CONNECTICUT SCIENCE & ENGINEERING FAIR

78th Annual Fair
March 2-14, 2026

Student Abstracts

Fair Categories

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

Special Categories

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

Special Category Composites

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

CSEF Official Abstract and Certification
2026

Title: Comparative Analysis of Desalination Efficiency: Reverse Osmosis, Solar Distillation, or Boiling

Student Name(s): B. Saltzman, J. Brocia, C. Guidotti

Abstract:

The purpose of this project was to find the most efficient way to desalinate water. This study answers the investigative question of what desalinates water the best, Reverse Osmosis, Boiling, or Solar Distillation. The hypothesis is that the boiling would purify the most water with the least salt leftover after the experiment. The summary of the procedure is to get water and put a certain amount of salt (ranging from 25 grams-100 grams,and going on intervals of 25) to make salt water, then use a different desalination method to purify it back into clean water, and finally measure how much salt is left in the cleaned water. The results were that boiling was the best method of desalination because it had a 9.42% of the starting amount of salt, where the other methods had about 11% of leftover salt. The hypothesis was supported by the data. Well solar distillation had a slightly lower average than boiling, but including the incredible amount of time it took for solar distillation to work, boiling worked the best.

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

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

☐ human subjects   ☐ potentially hazardous biological agents

☐ vertebrate animals   ☐ controlled substances

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

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

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

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

☐ Yes   ☒ No

CSEF Official Abstract and Certification
2026

Title: Dual Axis Automatic Solar Tracker v.2

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

Abstract:

Solar energy is crucial to the world we know today, and is 11.7% of the global energy produced. It helps fight climate change, lowers electricity bills for consumers and so much more! This project examined the potential for a Dual Axis Solar Tracker v.2 to boost solar energy output in comparison to a traditional stationary solar panel. This is crucial since fixed solar panels only face one direction, which means they receive sunlight at inefficient angles all day long, which lowers their total energy output. Enhancing energy generation and optimizing solar irradiance can be achieved using an automatic tracking system that continuously aligns a solar panel with the sun. We predicted that by keeping in perfect alignment with the sun's position, a dual-axis solar tracker would generate more electricity than a stationary panel. Four light-dependent resistor (LDR) sensors, an Arduino microprocessor, and servo motors that dynamically moved the panel along both horizontal and vertical axes were used in the system's design. To enable accurate and steady panel movement, we specially created 3D-printed structural elements. A rechargeable lithium-ion battery with a charging module and battery management system built in powered the tracker. Through a mobile application, wireless battery voltage and sensor reading monitoring was made possible by a Bluetooth connection module. The voltage output of a tracking panel and a fixed panel under comparable environmental circumstances was measured and compared as part of performance testing. The dual-axis tracker produced more electricity throughout the day and maintained more stable solar alignment.

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

EE ET 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

Word Count

248

CSEF Official Abstract and Certification
2026

Fair Category

PT

Project Number

4004

Title: Evaluating the Effectiveness of Supplementing Simulated Lunar Soil to Promote Crop Growth for Future Lunar Missions

Student Name(s): L. Hohensee, P. Yantz, L. Chase

Abstract:

The problem we decided to research for our project was, Evaluating the Effectiveness of Supplementing Simulated Lunar Soil to Promote Crop Growth for Future Lunar Missions. With this project we were trying to figure out if scientists and astronauts could grow plants on the lunar surface. This would be helpful for future lunar missions because astronauts could stay on the moon longer, and not have to worry about not having enough food. This could improve potential extended missions. We predicted that adding biochar and compost to lunar soil would enable radish seeds to germinate and grow the best, after our soil control. This is because compost would add organic matter and nutrients and biochar would increase porosity. We planted radish seeds in regular soil, lunar soil by itself, lunar soil with compost, lunar soil with biochar, and lunar soil with both biochar and compost. We made three pots of each and put five radish seeds in each pot. Then, over the four weeks we watered the plants accordingly and tracked germination, growth and nutrient levels. After 3 weeks, we have germination in all soil types, but the only soil type with actual plant growth is the regular soil. The lunar soil and compost mix is looking most promising of the variables with the most seeds germinated after the soil control. In conclusion, adding compost to lunar soil may help astronauts be able to stay on the moon for a longer period of time by providing crops in space.

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

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CSEF Official Abstract and Certification
2026

Title: Detecting Astroparticle Flux Under Different CME Strengths Using Household Materials

Student Name(s): S. O'Marra, A. Santiago-Stra

Abstract:

By measuring the variety and quantity of solar particles detected under changing geomagnetic conditions, this project aims to raise awareness about the types and levels of particle exposure people experience. The research question of this project is: Detecting astroparticle flux under different CME strengths using household materials. If the experiment is conducted on a day with a higher kp index, then there will be more cosmic muon flux in the cloud chamber. That would mean that more CMEs occurred so there was more geomagnetic activity. A homemade cloud chamber with dry ice was used to detect cosmic particles on different days with different geomagnetic indices forecasted. The higher the Kp value forecasted, the more astroparticles were detected in the chamber. For example, at 3 kp, there were 6 muons detected and a total of 24 particles. But, when tested on a day with 5kp, there were 11 alpha particles, 13 beta particles, 9 muons, and 3 protons detected for a total of 36. That is a 12 particle difference between them. In conclusion, when the experiment was conducted with a higher geomagnetic indice, there were more cosmic particles detected. On the other hand, when the experiment was conducted with a lower geomagnetic indice there were less cosmic particles detected.

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

Word Count

CSEF Official Abstract and Certification

Fair Category

Project Number

122

2026

PT

4006

Title: SMART CANE

Student Name(s): E. Aquino Lantigua, D. Caetano

Abstract:

The purpose of my project was to make a stick that helps blind people detect obstacles. I thought that if I added sensors, the stick would alert the user when something was in the way. To test this, I built the stick with sensors and tried it with different obstacles. People should care because it can make moving around safer for blind people. The results showed that the sensors could detect objects and warn the user before they bump into them. This experiment gives us new information by showing how sensors can help improve navigation. This invention can improve lives by reducing accidents and giving blind people more independence. Overall, my stick makes traveling safer and easier for those who need it.

