Word Count

272

2019

Fair Category

PS

Project Number

6089

Title: Single-Use, Insulative Tableware Made from Cornstarch and a Hydrophobic Edible Thin Film, as a Biodegradable Replacement for Styrofoam

Student Name(s): T. Fox

Abstract:

Our over-reliance on consumer-friendly, single-use tableware, when disposed of, severely impacts our ecological footprint. Plastic and Styrofoam products, for instance, can take upwards of 500 years to begin decomposition when buried in a land-fill. An eco-friendly alternative to these persistent tableware materials is needed; one that is single-use intended, safe for food use, sustainable, and biodegradable. In this research, such an eco-friendly tableware composite was manufactured, from cornstarch, 5% acetic acid, and di-water. When mixed in a ratio of 32:10:25 (m/m/m), and heated in a consumer microwave for 45sec, an initially pliable, but soon (1-minute, post-heating) rigid tableware composite is formed. SEM analysis of the composite highlights a dense, rigid outer layer, composed of tightly-packed, 10 μ m microparticles. The inner, insulative sheet, however, is composed of fluffy, sponge-like layer, with 300 μ m air pockets. ATR-FTIR analysis of both portions highlight similarities to cornstarch, the "food-safe," main constituent. To provide water resistance, 20mg/ml Beeswax was sprayed onto the newly formed composite, and dried for 5 minutes, creating a uniform, water-impermeable 5 μ m coating (supported via SEM & ATR-FTIR). In thermal studies, the new Cornstarch-Beeswax (CB) tableware composite performed as well as Styrofoam, the current coffee-cup preference. Finally, the landfill decomposition of CB tableware (against Styrofoam and Cornstarch w/o Beeswax) was simulated by placing 0.40g pieces of each material in soil for 1 week. Mass differences and SEM/light microscopy examinations were conducted each day, to determine decomposition rates. While Styrofoam remained persistent during that time, CB and Cornstarch (alone) composites degraded by 35% and 41%.

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

EM EN AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

255

2019

Fair Category

PS

Project
Number

6090

Title: Al(III)-Mediated Ionic Conduction in New Abundant Metakaolin Solid Electrolyte for Safe, Efficient Power Grid Na-Ion Batteries

Student Name(s): A. Kosyakov

Abstract:

Many concerns have arisen in recent years regarding lithium-ion batteries (LIBs), mostly due to the rapid depletion of lithium reserves and the volatile liquid electrolytes used to make them. This limits their ability to be incorporated into the energy storage systems (ESSs) of renewable energy power grids. Sodium is 37 times cheaper and 2000 times more abundant than lithium and can be used in sodium-ion batteries (SIBs). However, SIBs are less energy-dense than LIBs and possess the same issues with liquid electrolytes. In this research, a new metakaolin solid electrolyte (MSE) was developed from the highly abundant clay aluminosilicate kaolinite. Full CR2032 cells were built with MSE pellets and standard NaNiO₂ cathodes and biochar anodes. These cells exhibited a maximum voltage of 1.1V and indicated no loss of capacity after 200 cycles despite undergoing tests that would have otherwise compromised conventional LIBs and liquid-electrolyte SIBs. In addition, a cost analysis revealed that the MSE SIBs were capable of providing power for \$587/kWh on a laboratory scale and, potentially, \$300/kWh on an industrial scale. Meanwhile, LIBs can currently only provide power in ESSs for \$810/kWh. Metakaolin was found to be able to transmit ions via a potentially previously-undiscovered conduction mechanism, which was hypothesized in this research to rely on the unique metastability of the material as well as the speculated presence of three-coordinated aluminum atoms. Experimental support for this theory was found in this research, though more investigation is necessitated to assess the intricacies of the mechanism.

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

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

250

2019

Fair Category

PS

Project
Number

6091

Title: The Selective Oxidation of Benzyl Alcohol to Benzaldehyde Using a Mesoporous Vanadium Doped Ceria Catalyst

Student Name(s): A. Aggarwal

Abstract:

In this study a mesoporous vanadium doped ceria catalyst was synthesized to help make the production of benzaldehyde more economical, environmental, and safe. Benzaldehyde (C₆H₅CHO) is a compound with numerous industrial applications in pharmaceuticals, cosmetics, and more. Conventional methods to synthesize benzaldehyde harm the environment, contaminate products, and endanger human health. The selective oxidation of benzyl alcohol to benzaldehyde decreases these issues; however, it's too expensive to implement conventionally. Since known catalysts use expensive metals, here we create a more cost effective catalyst. Our catalysts were mesoporous due to their tunable structural properties, used ceria due to its high oxygen storage capacity (OSC), and used vanadium to enhance ceria's high OSC. This reaction is green chemistry since using hydrogen peroxide (H₂O₂) as an oxidizer created a water by-product. The catalysts were created using a sol gel inverse micelle method and tested for conversion and selectivity by heating in reflux for 24 hours. The reaction results were analyzed using gas chromatography mass spectrometry. Structural properties of the catalyst were studied using nitrogen sorption, scanning electron microscopy, and powder x-ray diffraction. The 5% vanadium doped ceria catalyst exhibited the highest conversion of 79% with 100% selectivity even without optimization of reaction parameters. This catalyst exhibited a mixed phase consisting of cubic crystal phases of cerium oxide and tetragonal phase of cerium vanadate. Furthermore, the material was mesoporous with a pore diameter of 3.4 nm. With future studies optimizing this reaction, our catalyst may achieve greater efficiency and be used conventionally.

**Technical Disciplines Selected by the Student
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CH EN

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

242

2019

Fair Category

PS

Project Number

6092

Title: The Effect of Piezoelectric Cantilever Beam Design and Spatial Positioning in a Network on the Efficiency and Maximum Energy Output of a Vibro Wind Unit.

Student Name(s): J. Pasato

Abstract:

The piezoelectric effect is the process of converting mechanical energy into electrical energy through the motion of ceramic crystals. By attaching a piezoelectric transducer to a cantilever beam, vibrations caused by low-speed winds can generate low voltages. This project aims to develop an efficient piezoelectric cantilever beam design that maximizes power output at low wind speeds.