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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CSEF Official Abstract and Certification
2026

Title: Evaluating Biodegradable Plastics Made from Avocados, Bananas, and Mangos

Student Name(s): L. Davidoff, G. Nicholas

Abstract:

Only 5 to 6% of single-use plastic is recycled every year across the world. This ends up in landfills and marine environments, damaging ecosystems. We therefore wish to create a biodegradable material to replace plastic. To solve this issue, we decided to create 4 bioplastics. Each recipe was the same except for the starch used. What stayed the same was the glycerin used for flexibility, the vinegar for bonding, the gelatin as a binder, and either cornstarch as the control starch or fresh fruit or vegetable for the experimental starch (mango, avocado, or banana). Each mixture was heated, poured into a mold, left to dry, and then tested. To test which was best, we performed three tests, biodegradability, strength, and flexibility. The material that decomposed fasted was the avocado and the one that took the longest was banana. Banana may be the best in this regard to ensure product longevity. The one that held the most weight was the cornstarch control. The strongest out of the fruit/vegetable bioplastics was avocado, with banana close behind. Finally, the most flexible bioplastic was mango, with the control coming in close second and banana right behind the control. To summarize, the cornstarch control can be considered the best even though there was no fruit in its recipe. The best fruit-based bioplastic was the banana due to its combination of strength and flexibility. In the future, we wish to look into adding an antimicrobial substance to our bioplastic as mold formed during biodegradability testing.

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

Word Count

CSEF Official Abstract and Certification

2026

Fair Category

Project Number

249

PT

4008

Title: Modeling the Coriolis Effect on Ocean Currents with Different Water Temperatures

Student Name(s): H. Galvin, S. Martos Carchi

Abstract:

This project's goal is to find out how ocean currents are affected by environmental occurrences: wind, temperature, and the Coriolis effect. Climate change is a topic discussed as a scientific occurrence that is changing the earth's temperatures and as a result water temperature. This project will identify how temperature change, coupled with a simulated earth rotation impacts currents.

The hypothesis is that environmental occurrences , water temperature and the Coriolis effect affect ocean currents. The Coriolis effect, caused by the Earth's rotation, causes water and air to curve, causing the ocean currents to curve. This can be tested by making the water in the project to curve. The hypothesis was formulated because the Coriolis effect is caused by the movement of the Earth which causes things such as wind and ocean currents.

This experiment modeled how wind and spinning of the Earth affects ocean currents-specifically their temperature. By spinning a container/bowl on a lazy susan (the spinning Earth) with two different temperature waters (the different temperatures of water in the ocean and how they are affected) and wind pushing the surface of the water with a portable fan, modeling how the wind on Earth affects ocean currents.

The results reflect the Earth's movement and wind affect ocean currents because Earth's rotation changes the direction of currents (the Coriolis effect) and wind pushes surface water and affects current paths.

The findings in this experiment are important because what affects ocean currents helps to understand what environments ocean currents affect.

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
2026

Word Count
170

Fair Category
PT

Project Number
4009

Title: How Does the Wing Design Affect the Speed of a Model Plane?

Student Name(s): S. Lin, I. Amenta, A. Kay

Abstract:

The purpose of this project is to determine which wings are faster and more fuel-efficient so that aircraft can be more reliable and so people can arrive at their destinations faster. This study determined how different types of wings affect how fast a model plane flies. The solution to the problem was to construct more stable plane wings that are faster and more fuel-efficient than standard ones. A plane base was created along with four different types of wings, each constructed by using wood as the frame and cutting pieces off of a foam board to expand the structure, and testing was done. Out of the four different wing types, the fastest wings were the elliptical wings, which have the least amount of drag compared to the others. Ultimately, wings with less drag, such as elliptical wings, are optimized for flying as they are faster, more stable, and overall more aerodynamic compared to others. Engineers should use similar wing designs so that aircraft performance and stability can be improved.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) ET MA 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
2026

Title: Testing Different Types of Algae To Reduce The Amount to Carbon Dioxide Emissions in the Atmosphere

Student Name(s): R. Driscoll, G. Leveille, C. Villar

Abstract:

Carbon dioxide is the primary contributor to modern climate change, largely due to the burning of fossil fuels and deforestation. This project explored using algae as a method of capturing and storing atmospheric carbon dioxide. We hypothesized that Chlorella would absorb CO_2 more efficiently than other algae tested, due to its fast growth rate and high photosynthetic activity. The independent variable was the type of algae used and the dependent variables were the pH level (indicated by BTB color changes) and the percent transmittance measured by the spectrophotometer. Bromothymol blue was used as a visual and pH□based indicator of CO_2 levels. BTB appears yellow in acidic, high□CO_2 conditions and shifts toward blue as CO_2 decreases. Each algae type was placed in BTB solution and CO_2 was added. Color changes were recorded over time to track CO_2 uptake. A spectrophotometer measured percent transmittance for each sample, providing information on how quickly each algae type reduced CO_2. The results of this experiment show that both Chlorella vulgaris and Spirogyra lowered the light transmission rate in a spectrophotometer compared to their control groups. This suggests that algae removes carbon dioxide from the environment through photosynthesis because blue lets less light through than yellow. Blue BTB means CO2 has been absorbed. Chlorella vulgaris reduced carbon dioxide more than Spirogyra according to the color of the BTB and pH values. Overall, the results support the hypothesis that different types of algae remove carbon dioxide at different rates and that Chlorella may be the best choice.

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

EV EM 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

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☐ Yes ☒ No

Title: Erosion Of Different Materials With Water

Student Name(s): C. Werlin, F. Dooley

Abstract:

In our project we tested materials by dripping water on them for 21 days. The materials we tested were iron, chalk, Styrofoam, balsa wood, cedar wood, rubber, and quartz. We built a drip irrigation system. Dr. Frame helped us with the project. Every day at 4 PM we checked the samples for dents or holes caused by the water and we weighed the sample. We pumped the water back up into the higher bucket three times a day. What we expected to see was that the higher density materials to be less eroded than the lower density materials. However when we looked at the results it turned out that the erosion was influenced more by the chemical reactions taking place like the dissolving of the chalk and erosion of the iron than the density. Although the project went well we ended up having some problems: the drip irrigation system clogged because of debris in the water, the kitchen scale we used was not very accurate and the weight changed depending where you put the sample on the scale, and we put the samples in different spots under the dripper nozzles because we did not mark out where and how to put them. Future expansion of this project could include testing the strength before and after we expose them to water to see how they would hold up in real conditions, doing the experiment for a longer period of time, and having a constant flow of water instead of drips.