Piezoelectric cantilever beams consist of two parts: a metal substrate which the transducer attaches to and an inertial mass at the end of a beam to sustain oscillation. Inspired by the work of Kluger, et, al, four inertial masses of conical, rectangular, trapezoidal, and triangular geometries were designed in CAD and run in a Computational Fluid Dynamics simulation to provide a visual perspective for areas of airflow based on the geometry. Finite Element Analysis was used to simulate wind loads on aluminum substrates of varying widths and lengths to predict the vertical displacement of each beam. The larger the displacement of the cantilever beam, the more energy used to generate electricity.

Four trials were conducted for each geometric inertial mass on eight substrates in a wind tunnel for a period of one minute. Wind tunnel testing determined that the configuration with a rectangular inertial mass with the 25x250 mm substrate produced 0.00810 W of power over a span of 60 seconds at maximum 5 m/s wind speed. Additional research and wind tunnel testing will focus on a combined network of piezoelectric cantilever beam designs.

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

248

2019

Fair Category

PS

Project Number

6093

Title: Geospatial Analysis of the Martian Surface to Promote the Growth of Photosynthetic Exoagriculture

Student Name(s): N. Fawcett

Abstract:

Colonizing Mars is not only about putting people on the planet, but also being able to keep them there. One factor needed to keep people on Mars is a reliable food source, but, Mars is 1.5 times farther away from the Sun than the Earth is. Because of this large increase in distance, there is a decrease in the amount of quantum energy that can reach plants. Therefore, working toward a way to grow plants, or determining ideal destinations on Mars for plant growth, helps future colonization on Mars.

In order to accomplish this, one idea is to build contained farms on the surface, having a glass roof, but an Earth replicated atmosphere. To put this into process, the amount of light that reaches the planets surface was calculated. This was done by determining the average amount of light that reaches the planets surface if there was no interference, and then subtracting off of the light scattered in the atmosphere. It has been calculated that 591 W/m² reach the Martian surface without accounting for the atmosphere. Adding to that, it has been deciphered that the amount of carbon dioxide in the atmosphere does not scatter enough light to make a difference on plant's ability to photosynthesize.

This will allow organizations like NASA and SpaceX to save money and energy on lighting because they will be using sunlight to grow the plants.

The future goals of this study include accounting for dust storms and residue of dust particle.

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

PH MA PS

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

4. Is this project a continuation? Yes No

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

264

2019

Fair Category

PS

Project Number

6094

Title: Using Vibrational Spectroscopy to Analyze DNA in Museum-type Bone Specimens

Student Name(s): J. Trudeau

Abstract:

Recent genetic research has focused on sequencing the genome and analyzing the DNA of extinct species. A major obstacle to this research, however, lies in the poor DNA quality contained in archeological samples, which are often destroyed by the extraction and analyses of DNA. A process is needed to accelerate the aging of a modern bone, to create an artificially-aged, simulated archeological specimen, for genome/DNA studies. In this research, a process was developed to artificially age forensic bones, to create archeological bone specimens that are useful in genetic research, including study of DNA composition. Cleaned, new chicken bones were separately heated at 500oC and 700oC, for 4hours. ATR-FTIR spectra were collected for original and artificially-aged bones; Crystallinity Index (CI) and carbonate/phosphate ratios (C/P) were determined using absorbances from 590-1428cm⁻¹. Spectral results for artificial aging highlight a decrease in C/P from 1.15 for forensic bones to 0.083 (500oC) and 0.022 (700oC), for the artificially-aged specimens. Similarly, CI rose from 2.07 to 2.50 (500oC) and 2.58 (700oC) during the artificial aging process. For both temperatures, the new indices for the artificially-aged bones fall within the literature-accepted values for true archeological specimens, verifying success of the technique. Light and scanning electron microscopic analyses further supports these findings; bone morphologies of artificial-aged bones resemble that of their archeological counterparts (in literature). Finally, unique FTIR peaks of cytosine were present in both forensic and artificially-aged bones; cytosine content can be estimated, and related to the total DNA content in the artificially-aged (and thus archeological) specimens.

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

EN AT

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- Yes No

CSEF Official Abstract and Certification

Word Count

232

2019

Fair Category

PS

Project
Number

6095

Title: Is There a Sliver of Reason Behind Metal in Rosin

Student Name(s): K. Roy

Abstract:

Rosin is a type of resin extracted from tree sap. It is used for many purposes, including getting applied to violin bows in order for the instrument to produce sound. Rosins often have precious metals, such as gold, silver, and bronze, incorporated into them. These additions to the rosin are said to change the tone of the sound of the violin by changing the static friction of the bow. However, the amount of metal in the rosin is minute, and the amount of rosin applied to the bow is not very large, making it questionable as to if this metal has any impact. The original hypothesis was that the metal incorporated into the rosin was in such a small amount that it would not make a noticeable difference to the quality of the sound. The violin was played into an online oscilloscope with two different bows, one coated in rosin without metal, and one coated in rosin that had gold in it. After three trials were run, the soundwaves from both types of rosin were analyzed, and clips of each sound were played for music professionals, it was determined that the addition of metal, in this case gold, to the rosin did make a difference in the sound, disproving the hypothesis. Further work would mainly include testing rosins with different types of metals to see if they sound different from each other.

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

PH EN

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 vertebrate animals controlled substances

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- Yes No

CSEF Official Abstract and Certification

Word Count

137

2019

Fair Category

PS

Project Number

6096

Title: Kite-Powered Technology: Creation of an Efficient Wind Harvester to Produce Power

Student Name(s): R. Glanville

Abstract:

The purpose of this project was to create an alternative wind energy harvester using kite technology over traditional wind turbines. This project compared the efficiency of the kite power system to that of a normal wind turbine by designing and constructing a kite powered system. This device used a coil which was attached to both the Permanent Magnet Motor Generator and the parafoil kite. The kite turned this coil, in turn, producing energy through the generator. The coil that connected the kite had to be designed and 3D printed for the project. Data was collected and efficiency compared to traditional wind turbines using data from online sources. It was concluded that although a kite powered system is unique and potentially cost effective, consistent energy production was not achieved in this model, thus the comparison produced inconclusive results.

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

EE ET AT

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

264

2019

Fair Category

PS

Project
Number

6097

Title: Unprecedented Waste Free Biofuel by Izomerization and Cross Metathesis of Sunflower Oil.

Student Name(s): E. Haddad

Abstract:

In contrast to the well-established hydrolysis of vegetable oil into long chain biodiesel, little effort was made to convert this precious oil into shorter alkenes, providing higher quality fuel compared to biodiesel. Sunflower oil, Corn oil, Rapeseed oil, and others include double-bonds in their fatty acid chains. The objective of this project is to test the application of alkene Isomerization and cross metathesis of sunflower and corn oil with shorter alkene (trans-Stilbene) using second generation Grubbs Catalyst.

The catalyst, trans-Stilbene, the oil, and Mesitylene (internal standard) were heated in a closed vial to 150°C for 2 hours. Gas Chromatography Mass Spectroscopy (GC-MS) was used for analysis. The results consisted of two sets of multiple peaks which differ in 14 mass units (-CH₂- fragments). One set contains trans-Stilbene fragments with molecular weight range of 160 to 244 (C₅-C₁₁ alkenes) while the second set is in the weight range of 154-258 (C₁₁-C₁₇ alkenes). The formation of these product mixtures is the result of fast Isomerization of the double bond in the fatty acid chains followed by trans-metathesis. The efficiency of this reaction was measured by comparing trans-Stilbene in the reaction mixture to the internal standard before and after heating. The results indicate 50% conversion of trans-stilbene to products. Similarly, a mixture of short alkenes was formed in absence of trans-Stilbene providing statistical distribution of C₁₁ to C₂₁ chain links.

This project provides a proof of concept for unprecedented isomerization/cross metathesis with single catalyst and provides the basis for production of sustainable biofuels.

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

CH EM ET

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 vertebrate animals controlled substances

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- Yes No

CSEF Official Abstract and Certification

Word Count

215

2019

Fair Category

PS

Project
Number

6099

Title: Testing How Different Materials Reduce Frequency and the Effectiveness of that Material in Reducing White Noise

Student Name(s): B. Salvador

Abstract:

Large spaces, such as gymnasiums, that are used to host large events often have one major problem; there is so much white noise in the room that it is extremely difficult to hear. The purpose of this experiment was to determine how to reduce white noise in a room to prevent this problem. White noise is defined as equal energy in all frequencies. Therefore, the reduction method would need to be able to effectively absorb both high and low frequencies. In order to find the best method of reducing white noise, several different professional sound absorbing materials were placed in the center of a model room. On one side of the material was a white noise generator, and on the other was a decibel meter. After determining the most effective material, research was conducted to see what properties of this material made it the most effective in reducing both the high and low frequencies of white noise. One major property of these sound absorbing materials is the amount of space between the fibers. Using this information, a new sound absorbing material was designed out of unconventional items that shared this property. The newly designed sound absorbing material was then run through the same testing and showed results similar to the most effective professional sound absorbing material.

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

EE EN

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

4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

150

2019

Fair Category

PST

Project
Number

6502

Title: Faster and More efficient salt remover

Student Name(s): B. Parson, A. Potter

Abstract:

The intention of our experiment was to find a more efficient and natural way to extract salt from water. A lot of seaside communities may not have access to clean water but by giving them a natural and efficient way to make the ocean water potable, they could be provided with a constant source of water. Our project looks at three different high potassium plants and tests their salt absorption ability. The three foods, potatoes, bananas, and oranges were dropped into a stew for the same time interval and were measured to see which plants lowered the sodium count the most. Our hypothesis was that the potato would lower the salt concentration in the stew the most. Our hypothesis was somewhat supported by the end results showing the potatoes falling in between, bananas and oranges. Then parts per million (ppm) dropped down to around from 6,100 ppm to around 5,600 ppm for each food.

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

EA

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

241

2019

Fair Category

PST

Project Number

6503

Title: Creation of a Fire Resistant Membrane in the Makeup of a Wall

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

Abstract:

The goal of our experiment was that if a fire-retardant membrane was placed on top of rolled insulation and plywood and covered with sheetrock, that this new protective membrane will delay the burning process. The procedure consisted of testing three walls, A, B, and C. Wall A, our control consisted of 8ft x 4ft plywood structure with rolled insulation and sheetrock meant to mock the inside of a regular home's wall. Wall B consisted of the same materials, however a store-bought fire resistant tent material was placed between the insulation and the sheetrock. For Wall C, the same structure was used but sodium polyacrylate secured in place with a cotton cloth stapled to the wood was used instead of the fire tent, also to act as a fire-resistant membrane. The results supported the hypothesis because Wall B, containing the store-bought fire-resistant tent, doubled the burn time that the control, Wall A, had. However, Wall C was not as successful as predicted. It is believed that when the activated sodium polyacrylate was placed in the structure and set to flames, the moisture caused the sheetrock above it to form into a paste-like consistency, crumble, and that moisture "smoked out" the wall. Although the sodium polyacrylate did not achieve the goal from inside the wall, the loose sodium polyacrylate tossed on top of the fire completely smothered it, further proving that it is an exceptional fire retardant.

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

CH EN

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4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

188

2019

Fair Category

PST

Project Number

6504

Title: The Application of the Venturi Effect to Passively Accelerate Wind as a Means to Improve Turbine Efficiency

Student Name(s): E. Meindl, W. McLaren

Abstract:

The objective of this project was to improve wind turbine efficiency by studying both the Venturi effect and Bernoulli's principle. We built a wind turbine inspired by these two concepts. It consisted of a "wind tunnel" that funneled the wind from a larger area (diameter of a circle), to a smaller surface area (smaller circle diameter). In accordance with the Venturi effect, it accelerated the wind velocity relatively proportional to the change in area. In the smallest diameter of the turbine, 3 wind turbines were constructed that go to a voltmeter. The data demonstrated that the Venturi effect and Bernoulli's principle can be applied to passively accelerate wind speed in a turbine. The wind was accelerated to 11 times the speed from the beginning to exit. Based data analysis, the objective was achieved. The wind speed was vastly improved and the turbine was very efficient compared to a normal turbine. Further studies are needed to test the real world impact of this innovation. The data obtained showed a positive trend, but it needs to be tested in real wind and at an altitude where it can be effective.