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

EA EV EM

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

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: Green Walls: The Power of Plant-Based Materials for Home Cooling

Student Name(s): W. Marley, A. Suri

Abstract:

BACKGROUND-Global warming has led to rising temperatures worldwide, increasing energy demands for cooling buildings. Many homes rely on inefficient insulation, which fails to maintain comfortable indoor temperatures and increases energy consumption. This project explores natural, plant-based, and recycled materials as sustainable insulation alternatives to reduce indoor heat and promote eco-friendly building practices. PURPOSE-The purpose of this project was to determine which plant-based or recycled material most effectively reduces indoor temperature and how these materials could contribute to sustainable, energy-efficient homes. We hypothesized that using plant-based materials for roofs and walls instead of conventional building materials would reduce environmental impact and improve long-term sustainability. PROCEDURES-Two rounds of experiments were conducted. In Round 1, cardboard model houses were lined with moss, straw, coconut coir, denim, or cotton, with one unlined house serving as a control. Models were exposed to a reptile lamp under simulated hot, moderate, and cool climates, and internal temperatures were recorded. Based on those results, Round 2 tested wooden houses insulated with denim alone and a composite of denim and coconut coir. A Green Insulation Index (GII) was developed to standardize cooling efficiency per centimeter of insulation using a dimensionless percentage scale. OBSERVATIONS-Denim consistently maintained the lowest internal temperatures due to its dense fibrous structure and strong heat-trapping ability. The denim–coir composite achieved the highest GII (9.63), confirming enhanced performance across both model types. CONCLUSION-Recycled denim, alone or combined with coconut coir, is an effective, low-cost insulation material that reduces textile waste and supports sustainable, cooler homes.

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

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

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: The Effect of Electrolyte Concentration on the Voltage Produced by a Baghdad Battery

Student Name(s): L. Schneider, D. Sposato

Abstract:

This project investigated how electrolyte concentration affects the voltage output in a Baghdad battery, an environmentally friendly alternative for affordable power. We hypothesized that a higher citric acid concentration would produce greater voltage due to increased ions. Testing involved adding 240 mL of lemon juice to the battery, then incrementally adding citric acid in 5 mL intervals up to 25 mL while measuring voltage with a multimeter. Results showed peak performance at 5 mL of citric acid (0.14 volts average, 0.19 volts peak) and lowest output at 25 mL (0.026 volts average, 0.01 volts low). The hypothesis was disproved: excessive citric acid created a thick oxidation layer on the iron and copper electrodes, reducing electrical conductivity through saturation.

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

CSEF Official Abstract and Certification
2026

Title: Purifying Water using Different Types of Graphene to Adsorb Harmful Pollutants

Student Name(s): A. Hassani-Sadi, M. Bazie

Abstract:

Testing graphene as a water filter is important due to the rising amount of people who are consuming harmful substances in water. We hope that through this project, we will be able to find a way to remove pollutants to create clean, filtered water. We hypothesized that if we use different types of graphene to adsorb chemicals from impure water, then multi-layered graphene will remove the most chemicals and create clean drinking water because of the advanced pore structure of the graphene. We also hypothesized that if graphene is left in a pollutant for longer periods of time, more pollutants will be removed due to increased contact time. We used copper solution as the pollutant and tested graphene contact time for 10 minutes, 2 days, and 5 days. We tested it in the spectrophotometer to check the % light transmittance through the solution. The graphene in contact for 5 days removed the most copper compound from the solution. When testing the different types of graphene, our most promising outcome was multi-layer graphene. After letting it sit for 10 minutes, the % transmittance rose from 80% for the copper control to 100% after filtering. The effectiveness of filtering the pollutant depended on the amount of time the graphene was in the pollutant and the type of graphene used. In the future we would like to re-test all controls and variables due to some limitations we encountered, such as testing in two phases that did not start with the same copper control.

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

EV EM EN

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: High-Speed Trains: How Maglev and Hyperloop Systems Are Modifying Transportation

Student Name(s): M. Bu, J. Mak

Abstract:

Background:

Every day, around 90,000 people in the United States rely on train transportation for travel. Therefore, it is important to enhance the speed and stability of our trains. In our project, we built a small-scale model of a maglev train with a hyperloop function. Our engineering goals are to improve the speed and stability of our train, to increase energy efficiency, to ensure levitation, and to reduce air drag.

Methods:

We created 2 designs before our final. Throughout the process, we used our knowledge of magnetic properties, circuits, and wires. The first 2 designs lacked guidance rails and had an unbalanced train mass. Our third design included the 2 missing components from our first 2 designs. We tested our designs by observing how long the train would levitate steadily above the track within a minute, and observed how much our train propelled forward with our circuit.

Results:

The first 2 designs had times around 0-1 seconds of levitation during testing, but our third/final design lasted the full minute for levitation and reached a levitation height of 0.9 cm. Also, we measured how much the train moved forward each time we turned on our circuit; on average it was 6.5 centimeters.

Conclusion:

After creating our final design, we observed that our train model was more stabilized when it had guidance rails and a balanced train mass. Furthermore, future improvements include reducing the cost of the train, maximizing safety, and improving our propulsion system.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) 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
2026

Title: The Impact of Phone Case Material on EMF Radiation Emitted from an iPhone During Multiple Usage Conditions

Student Name(s): G. Vallinayagam, E. Sola, R. Barreto

Abstract:

This project was made to help people know what phone case materials that are best to protect people against Electromagnetic Field radiation (EMF) under different variables. This study investigated the effect of different phone case materials on EMF radiation emitted from an iPhone under various usage scenarios.The phone case that emitted the least radiation was predicted to be aluminum as it will convert the waves to heat, and the longest distance away should have less EMF radiation as it would have spread along the way. A plastic phone case was added on to the phone, then an EMF detector was used to measure the amount of radiation, from different distances, and the phone was measured with the different added variables (leather, aluminum, silicone, and EMF blocker). As the distance between the phone from the EMF detector is increased the value of the EMF radiation in microwatts per square meter decreased. When the phone cases are compared to each other, overall, the best materials were determined to be silicon and aluminum. It was also proven that when calling or talking to somebody on the phone emitted the most EMF waves. In conclusion, different distances and phone cases interact with the phone in different ways, and knowing that using a silicon/aluminum phone case and having the phone about 25 centimeters away from your head, may help in reducing the overall exposure of EMF waves.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: Bio Fuel from Bamboo: Comparing the Yield of Ethanol Produced from Fermentation to the Bio Oil Produced from Solvent Extraction

Student Name(s): R. Williams, P. Tonkovich

Abstract:

The combustion of fossil fuels generates substantial amounts of greenhouse gases, such as carbon dioxide, into the atmosphere. These gases contribute to the greenhouse effect by trapping heat and accelerating climate change. Bamboo bio-oil is a renewable energy resource derived from the thermal or chemical conversion of bamboo biomass. This alternative to fossil fuels offers a more sustainable and potentially cost-effective energy solution. Unlike fossil fuels, bamboo bio-oil has the capacity to reduce net carbon emissions, as the carbon released during its combustion is partially offset by the carbon absorbed by bamboo throughout its rapid growth cycle. This study compared two methods of converting bamboo powder into fuel: ethanol production through enzymatic saccharification and fermentation versus organic bio-extract production via ethanol solvent extraction. It was hypothesized that fermentation into alcohol would produce a greater yield of fuel than the oil produced from alcohol extraction. Bamboo powder was saccharified to release fermentable sugars using a mix of cellulase and glucoamylase, then fermented using yeast, yielding a measurable amount of ethanol. Results for the fermentation are underway. In contrast, solvent extraction of the bamboo powder using alcohol recovered organic bio-oil material at a 19% yield when comparing the mass of oil produced to the mass of powder used. Sonification of the alcohol extraction mixture was used and produced a higher yield at 24.6%. Results for fermentation are still underway and will highlight trade-offs between mass recovery, fuel product goals, and complexity of the extraction process.