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

ET ET 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

246

2019

Fair Category

PST

Project
Number

6505

Title: Building a thermometric generator which creates electricity from wasted shower heat

Student Name(s): A. Mohammed, A. Zeinalabidin, M. Sharaf

Abstract:

Abstract

It has been estimated that 80 to 90% of the energy used to heat water in our homes ends up escaping. But what if all that wasted heat could be turned into electricity?

Our design is made up of a cube of foam that was carved to hold 2 copper pipes with 3 peltier tiles connected together in a series circuit. The pipes were made flat on one side to ensure maximum contact with the flat peltier tiles. One pipe will have cold water run through while the other will have hot water. This simulates the shower plumbing in a house. The temperature differences between the pipes will produce electricity with the peltier tiles.

We placed the experiment in a tub with two separate funnels for hot and cold water. We ran hot and cold water throughout the experiment for 2 minutes recording amps and volts every 30 seconds using a multimeter. We repeated this five times for our five trials. In the experiment, we produced an average of 0.28 volts and 0.97 amps (or 0.27 watts) per reading.

We produced 81 watts over 5 minutes, so a ten-minute shower would produce 162 watts of electricity. If a 4 person family takes a shower 10 minutes each every day of the week, 4562 watts are produced in a week. This energy can then be stored in a power bank for use at a later time and help reduce electricity usage from the utility companies.

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

EE AT ET

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

255

2019

Fair Category

PST

Project Number

6506

Title: Non-Invasive Cross-Pollination Mechanism for Commercial and Subsistence Agriculture

Student Name(s): G. Guzzo, A. Lacunza

Abstract:

Due to the destruction of biodiversity and habitats, the bee population is declining. By cross-pollinating, honeybees ensure the growth of numerous species and the production of food and shelters. Insufficient pollination is the main cause of low yields in many fields and orchards. As a result, artificial cross-pollination mechanisms need to be designed to counterbalance the decrease in natural pollinators. The purpose of this project is to design an effective and cost-efficient artificial cross-pollination mechanism.

During flight, honeybees develop a positive charge of 23.1pC on average. Due to the texture of the bee's fur and the negative charge of pollen, bees electrostatically attract and carry pollen. Recent studies have proven the accumulated charge on airborne honey bees is adequate for non-contact pollen detachment via electrostatic forces. Other research around the use of electrostatic techniques in pollination found that fruit produced was increased by 85% to 175% and yields of pistachio were raised by an average of 20%.

This project simulates the bee-flower relation through the use of an electrostatically charged mechanism that attaches to drones. The mechanism consists of copper mesh with protruding copper spikes to simulate bees' hair and electrostatic charge distribution. A Wimshurst Machine is used to positively charge the copper mesh initially. Thereafter, the mechanism is sent into flight in order to attract the pollen electrostatically and later disperse the pollen when the copper mesh is given a negative charge. Due to seasonal conditions, experimentation is scheduled to take place in the spring with local farms.

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

EE EN PS

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

249

2019

Fair Category

PST

Project Number

6507

Title: Increasing The Amount Of Electrons Harvested From The Soil Supporting Aloe Vera (Barbadensis) Plants By The Addition Of Potassium Gluconate And Ferrous Sulfate Into The Soil.

Student Name(s): S. Carle, I. Hasson

Abstract:

Is it possible to increase the amount of electrons harvested from the soil supporting Aloe vera (barbadensis) plants by the addition of potassium gluconate and ferrous sulfate into the soil? Plant soil harbors stray voltages which can be captured by electrodes. Microorganisms in the soil of plant root systems break down sugar excreted by the plant and release free electrons through the process of glycolysis. These electrons can then be harvested by putting electrodes into the soil. Our initial tests showed that the plant soil generated a voltage of 20mV. The experiment involved putting two carbon rods, (electrodes) into the plant soil and measuring the voltage with a multimeter. It would be necessary to increase the efficiency of the process to make it a practical renewable energy source. Therefore, it was speculated that adding metal salts to the soil would increase the voltage through a physical as well as a chemical process. Firstly, the soil would become more conductive. Secondly, it was thought that when the metal salts broke down they would form voltaic cells and donate electrons to increase the voltage. The experiment proved that the metal salts did increase the voltage. The ferrous sulfate increased the voltage production by 81%. The potassium gluconate achieved a 136% increase in voltage output. Adding metal salts to the plant soil increased the voltage produced. By increasing the voltage and up scaling it could provide enough voltage to charge cell phones or run lights creating a practical, renewable, sustainable energy source.

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

PS

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

210

2019

Fair Category

PST

Project
Number

6508

Title: Transformation of Mechanical Energy via Piezoelectric Circuits to Power a Bicycle Light

Student Name(s): T. Chang, R. Winston

Abstract:

The objective of this project was to harvest energy by using piezoelectric generators and transfer the harvested energy into electric current. It was hypothesized that if large enough charge was created by the piezoelectric element, the capacitor would store the charge, and the LED would remain lit even when the bike was not being pedaled. To allow for stationary testing, a bike stand was constructed to hold the bike in place when the back wheel was spun. The breadboard itself consisted of a diode bridge, jumper wires, a capacitor, a piezoelectric element, and an LED. A waterproof casing made from acrylic was constructed to protect the breadboard from all the elements of nature. Challenges occurred in powering a higher voltage LED because of the small amount of voltage ultimately produced by the piezoelectric element when directed through the diode bridge. Piezoelectric flaps and discs were both tested, with the flaps producing a higher voltage at a more consistent rate. By running different voltage amounts through different LED lights, optimal levels of direct and square current was determined in order to produce a bright enough shine, and a manageable voltage for the piezo element. Various prototypes and breadboard designs were constructed and tested to produce the most feasible and reliable light.

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

EE ET AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

PST

Project
Number

6510

Title: Optimization of High-Efficiency Organic-Inorganic Lead Halide Perovskite Solar Cells via a Novel Polycaprolactone Additive Pathway

Student Name(s): S. Prasad, A. Prasad

Abstract:

The recent global energy crisis has resulted in a push for the development and commercialization of renewable energy sources, most notably solar cells. In 2009, Kojima et al. revolutionized the field of photovoltaics by synthesizing the first perovskite-based solar cell (PSC). Perovskites are semiconducting materials with the crystal structure ABX₃, whose unique optoelectronic properties make them very suitable as the light-absorbing layer in photovoltaic devices. Techniques used to fabricate these devices, however, often result in poor surface morphology. The goal of this study was to manufacture perovskite layers with fewer defects, resulting in solar cells with higher power conversion efficiencies (PCEs). We investigated the effect of a biodegradable, environmentally-friendly polycaprolactone (PCL) additive on the film quality and photovoltaic performance of methylammonium lead iodide (MAPbI₃) PSCs.

The devices were fabricated using spin-casting techniques. To characterize the film, atomic force microscopy, UV-Vis spectroscopy, and X-ray diffraction measurements were performed; an efficiency test was conducted, with help from our mentor, to quantify efficiency. The results indicate that PCL additives passivate grain boundary defects and enlarge grain size by controlling perovskite crystallization rate during film formation. The resulting films are smoother and thus exhibit extended charge carrier diffusion length and suppressed charge recombination. The optimal doping concentration, 0.6 mg/mL, increased the efficiency of the device by 39.7% to a PCE of 13.2%. These high efficiency devices fabricated with the novel, biodegradable, and easily-processable PCL dopant suggest its viability as a promising component of commercial, high-efficiency PSCs.

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

EN ET EE

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

238

2019

Fair Category

PST

Project
Number

6511

Title: The Effect of Hydrofoil Design Parameters on Dynamic Behavior and Energy Extraction Efficiency of an Oscillating Hydrofoil Power Generation Unit

Student Name(s): C. Rinaldi, A. Tirumala

Abstract:

Oscillating Hydrokinetic turbines provide a viable method of electrical power generation through the sinusoidal motion of hydrofoils through a fluid flow. Hydrokinetic turbine elements follow both an angular pitching motion and a linear heaving motion to guide the system into a sinusoidal motion. After reaching a maximum angle, where the foil stalls, vortex shedding causes the foil to pitch in the opposite direction, further guiding the foil linearly. This project investigates the effects of varying the flexural modulus of the rear half of the hydrofoil on the overall coefficient of power.

A literature review was conducted in conjunction with Computational Fluid Dynamics simulation, and material properties evaluation. Throughout experimentation, 3d printed samples were fabricated from Polylactic Acid, Thermoplastic Elastomers, and various grades of Thermoplastic Polyurethane. For each polymer, the percent infill was varied from 5% to 100%.

The flexibility of the material is essential in increasing the efficiency of the system. A higher pressure on the trailing edge compared with the leading edge causes the hydrofoil to rotate. Allowing the trailing edge to flex increases the frequency of the heaving motion that the system is able to achieve. It is thought that one of the most important factors influencing the efficiency of power generation of this combined angular and linear system is frequency. This configuration of a Hydrofoil consisting of two different flexural moduli is capable of increasing the highest theoretical efficiency beyond the present limit of 35.27%.

**Technical Disciplines Selected by the Student
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AT EE MA

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

156

2019

Fair Category

PST

Project
Number

6512

Title: Which pain medication is more soluble in stomach acid?

Student Name(s): A. Stack, J. Kitengie

Abstract:

This experiment will determine and give a visual representation of pain medicine dissolving in a stomach acid. Perfecting the acid simulation was a main key in this experiment, if the simulation didn't work the entire experiment would have been a fail. Each pain medicine used in this experiment have their differences, but overall they all have the same purpose. The pain medications in this experiment represents the category of pain reliever they're in. The ones used in this experiment are Acetaminophen (Tylenol), Aspirin, Naproxen (Aleve), and Ibuprofen. The question being resolved is will the time needed to break down the medicine determine how soluble the pill is. Ibuprofen was the most soluble out of all four pills used in this experiment. Compared to the other pills, Ibuprofen took 17.7 minutes to dissolve, which is a low number. Our hypothesis was that ibuprofen would dissolve the fastest out of all four pills, which our data does support.

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

CH BI ME

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

- human subjects potentially hazardous biological agents
 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

247

2019

Fair Category

PST

Project Number

6513

Title: The Effect of Spatial Attention on Oratorical Performance

Student Name(s): P. Joseph, M. Shabazz

Abstract:

Staying focused is a fundamental skill that is mainly developed in classroom environments but it can also be challenging to stay attentive in class because of distractions. Through these observations, we had wondered if a person's attention can affect their nervousness when they speak in front of an audience. To measure attentiveness, we assessed how many times the pupils of the participants (age range: 12-15 years old) strayed away from a point as they watched two videos separately that contained a middle point and various backgrounds. We also measured the period of time in which they stayed focused on the point. The second test was a measurement of bpm as participants read the Old English poem; Sonnet 18 by William Shakespeare. Initially, we had hypothesized that individuals who were able to focus on the point consistently and for longer periods would show little to no nervousness indicated by a heart rate similar to normal because those individuals would be able to better concentrate on the task. After analyzing the data from our experiment, our findings were that 60% of participants had phenomenal eye focus. On average, their pupils strayed 0-2 times away from our acceptance area when they watched the test video. These subjects also had presenting BPM data that stayed close to the resting heart rate (strayed 5-10 bpm). To conclude, our data partially supported our hypothesis but we believe that further extension on the project and a more controlled setting would achieve more justified results.

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

BE AT

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

232

2019

Fair Category

PST

Project
Number

6514

Title: Thermal Performance of Alternatives to Silicone Based Thermal Interface Materials

Student Name(s): Z. Bachofner, A. Bryant

Abstract:

Thermal interface materials are used to transfer heat away from high-performance computer parts to a heatsink, which then dissipates the heat. Their efficiency is dependent on multiple factors: composition, density, viscosity, and surface tension. This experiment was conducted to determine if any thermal interface materials could offer greater thermal performance than a silicone based thermal paste. To do this, the silicone-based thermal paste, graphite cooling pad, liquid metal, and toothpaste, were each applied between the integrated heat spreader of the CPU and heatsink in the computer. Software was used to log the CPU temperature approximately every 2 seconds for 30 minutes for each treatment. The results showed that the silicone-based paste had the greatest thermal performance, followed by the graphite pad, then the liquid metal, and finally toothpaste. These results did not support the hypothesis. These results most likely occurred because although liquid metal had the highest thermal conductivity, its surface tension is very high making it spread unevenly when it was sandwiched between the heatsink and heat spreader of CPU creating thermal hotspots. Desktop PCs have existed for far longer than mobile computers like phones and tablets; these results have a significant application because eventually mobile processors will have to overcome the same thermal challenges that desktop PCs have already overcome. Finding efficient thermal interface materials will help mobile processors become more cost-effective and operate more efficiently.