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

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

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

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Word Count
176

Fair Category
P7

Project Number
5001

Title: Strength of Passwords Based on Character Combinations

Student Name(s): T. Finch

Abstract:

The question being researched is "Which passwords and character combinations are the most secure?" This project will collect data based on how long it takes a computer program to guess a set of random sample passwords. The hypothesis is that passwords with more variety in them will be more difficult to guess. Examples of things that would make passwords more secure include punctuation, numbers, a mix of uppercase and lowercase letters, less common words or gibberish, and making the combination longer. If the password is limited to something such as just four characters or only numbers, 2784 would work better than 1111 or 1234. To successfully and accurately investigate this question and hypothesis, websites will be used to try to crack different provided passwords that. Data will be recorded on the contents of the password and how many attempts it takes for the computer to guess it, and presented in a chart or graph. All the passwords used will not lead to real accounts and instead will be made up for the sole purpose of research.

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

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

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

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

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

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

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

☐ Yes ☒ No

Word Count

CSEF Official Abstract and Certification

2026

Fair Category

Project Number

165

P7

5002

Title: Quantifying the Effects of Leg Length and Foot Traction on Robotic Gait Performance

Student Name(s): J. Vazquez

Abstract:

Stable and efficient locomotion is a key challenge in walking robot design. This study examined how variations in leg length and foot traction influence the walking performance of a mechanical robot. A walking robot prototype with adjustable leg lengths and modifiable feet was used for testing. Three experimental conditions were evaluated. When the leg length was set to 2.50 inches, the robot demonstrated excessive instability, resulting in repeated slipping and falling. Reducing the leg length to 2.375 inches improved balance and prevented falls; however, insufficient foot traction still caused slipping. In the final condition, additional traction was applied to the feet while maintaining a leg length of 2.375 inches. Under these conditions, the robot successfully walked without slipping or falling. The results indicate that leg length directly affects balance, while foot traction plays a critical role in preventing slippage. These findings suggest that optimal robot locomotion requires careful coordination between leg geometry and surface interaction, providing insight into the design of more stable walking robots.

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

EN EE AT

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

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☐ vertebrate animals ☐ controlled substances

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

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

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

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

☐ Yes ☒ No

Word Count

254

CSEF Official Abstract and Certification
2026

Fair Category

P7

Project Number

5003

Title: Engineering A Novel Durable Algae-Argonite Alkalinity System To Reduce CO2 Driven Ocean Acidification And Enhance Biological Resilience In Coastal Marine Ecosystems

Student Name(s): R. Doshi

Abstract:

Coastal acidification threatens marine ecosystems worldwide. Our oceans have absorbed ~30% of CO2 emissions since the Industrial Revolution, increasing acidity by 26%. This study examined two macroalgae, sea lettuce (Ulva lactuca) and red algae (Gracilaria), to investigate if they could lower coastal acidification when combined with calcium carbonate buffer treatments. A 42-day experiment compared three alkalinity sources: aragonite sand, crushed oyster shell, and sodium bicarbonate (0.08 M, 0.16 M, 0.25 M) on water chemistry and algal biomass in artificial seawater and natural Long Island Sound water, using triplicate samples across 11 treatment groups per species (66 total jars) with measurements at nine time intervals. Ulva growth (58% biomass increase vs. 8% in controls) significantly improved with aragonite, preserved elevated alkalinity (6.83 vs. 3.40 dKH), and produced the most stable pH (+0.30 vs. +1.23). High-concentration bicarbonate (0.25 M) caused a 7% biomass decline, showing excessive alkalinity inhibits growth. One-way ANOVA confirmed significant treatment differences ($F = 1362.6$, $p < 0.000001$). PyCO2SYS analysis showed buffered treatments maintained dissolved CO2 97% lower than controls (1.6 vs. 59.9 µmol/kg), with light treatments achieving 99% reduction by Day 42. Aragonite-treated cultures fixed 0.203 g carbon per 10 g initial biomass (0.745 g CO2 over 42 days), ~7× greater than controls. A Michaelis-Menten kinetics model predicts 2.5 g aragonite with 10 g Ulva per liter as optimal, projecting ~17,880 kg CO2 annually for a 10,000 m2 operation. These calculations suggest combining aragonite buffering with macroalgae cultivation offers a promising, low-cost technique for coastal acidification mitigation.

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

EA EM 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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CSEF Official Abstract and Certification
2026

Title: The Effect of the Temperature of the Environment on Ice and Temperature of the Water for 24 Hours

Student Name(s): B. Chambers

Abstract:

My experiment aimed to explore if viral water bottles are actually worth it for people to spend their money on. Water bottles are crucial for all people, as they can be there for almost every situation of an average person, from a 9 to 5 job or seldom getting stranded on the side of the road because your car broke down. The water bottles I tested were the Yeti, the Stanley, the Hydro Flask, the Owala, the Camelbak. My hypothesis was that if a person drinks from a Stanley, then the Stanley would keep the ice the most intact compared to other tumblers and keep the water the same temperature for 24 hours, because of its insulated wall. I collected all my data by taking the temperature and taking photos of the water bottles. My hypothesis did in fact turn out to be disproved and the Yeti ended up winning all of the tests.

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

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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
2026

Title: Cake Chemistry and Leavening Agents

Student Name(s): T. Tellez

Abstract:

This project is about testing baking soda could be a good substitute for baking powder. This project provides the opportunity to address the need during baking to deal with running out of baking powder and this will determine if there could be a replacement that could work similar. The purpose of the project is to see if baking powder and baking soda are interchangeable, to see if it rises the same and tastes the same. This project helps answer the question of what happens when you substitute baking soda for baking powder. Baking soda and baking powder helps baked foods rise and become fluffy.

 The hypothesis is that baking soda might be a good substitute for baking powder. This assumption was made because baking soda and baking powder leave ingredients that help food become fluffy.

To test the hypothesis two batches of vanilla cake will be made ,using baking powder in one and baking soda as a substitute in the other. Then a comparison of the the difference between how much each cake rises,the texture,and the difference between the tastes.

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

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CSEF Official Abstract and Certification
2026

Title: BiteSight: Development of a Deep Learning Mobile Application for Bug Bite Identification

Student Name(s): C. Joseph

Abstract:

My project is BiteSight, a mobile application that utilizes machine learning to identify insect bites through smartphone photography. The system employs a trained convolutional neural network that analyzes distinctive bite visuals in skin images, achieving diagnostic precision across multiple insect bites. Built with Flutter for cross-platform compatibility, BiteSight provides an intuitive user experience from image capture through result visualization, presenting identifications with confidence metrics.

This project addresses the critical need for quick and accessible insect bite identification by developing BiteSight, a mobile application powered by machine learning. Many individuals require immediate bite recognition to determine appropriate treatment, yet lack accessible tools for accurate identification. Using Google Colab, I engineered and trained a sophisticated convolutional neural network model that analyzes photographic patterns to distinguish between eight common bite types with remarkable precision, as well as segment images to differentiate between bites and skin. I then converted this model into TensorFlow Lite format so as to implement it into the mobile app. The model achieved an average accuracy of 98% on the data, making it a reliable choice for the public.

BiteSight provides the immediate identification that users require, empowering them with rapid insights for informed health decisions without the delays of traditional medical consultation at a hospital.

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

ME 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

Word Count

129

CSEF Official Abstract and Certification
2026

Fair Category

P7

Project Number

5010

Title: Bridge Weight Bearing Capacity Science Fair Project

Student Name(s): A. Cote

Abstract:

The purpose of my project was to find out how much weight a bridge can hold. My hypothesis was that the truss bridge will hold more weight than the beam bridge and the arch bridge. First, I started to get all the materials I needed to build bridges. Next, I started to test all the bridges to see how much weight each bridge can hold. Then after I tested all the bridges I found out how much weight each bridge held. I had the most confidence in the truss bridge. It held 164 pounds. I concluded the reason why it held so much weight is because of the triangles on the bridge it distributes the weight evenly so that the weight doesn't go to one spot in the bridge.

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

EN

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☐ vertebrate animals ☐ controlled substances

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

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

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: The Hot-Weather Whiff Effect

Student Name(s): S. Mishra

Abstract:

This research is beneficial as it explains how temperature affects an odor. Most people don't understand how the temperature outside can affect trash you throw out. This experiment explains that. The hypothesis investigated was if the temperature of the air increases, then the scent will reach the other side of the container faster. The approach to this experiment was to use a cotton ball scented with five drops of liquid fragrance and tape it to the left wall inside a large transparent box, and measure the time required for the scent to diffuse 30 cm to a detection point. The scent was measured at three temperatures: room (70°F), cold (32–35°F), and warm (120–130°F). Three trials were conducted at each temperature, and diffusion times were recorded using a stopwatch and averaged. As a result it was discovered that the high temperatures were easier to detect odor. It took an average of 3.11s for White Vinegar to be smelt in warmer temperatures, while it took an average of 10.54s for it to be smelt in colder temperatures. This project contributes to the understanding of how temperatures can affect the reaction time of smelling an odor in one everyday substance. These results confirm that increased temperatures will increase the rate of the reaction, and illustrate the similarities in the reaction of different smells to temperatures. The simplicity of the materials makes the experiment easy to replicate and could be a benefit in an educational setting.

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

PH EV EA

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: Catalase's pH Sweet Spot

Student Name(s): J. Lin

Abstract:

Catalase is an important enzyme in many living organisms, such as our own bodies, as it breaks down hydrogen peroxide into harmless oxygen and water in the form of foam. By finding catalase's pH sweet spot, we can find when catalase operates the most efficiently. Once catalase's pH sweet spot is found, it allows medicines that use catalase to operate far more efferently. This can heavily reduce the effects of diseases and disorders such as hypertension, better known as high blood pressure, bipolar disorder, and various other skin diseases. To find catalase's pH sweet spot, I had to extract catalase from potatoes by blending them, then straining them through cheesecloths. Once I completed that, I separated them into various test tubes, each differing in pH level, ranging from 4-10. After that, I poured 5 mL of hydrogen peroxide into the test tubes, measuring the amount of foam in each test tube. The results clearly showed that the most active pH level of catalase is 7 pH, as the results show that 7 pH was the most active, producing an average amount of 10.5 mL of bubbles, followed by 8 pH, averaging 8 ml of bubbles. Following this in third would be, pHs 6 and 9, as they both averaged 7.5 mL. Then 10 pH followed with an average of 6.5 mL of foam produced. Then there was 5 pH, producing an average of 4.5 mL. Under these results, it clearly shows that catalase works best at neutral pH levels.

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

Word Count

CSEF Official Abstract and Certification

2026

Fair Category

Project Number

98

P7

5013

Title: Exploring Scent Movement and Diffusion

Student Name(s): A. Aybar

Abstract:

This experiment analyzes how scent contamination can occur without liquids coming in direct contact. The motive to doing this project is to investigate how scent molecules travel. Focusing on scent molecules, the question arose of, "Can scent contamination occur without liquids mixing?"

If a cup with liquid imitation vanilla and a cup of sugar water are placed together in a closed container, with small holes in the cups, then the vanilla smell will spread through the air and be absorbed by the sugar water over time. The scent particles move from areas of high concentration to low concentration.

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

Word Count

CSEF Official Abstract and Certification

2026

Fair Category

Project Number

249

P7

5014

Title: What is the Best Ratio of Earth to Mars Soil to Grow Plants in?

Student Name(s): G. Hirsch

Abstract:

My experiment aimed to test the possibilities of growing plants in Mars's soil. It is often proposed that astronauts could grow plants on other planets. But, there are numerous problems with just the soil. Martian soil is similar in consistency to sand, unlike dirt making root systems more vulnerable. Martian soil also lacks necessary nutrients for plants. Some propose bringing Earth soil to help. However, Earth soil is heavy. Instead of pure Earth soil, I experimented with growing plants using different ratios of Earth to Martian soil. My objective was to find the lowest ratio of soil to grow the plants. I set up different ratios of soil: 0% mars, 25% mars, 50% mars, 75% mars, and 100% Mars soil. I chose radish microgreens, because they were small and light, were low maintenance, and grew fast. For 14 days, I tended the seeds and watered the plants, and every other day noted their height, color, and general status. I found that out of the five groups, the group that best combined the least earth soil and best growth was the 25% Martian. The 0% and 25% Martian soil mix were able to grow the plants, while 50% was barely able and 75% and 100% Mars soil were hardly able at all. This is important because in the future, humans will need to understand what is required to grow plants on other worlds in order to sustain themselves. This research experiment helps find best ways to grow plants off earth.