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

CS ET EN

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 vertebrate animals controlled substances

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

214

2019

Fair Category

PST

Project
Number

6515

Title: Neutralization of Sulfur Dioxide in an Effort to Decrease Sulfuric Acid Generation in the Atmosphere.

Student Name(s): L. Borcharding, C. Mackesy

Abstract:

The objective of this project is to create a filter system to line the walls of a cruise ship's smokestack to neutralize the sulfur dioxide. The neutralized acid will then be collected before being released into the atmosphere and becoming acid rain. The first phase of the project included six sets of tests to establish a baseline for changes of pH in a liquid sample when exposed to sulfur dioxide. Sulfur dioxide was created by heating copper wire and sulfuric acid. The second phase consisted of 9 trials of sulfur dioxide being run through a smokestack lined with a foam continuously soaked with either distilled water, salt water or a calcium carbonate solution. After completion of each trial, pH of the liquid sample at the end of the system was recorded to establish the efficiency of the foam buffer across the various buffering solutions. An additional procedural check was conducted by running a separate tube from the top of the "stack" to establish how much gas, if any, escaped the system. Results were analyzed and indicate that each substance did, in fact, absorb and neutralize a significant amount of sulfur dioxide, with the most effective buffering solution being calcium carbonate. This was not surprising based on calcium carbonates buffering potential in marine ecosystems overall.

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

BI ET

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

242

2019

Fair Category

PST

Project
Number

6516

Title: Designing a multi-climatic tent system to help manage the comfortable sheltering of people during international crises and natural disasters.

Student Name(s): A. Zoghol, E. Shelbaya

Abstract:

Insufficient access to multi-climatic emergency shelters has created the need to develop an inexpensive eco-cooled and heated tent system. To address this need, our group designed and assembled an economic, solar-powered tent system that effectively uses solar radiation and a combination of accessible materials. This tent-system utilizes a reversible fabric comprised of an insulating layer sandwiched between a heat-reflective layer and a heat-absorbing layer. To heat the tent, the external fabric layer absorbs solar radiation (heat), while the interior insulative and reflective layers preserve internal heat. A Fresnel lens heater is used to provide an additional source of heat. In conjunction with a solar-powered fan, the tent fabric can be reversed to implement the cooling system.

At temperatures below freezing and with wind speeds up to 30 mph, the tent-system demonstrated its ability to deliver comfortable temperatures. With a source of internal heat (representing body heat), the system was able to maintain an average temperature of 61F (16C), outperforming the control by 21%. With the Fresnel lens heater alone (during sunset) a crucial increase in temperature above 5 F was observed, outperforming the control by 26%. Proved to be low-cost, effective in extreme temperatures, and primarily eco-powered, the climate-controlled tent-system can have applications in a variety of settings such as in FEMA or UN temporary housing, natural disaster/refugee camps, survival situations, field research centers, and even affordable recreational camping.

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

EM ET EE

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

80

2019

Fair Category

PST

Project
Number

6517

Title: R.P.G

Student Name(s): K. Patel, T. Jones

Abstract:

Our project is designed to help the environment. Its purpose is to lower plastic production and save the life of marine life. The product also allows you to make things that you can use around your house, Like a spoon, or a fork. The model we made is supposed to melt plastic, and then turn it into filament. The filament will be placed into a 3d printer so that you can create whatever you want from bottles to plastic spoons.

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

EM EV

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

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 vertebrate animals controlled substances

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

168

2019

Fair Category

PST

Project
Number

6518

Title: Creation of a Geometric Circular Structure to Harness the Rotational Force of Water and Produce Energy

Student Name(s): P. Lehrman, A. Burdick

Abstract:

The purpose of this project was to construct a hydroelectric turbine which creates artificial rotary currents in order to power a generator. It was hypothesized that this renewable energy source would be close to as energy efficient as modern-day dams and would, in fact, be more environmentally friendly. The entire engineering process was composed of three distinct stages. The first of these being the construction and implementation of a number of models. The first of the models was primarily used to determine the appearance and rough design of the turbine, whereas the second model was used to illustrate the design and flow of the water, as it was fully waterproof. The next stage was the construction of our intended full-scale turbine which was used for testing. Different flow rates were passed through the turbine and results were analyzed by comparing the unique electrical outputs. Further studies are needed to better determine the energy efficiency of an industrial scale turbine that could be implemented in a river.

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

AT EE EM

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

239

2019

Fair Category

PST

Project
Number

6521

Title: Development of In-situ Fabrication Methods of Martian Construction Material

Student Name(s): C. Rodriguez, S. Godilla

Abstract:

Future Martian explorers will require construction material to build habitable structures and shelters on the red planet. The high cost and lengthy process of shipping material from Earth to Mars makes it an impractical approach to solving this problem. The goal of this research project is to develop a method by which astronauts can fabricate construction material on-site. The first phase of this research project involved finding the optimum conditions for manufacturing bricks using simulated Martian regolith (Martian soil). A load of 6 tons was applied to the simulated dirt contained in a compression mold to form circular "bricks". Bricks made of various grades of regolith were tested under compression to understand the effect of soil particle size on brick strength. It was found that bricks formed with superfine grade regolith (< 500 microns diameter particulate) had the greatest ultimate compressive strength. The second phase of this research investigated the effect of adding organic (potato starch and cornstarch) and inorganic (Sulfur) binders. Sulfur was chosen as the inorganic binder because Mars is a sulfur-rich planet and the plant-based binders were chosen based on their ability to be grown on the planet. It was found that regolith mixed with molten Sulfur and then compressed into a brick produced a composite material with the greatest ultimate compressive strength similar to that of conventional concrete. Additional erosion, impact, and hardness testing will be done to simulate harsh environments on Mars.