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

PS EA EV

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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

Word Count

211

CSEF Official Abstract and Certification
2026

Fair Category

P7

Project Number

5015

Title: The Effect of the Different Types of Baseball Bats on the Exit Velocity of the Baseball

Student Name(s): C. Martin

Abstract:

From when baseball was invented, it has evolved enormously. The equipment in the game has evolved the gloves and the bats the most (Nicholls, et al., 2005). My hypothesis is that if the student takes a USA bat, USSSA bat, BBCOR bat, and a wood bat, then the USSSA bat will have the highest exit velocity because the bat is metal and how the bat is constructed (Smith, 2002). The way I collected my data was by using a tool called Hittrax. Hittrax is a high-tech camera that looks at your swing and can track balls hit. When a ball is coming off the bat, the Hittrax camera uses its sensors to give you an immediate measurement of the speed the ball is traveling. The results of my experiment show that the USSSA had the highest exit velocity. The highest average exit velocity was 71.64 MPH. In second place was the wood bat with 65.85 MPH. In third was the BBCOR with an average of 63.68 MPH. In last place was the USA bat with 61.7 MPH. Exit velocity means the speed of the ball off the bat. Yes, my hypothesis was proven to be valid, as the USSA bat had the highest exit velocity out of all four bats.

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

PH EN BI

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

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☐ Yes ☒ No

Word Count

184

CSEF Official Abstract and Certification
2026

Fair Category

P7

Project Number

5016

Title: Potter Hill Problem

Student Name(s): V. Gynther

Abstract:

I decided to find out about the best replacement options for the Potter Hill Dam, a dilapidated and decaying old dam in Westerly, Rhode Island. I hypothesized that an embankment dam with a fish ladder would be the best replacement for the Potter Hill Dam. I found out that embankment dams are the cheapest and least time-consuming to build.

To demonstrate what different types of dams look like, I made a few models. I used modeling clay, soil, small pebbles and sticks to display the differences among embankment dams, concrete dams and masonry dams. This allowed for a better understanding of my research.

If I was in charge of the Westerly Town Council, I would look into an embankment dam. For this project, despite many hours of research, I found that information about simple things such as construction costs for dams of similar size to the one at Potter Hill, are very difficult to compile. If I were to improve on this project, I would contact local contractors or the town halls about costs, because that would have possibly provided more valuable information.

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

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

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☐ vertebrate animals ☐ controlled substances

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

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

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

☐ Yes ☒ No

Word Count

138

CSEF Official Abstract and Certification
2026

Fair Category

P7

Project Number

5017

Title: Comparing Airborne Particulate Concentrations and Potential Health Risks Across Three Distinct Environments

Student Name(s): N. Forrest

Abstract:

Air quality is affected by microscopic airborne particles known as particulate matter. This project investigated how particulate matter levels differ across outdoor environments. Particulate matter collectors were exposed to the air for three-day intervals at a public park, a residential backyard, and a school environment. The collected particulate matter was measured and averaged for each location.

The results showed that the park had the highest average particulate matter level, with a mean value of 24. The backyard had the second-highest average, while the school environment had the lowest levels. These differences suggest that factors such as vegetation, airflow, and human activity influence the concentration of airborne particles.

This study demonstrates that air quality can vary between nearby locations and highlights the importance of monitoring particulate matter to better understand local environmental conditions and potential health impacts.

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
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☐ Yes   ☒ No

CSEF Official Abstract and Certification
2026

Title: Breaking Down Rust with Everyday Liquids

Student Name(s): T. Madore, A. Pember

Abstract:

The purpose of this experiment is to investigate how liquids with different pH levels affect rust on nails. Rust forms when iron in steel reacts with oxygen and water. Some liquids may increase rusting, while others may help dissolve existing rust. In this experiment, rusty steel nails will be placed in several common household liquids with different pH levels, such as acidic, neutral, and basic solutions. The nails will remain in the liquids for 48 hours. Observations and data will be recorded daily, including changes in the amount of rust and the appearance of the nails. The results will be compared to determine which liquids have the strongest effect on rust. This experiment will help explain how pH levels influence the rusting process of steel.

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
2026

Title: Carbon Combustion Residual Processing for Beneficial Use

Student Name(s): M. Schwartzstein

Abstract:

As global energy demand rises, coal remains a primary power source, but its emissions overshadow another dangerous and expensive problem: Carbon Combustion Residuals (CCRs). Previous research has shown that CCRs often contain heavy metals that leach into groundwater, forcing many coal-fired power plants to store their waste in storage-field impoundment liners, which is costly. These plastic liners have a finite lifetime, exacerbating the problem. Clearly, there is a need for a better solution to CCR storage. A method to promote reuse of CCRs is highly desirable, and this is the focus of this research. Two coal and three CCR samples were obtained, and first analyzed via ATR-FTIR spectroscopy. Coal spectra highlighted the presence of combustible maceral molecules, formed from peatification and coalification of plant parts. Conversely, CCR spectra each highlighted a 1090cm^{-1} peak, attributed to Si(Al)-O-Si bonds that form during coal combustion. Thereafter, SEM/EDS analyses revealed the presence of ppm-levels of Cadmium in all coal and CCR samples. To immobilize this cadmium in CCR, 2%(w/w) $Ca(OH)_2$ was added to each, and 25g of each mixture was soaked in 30ml di-water. These sat for 1-week, and the water then was centrifuged-separated, and its cadmium content measured with a DipStik Heavy Metal test-strip. While 5-10ppm Cd leached out for all untreated-CCRs, no Cd was found in each $Ca(OH)_2$-infused-CCR sample. This research supports the idea that lime could be added to CCRs in the future to make them eligible for beneficial use, to mitigate the environmental effects of coal-fired power plants.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) | EN EM 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
2026

Title: A Haptic Wearable for Enhancing Digital Accessibility Through Tactile Interaction with Virtual Objects

Student Name(s): D. Simpson

Abstract:

Individuals who are blind or visually impaired often rely on sound and physical touch to understand their surroundings, which can make interacting with digital or virtual environments challenging. The purpose of this project was to design and test a wearable haptic glove that uses vibration-based feedback to simulate the sense of touch when interacting with digital objects. The goal was to determine whether vibration alone could help users identify shapes, object boundaries, and spatial positioning without relying on sight.

A prototype glove was built using small vibration motors placed at key points on the fingers. The motors were programmed to produce different vibration patterns, intensities, and durations to represent various digital object features. Test participants interacted with simple virtual shapes and were asked to identify differences based only on the vibration feedback. Accuracy and response time were recorded and analyzed.