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

EN CH

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

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

4. Is this project a continuation? Yes No

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

- Yes No

CSEF Official Abstract and Certification

Word Count

142

2019

Fair Category

PST

Project
Number

6522

Title: The Efficiency of Wind Turbine Blades

Student Name(s): M. Zayas, C. Kalidindi

Abstract:

For our project, we tested whether the shape and angle of a blade affects the amount of volts a wind turbine generates. In order to do this, we made the base of the wind turbine out of PVC pipes. We made each shape turn at a 30 degree angle, and made the hub 3 blades each. Our shapes were an oval leaf shape, a right triangle, and a rectangle. We placed each hub on the DC motor in the base to do our tests. We thought the rectangle would be the most effective, but we were wrong. The oval/leaf blades spun the fastest, creating more volts. As an extra experiment, we also tested a hub with curved blades. The curved blades generated the most volts in all. In future trials, we will consider using a larger variety of shapes and curves.

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

EE EM

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

PST

Project Number

6523

Title: USE OF COILED MONOFILAMENT POLYMER TO CREATE A PROTOTYPE ARTIFICIAL MUSCLE SLEEVE AS AN EXO-MUSCLE TO ENHANCE HUMAN STRENGTH AND MOBILITY

Student Name(s): J. Oei, D. Murphy-Zink

Abstract:

An exo-muscle is a muscle on the outside of the body that provides support, increases mobility, and supplements natural muscles. The development of exo-muscles to assist the wearer in the movements they are making, and complement their natural power was explored in this project.

Individuals sometimes cannot get around because of weak muscles, bones, and joints. Wearable exo-muscles can aid injury victims (example: trauma or stroke), permanently disabled individuals and the elderly by providing them with enhanced strength and mobility.

A prototype artificial exo-muscle elbow sleeve was built using high-strength polymer fibers used for fishing line. The polymer can be transformed into artificial muscles that match or exceed the performance of mammalian skeletal muscle to deliver millions of reversible contractions while rapidly lifting heavy loads through the process of coiling. When the nylon is coiled in a specific manner and heat-treated so that the twists are made permanent, it becomes a muscle that responds to changes in temperature by expanding in diameter but contracting in length, thereby (reversibly) changing its shape. Various weights of nylon fishing line were tested.

The prototype was discovered to be extremely inexpensive (~4.88 cents per W). Twisting produces coiled muscles that can contract by 24%, lift loads over 200 times heavier than human muscle of the same length and weight, and generate 179.8 Watts of mechanical power per lb of muscle weight, comparable to that produced by a 6.2L I V8 Chevrolet Corvette engine.

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

EN AT ME

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- Yes No

CSEF Official Abstract and Certification

Word Count

181

2019

Fair Category

PST

Project
Number

6524

Title: Natural Disaster Relief Housing

Student Name(s): V. St. Peter, A. Ciarleglio, J. Rivera

Abstract:

The purpose of this project was to design affordable and sustainable emergency relief housing for natural disaster victims. To do this, we researched the needs and challenges that relief victims face such as a lack of clean water, overcrowding, disease prevention, the containment of human waste, and the lack of electricity. The final product is a model of a storage container that includes solar panels, composting toilets, water filtration and reuse, and energy efficient lighting options. Our research concludes the actual unit would cost less than \$20,000 to build and would house three people each. In addition to being sustainable for long term use, the containers can be transported by ship or flatbed truck from site to site. This setup would require removal of composted toilet materials, depending on how long the units are in use for. Also we would need a system for delivery of fresh water and removal of overused water. While there are other types of relief housing exist, this option is affordable, practical, and sustainable because it can be transported and reused over again at different sites.

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

EM EE AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

245

2019

Fair Category

PST

Project
Number

6525

Title: 2D and 3D Convolutional Neural Networks for Real-Time Classification of Dynamic American Sign Language (ASL) for Lightweight Applications

Student Name(s): S. McHale, K. Crooks

Abstract:

Using a 2D and 3D convolutional neural network (CNN) we are able to create a classifier for American Sign Language (ASL) that accounts for the temporal nature of ASL's dynamic gestures. We use a web-based application that streams video into a backend server that optimizes the video via pre-processing and then classifies it with the 2D and 3D CNN model. This server will stream the predicted word back to the client. The data set used for training is a scalable folder that can alter in size and labels, allowing us to conveniently to add words to the 'dictionary' of signs. This model of machine learning, and machine learning as a whole, has aided in advances in areas such as detecting written language and audio with high levels of accuracy. Currently, minimal progress has been made in visually recognizing ASL. Many pre-existing research projects demonstrate multiple methods for sign language detection, such as special gloves with sensors for the signer to use, utilizing a Microsoft Kinect or depth detecting cameras to improve feature identification, and 2D convolutional neural networks for static gestures. All these innovations were developed to decrease the language barrier; however, they lack efficiency and mainstream functionality. This project builds upon these studies to examine the effectiveness of a sign language detection model designed for lightweight applications. The model we have created enables the analysis and classification of dynamic ASL in real time without the cumbersome hardware used in previous studies.

**Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)**

CS AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

251

2019

Fair Category

PST

Project
Number

6526

Title: Detecting Intersection Blind Spots

Student Name(s): J. Marin, J. Zavala-Chavez

Abstract:

On many intersections around the country, there are obstructions like bushes which makes it difficult to see incoming vehicles on the intersecting road. Current solutions to this dilemma have several flaws which makes it hard for them to be successfully implemented in every intersection that contains blind spots. To come up with an optimal solution, research was done to understand the flaws in each current solution such as cost or reliability. Based on the gathered information, an ideal system should be able to warn drivers in time, be able to work reliably in most weather conditions, and be inexpensive to produce. This lead to the creation of a scale model of an intersection equipped with a monitoring system composed of ultrasonic sensors to represent radar sensors to detect incoming traffic on a road. Once vehicles are detected, it causes lights perpendicular to the monitored road to blink in differing intervals, alerting drivers who cannot see past the obstruction of incoming vehicles. After testing around, it was determined that the sensors should detect objects 150 feet away in real-life in order for the driver to be warned and react in time. The system mostly works as intended but the only flaw is that unintended moving objects detected by the sensors may inadvertently trigger the lights, but this can be remedied with the addition of more sensors. Our model can be applied to an actual intersection that contains blind spots as it will be able to easily warn drivers about nearby cars.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