Results showed that distinct vibration patterns improved users' ability to recognize object edges and basic shapes. Higher-intensity vibrations were most effective for signaling boundaries, while shorter pulses were better for indicating surface changes. The findings suggest that vibration-based haptic feedback can enhance non-visual interaction with digital environments. This project demonstrates the potential of wearable haptic technology to increase accessibility and independence for individuals who are blind or visually impaired.

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):

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

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: Creating a Crab Trap That Uses Computer Vision to Detect and Capture the Invasive European Green Crab

Student Name(s): L. McQueen

Abstract:

European Green Crabs are an invasive species found all across the world, including in the Long Island Sound. European Green Crabs prey on other, native species to the estuary, and destroy the habitat for many more species. Current methods for eliminating invasive species are not effective or applicable for the European Green Crabs, both due to their underwater location and widespread effects. Furthermore, these methods often harm the native species, not just the invasive ones. This research aimed to create an automated trap that uses computer vision to capture only European Green Crabs, without harming native species. This was accomplished using a Raspberry Pi attached to a Havahart Trap, as well as other supplies (such as a camera and motors). Two computer vision models were developed and compared for this project. After the comparison, the fine-tuned model was used for recognizing images taken by the camera. After the image is classified, a motor was programmed to open the trap (if the image is classified as containing a European Green Crab). This trap can accurately capture European Green Crabs to hopefully help eliminate the dangerously invasive species. Future research would include waterproofing the
trap and testing it with an actual crab, as well as making changes for it to be applicable to other invasive species.

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

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☐ Yes   ☒ No

CSEF Official Abstract and Certification
2026

Word Count
249

Fair Category
P8

Project Number
5506

Title: OASIS: Solar-Powered Subsurface Moisture Harvesting Using Temperature Cycling and MOF-Assisted Vapor Amplification

Student Name(s): J. Luo

Abstract:

Water scarcity is a growing global challenge, intensified by climate change, desertification, and expanding urban development. Although arid regions experience chronic surface drought, research shows that deserts often contain stable subsurface moisture at depths of 0.5-1 meter, where relative humidity can reach 60-90%. Despite this hidden resource, a critical survival gap exists: young seedlings typically develop roots only 5-30 cm deep and cannot access deeper moisture. Meanwhile, conventional irrigation methods are highly inefficient, losing 50-90% of applied water to evaporation and surface runoff. Inspired by natural dew formation driven by day-night temperature cycles, this project develops OASIS (Off-grid Aquifer System in Sand) to bridge this gap. OASIS uses a nested, translucent tube structure that creates a controlled vertical airflow loop to extract moisture-rich air from subsurface sand. Powered by a small solar panel and battery, the system operates at extremely low energy input. Based on preliminary testing, the OASIS system achieved a measured raw extraction rate of 0.1 oz of water every 30 minutes from desert sand. When accounting for a 50% system efficiency factor, the device maintains an output of around 0.1 oz per hour, or 3 mL per hour. Over a full 24-hour cycle, this results in a total yield of 72 mL per day, providing a consistent moisture source for establishing young vegetation. By transporting this subsurface moisture into the shallow root zone, OASIS provides a sustainable, off-grid method to support seedling establishment, reforestation, and vegetation recovery in water-limited environments.

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

CSEF Official Abstract and Certification
2026

Title: Evaluating Dissolved CO_2 and Alkalinity in Coastal Waters

Student Name(s): K. Henske

Abstract:

Anthropogenic CO2 emissions impact the environment and human livelihood worldwide. It is estimated that oceans have absorbed 25-30% of CO2 emissions since the Industrial Revolution.

Over time the ability of the oceans to absorb CO2 will decline as ocean alkalinity increases, ph level decline and average water temperatures rise.

My experimentation is designed to show the link between carbon in the air and in sea water. I collected seawater samples from Long Island Sound at Todds Point and Greenwich Harbor. I measured multiple seawater factors: alkalinity, salinity, pH, and water temperature while on site collecting the samples. I also measured the level of CO2 in the air at the water sampling sites. I recorded data from the weather app and SailFlow for air temperature and barometric pressure.

I used an open source model called co2sys, to calculate seawater carbonate chemistry based on the data points I collected. Having established the CO2 partial pressure in the water, I used the Henry's law equation to then predict the CO2 levels in the air and compared to the atmospheric CO2 levels I measured.

Through this experiment, I proved that there is a direct relationship between carbon in the air and carbon in the water. I can show mathematically that as ocean alkalinity increases, ph level decline and average water temperatures rise the amount of carbon uptake by the oceans will decline. This result demonstrates the urgency of reducing carbon emissions and finding economic ways to remove carbon from the air and water.

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

Word Count

CSEF Official Abstract and Certification
2026

Fair Category

Project Number

166

P8

5509

Title: How Does Air Flow Around Different Shape of Cars?

Student Name(s): A. Samaroo

Abstract:

Aerodynamics is the study of how air moves around objects. I wanted to investigate aerodynamics because understanding how air interacts with different car surfaces can lead to fuel efficiency, stability and better performance. My hypothesis is if a vehicle is square, the wind will drag against the vehicle while in motion. The reason for this is the wind would just push against a flat object.

My investigation into aerodynamics was conducted by first getting two different toy cars. Then putting the cars in a clear box, a wind tunnel was created by flowing fog from one end to the other. The fog was used to represent the air flow, over the toy cars, to see which car had the better aerodynamics.

Aerodynamics is important for vehicle efficiency and performance. A lower drag means a car can move effortlessly and requires less energy which in return saves fuel. My investigation revealed that the air flowed around the sharper vehicle more efficiently compared to the square shape vehicle.

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

PH

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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

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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
2026

Title: Insulation Investigation

Student Name(s): L. Baence

Abstract:

Heat transfer is an essential concept because it explains why different materials reduce heat loss at different rates. Insulation materials are widely used in buildings, so understanding how effectively various materials retain heat is important for decreasing energy consumption. This experiment investigated how four different insulation materials affected how long heat was retained in the closed wooden box. Four boxes were constructed from 7.5 by 7.5 inch wooden panels, and each box was lined with a different insulation material: spray foam, fiberglass, foam board, and no insulation for the control. A small hole was drilled into each lid to hold a thermometer securely and minimize heat loss. Then a cup of boiling water at the same starting temperature was placed into each box; the lids were sealed, and temperature readings were taken every five minutes for one hour to determine how well each material prevented heat transfer.

The results showed clear differences in the thermal performance of the insulation types. The spray foam box maintained the highest final temperature at 90°F. The fiberglass box followed at 85°F, while the foam board box reached 82°F. The control box, which had no insulation, lost the most heat and dropped to 73°F. These results indicate that spray foam was the most effective insulation for retaining heat, likely because its air pocket structure and ability to create a tight seal reduces conduction and convection.