ET AT

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4. Is this project a continuation? Yes No

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- Yes No

CSEF Official Abstract and Certification

Word Count

221

2019

Fair Category

PST

Project Number

6527

Title: Robotic Head

Student Name(s): B. Diskin, J. Relaz

Abstract:

Our project centers on completing a fully functional robotic head. We chose this particular project because it is an opportunity to work with electronic applications. Our main goal with the robotic head is to have it successfully talk, move its jaw, and see. Our main problem while building was one thing would break after the other, it was a constant battle of keeping everything together and working at the same time, while adding in or changing parts. Most of the breaking and fixing happened with the jaw as there were many moving parts to the head and it was fragile. Another major problem was the eyes. From the start, there wasn't enough room on the interior of the skull for the eyes to "look around." This called for a re-organizing of the interior components until the eyes were able to move inside the skull. Since the head will be added to the full body robot we have in class, many aspects of movement don't have their own programmed control at this time. They will soon be in place with the controllers we use for the rest of the body. For now, they will be controlled by a serco recorder. Our robot head is a project that builds problem solving skills and tests our knowledge of electronic properties and their application.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EE AT CS

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3. This project was conducted at a Registered Research Institution. Yes No

4. Is this project a continuation? Yes No

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

244

2019

Fair Category

PST

Project Number

6528

Title: Flood Remediation In-House Dehumidification System

Student Name(s): A. Bolduc, A. Soltis, S. Clark

Abstract:

For our project we made an architectural model of a house with the Flood Remediation In-House Dehumidification System (FRIHDS) installed. It was cost prohibitive to build a full-scale, functional version of FRIHDS, so we made a 3-D model of the install as a first step in the design process. FRIHDS uses the refrigeration cycle that everyday H.V.A.C. air conditioning units use, but we're using it for very high capacity dehumidification in order to reduce flood damage on houses in flood zones. Air conditioners dehumidify the air, but can only run for so long before they cool a space below its comfortable temperature, also known as overcooling. Air conditioners use one coil inside to cool the air and remove moisture and one coil outside to reject the heat from inside. FRIHDS uses three coils: two inside and one outside. Air passes over the first coil on the inside, cooling it down and pulling the moisture out of the air. The second coil on the inside returns the heat back into the air you just cooled down and dehumidified. This prevents the overcooling effect. The third coil outside allows the unit to run on straight air conditioning instead of the dehumidifier, which is difficult to achieve and required modifying an existing part. FRIHDS would be able to replace around twelve of the small dehumidifiers already in use, and would allow you to control the level of temperature and humidity in a whole house.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EM EE AT

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4. Is this project a continuation? Yes No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes No

CSEF Official Abstract and Certification

Word Count

61

2019

Fair Category

PST

Project
Number

6529

Title: On the Polygon Determined by the Short Diagonals of a Convex Polygonn

Student Name(s): Y. Kim, A. Lee

Abstract:

Let K be a convex pentagon and let K_1 be a pentagon bounded by the diagonals of K . It has been conjectured that the maximum ratio of the area between K_1 and K is reached when K is an affine regular pentagon. We prove this conjecture in this project by examining the marginal triangles using the method of the outer product.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

MA CS

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4. Is this project a continuation? Yes No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes No

CSEF Official Abstract and Certification

Word Count

248

2019

Fair Category

PST

Project
Number

6530

Title: Optimizing Archimedian screw geometry to increase the power efficiency of a micro hydropower plant

Student Name(s): D. Kakkar, J. Bell

Abstract:

Hydroelectric turbines today are designed to work off of large reservoirs of water to generate electricity; however, much of the world does not have the infrastructure to support such systems and thus need a more adaptable solution. The solution investigated in this study is that of the use of an Archimedean screw with varying geometry for power generation in the same controlled environment. Different variations include changing blade angles, blade number, and orientation.

The first phase of the investigation was modeling the Archimedean hydroelectric turbines with these different elements in CAD (Computer Aided Design). Variations were evaluated initially using CFD (Computational Fluid Dynamics). These simulations were used to calculate rotational speed and torque to help identify the most efficient type of design because they both relate directly to power generation.

The second phase of the investigation was manufacturing the turbines using a 3D printer. A uniform flow channel was custom-built to test the power generation of the turbines. It was found that the turbine with a blade angle of 35 degrees generated 278% more power than a turbine with a blade angle of 65 degrees. Investigations of the turbine orientation with respect to the flow of water showed a 55% increase in power generation when the turbine was positioned into the oncoming flow. These experimental results agree with the CFD modeling which examined the rotational speed, torque, and power production of the turbines. Ongoing experiments regarding the different blade numbers will provide additional insight about turbine efficiency.

Technical Disciplines Selected by the Student (Listed in order of relevance to the project)

EE PH

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3. This project was conducted at a Registered Research Institution. Yes No

4. Is this project a continuation? Yes No

5. My display board includes photographs/visual depictions of humans (other than myself or my family):

- Yes No

CSEF Official Abstract and Certification

Word Count

239

2019

Fair Category

PST

Project Number

6531

Title: Panic Avoidance Safety System (P.A.S.S.)

Student Name(s): H. Bhargava, C. Ohlin

Abstract:

Driving is an essential part of any citizen's life. We drive to work, school, and a multitude of other places, all necessities in our lives. Since we use vehicles so often, shouldn't they be safe? Modern cars all have the safety features and intricate gadgets you can think of, with the exception of one very important one which we have solved. Rear-end collisions are the most common among types of accidents on the road. All modern safety systems work to protect the driver but never inform the victim who is about to be hit. If there was a system that would inform the victim then the accident could be avoidable and the person could brace themselves for the impact. This project solves this problem and looks at how cars can be made safer so people can put more of their trust in vehicles. Our project provides a device that will blow the horn automatically when it detects the driver driving recklessly in a panic situation. After multiple prototypes and various rewrites of code, we were able to create a device that worked as we wanted. This device blows the horn when the brake is pressed too quickly or the wheel is swerved violently. This device can be retrofitted to all cars and can make roads safer and make cars even more reliable. Despite modern vehicles having various safety features, having this one would make the cars far safer.

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