Overall, this investigation demonstrated how monitoring temperature change over time reveals differences in insulation efficiency, highlighting the value of high performance materials in engineering and construction.

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

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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
2026

Title: Pennies for Luck or Poison for Ponds?

Student Name(s): D. Bhavsar

Abstract:

Coins are commonly tossed into fountains, ponds, lakes and other large bodies of water for "good luck". These coins sometimes fall into inaccessible areas which can't be cleaned, if they even are cleaned. In outdoor locations like ponds and lakes near tourist attractions, where there could be wildlife living in said waters, can be affected by the long-term effects of metal leaking into the water from the coins. This experiment investigated how different types of coins affect copper levels in still water over time, here it was hypothesized that a full Copper coin would leach the most copper into the water. To test this, four types of coins were placed in containers filled with bottled water for one week, the coins being: post-1964 quarters, post-1982 pennies, pre-1982 pennies, and a pure copper bullion coin. A fifth container was filled, and left alongside the others, serving as a control. Each container held one cup of water, and was placed in sunlight to simulate an outdoor environment. After one week, the amount of copper was measured in milligrams per liter using household water testing strips. The measured data showed that the coins had leached copper into the water, with the Copper Bullion coin having the most milligrams per liter. The levels for the other coins were not unhealthy, but were present, which showed that coins do leak metal into water. This experiment is important as high levels of copper and other metals pose risk to animals, plants, and the ecosystem.

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

EV EA 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
2026

Title: Crash! Testing Model Cars

Student Name(s): S. Jass

Abstract:

The purpose of this project is to answer the question how does the material a car/package is made out of affect how much damage is done to a passenger/item. The hypothesis is that aluminum foil will best protect the contents because of its ability to crumple and absorb the shock from a crash.

I constructed four identical model cars, each out of a different material; cardboard, aluminum foil, fabric and wood. I also constructed an adjustable ramp. I then placed an egg in a plastic bag inside of each car and rolled each car down the ramp set to 90, 70 and 50 degree angles. I used a five star rating system to analyze the results, with 5 being no damage and 1 being entirely cracked.

The cardboard car produced the best results, scoring a 5 for all three angles and resulting in no damage to the egg. The aluminum foil car(4) and wood car (5) performed their best at the steepest angle/fastest speed while the fabric car (5) did its best at the least steep angle.

While the cardboard performed perfectly at all angles/speeds, the other cars performed well in certain circumstances. This result suggests other, more sustainable materials may have practical applications.

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
2026

Title: Timed Electromagnetic Induction as a Method of Producing Directional Motion

Student Name(s): R. Canela

Abstract:

This experiment investigated how magnetic field strength influences energy transfer and motion using a magnetic acceleration prototype. The purpose of the project was to determine how the spacing between a magnet and metal ball bearings affects the movement and final distance traveled by the ball bearing. It was hypothesized that decreasing the distance between the magnet and the ball bearing would increase magnetic force and result in greater acceleration and distance traveled.

In the setup, four metal ball bearings were placed between cylindrical magnets on a ruler, and four additional ball bearings were positioned in front of the magnets to help concentrate and strengthen the magnetic field. This alignment allowed magnetic potential energy to build and transfer through the aligned spheres, causing the final ball bearing to move forward.

The distance between the magnet and the first ball bearing was carefully measured and adjusted before each trial. Multiple trials were conducted to ensure consistent results. The distance the final ball bearing traveled was recorded and compared across trials. Results showed that smaller spacing generally increased the magnetic pull and led to greater motion. This experiment demonstrates how magnetic field strength affects energy transfer and supports the concept that magnetic forces can be used to accelerate objects through stored potential energy.

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

Word Count

251

CSEF Official Abstract and Certification
2026

Fair Category

P8

Project Number

5514

Title: Treat Them Proteins! Using Technology to Help Damaged Enzymes

Student Name(s): T. Nareddy

Abstract:

Each year in the United States, pancreatitis leads to about 275,000 hospitalizations. Pancreatitis is the inflammation of the pancreas when a specific enzyme, Trypsinogen, prematurely activates in the pancreatic ducts, enabling other digestive enzymes to break down pancreatic tissue. This project focuses on changes in the amino acid sequence responsible for affecting the trypsinogen activation peptide (TAP). Using TAP, we can characterize its effect on the likelihood of trypsinogen activation.

Using biotechnological data to develop analysis software that can assess the trypsinogen variant's probability of premature activation after TAP removal. The process to evaluate the probability is performed by inputting a UniProt ID Key (access key to the Universal Database of Proteins) for WT trypsinogen (most commonly found trypsinogen) and trypsinogen variants with TAP removed from the amino acid sequence. Then, the software analyzes the differences in both WT and TAP-knockout sequences, finds the importance of each amino acid, and outputs a result predictive percentage of the variant's probability to not prematurely activate (Likelihood of Functionality [LOF]).

This project settled on 4 groups of trypsinogen variants to test: Cationic (UniProt IDs: P07477, Q7Z5Y9, E7EQ64), Anionic (UniProt IDs: A0A0J9YYC8, A6XMV9, P07478), Mesotrypsinogen (UniProt IDs: A0A7P0MNE9, Q8N2U3, P35030), and Putative (UniProt IDs: Q7Z5F4, Q8NHM4, Q5NV56). Overall, the average LOF results were: 80%, 86%, 84%, 88% respectively. Moving forward, pancreatitis researchers can use this method to focus on creating mutated sequences to test in vitro and compare predicted LOF to experimental LOF, allowing for a streamlined process of creating a cure for pancreatitis.

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

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☐ vertebrate animals   ☐ controlled substances

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

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

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

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

☐ Yes ☒ No

CSEF Official Abstract and Certification

2026

Word Count
249

Fair Category
P8

Project Number
5515

Title: Computer Simulation For School Traffic Optimization

Student Name(s): I. Chen

Abstract:

Every day, millions of students commute to school, and many campuses experience significant traffic congestion during drop-off hours. This congestion reduces instructional time and increases safety risks for the students. The objective of this study is to identify an optimal traffic design for school drop-off areas using microscopic computer simulation.

Two traffic simulation designs were developed to model a two-lane school drop-off layout. In the first design, one lane was designated for parking and student drop-off, while the second lane was reserved for through traffic. In the second design, both lanes were used for sequential parking, requiring vehicles to exit the loop in order as the cars ahead departed. The simulations incorporated key parameters including vehicle arrival rate, pedestrian arrival rate, crosswalk location, parking lane length, and traffic layout configuration. Average vehicle waiting time was used as the primary metric to evaluate efficiency under different parameter combinations.

A case study was conducted using real-world observational data collected from Eastern Middle School in Greenwich CT to test the models. In the experimental comparison, vehicle arrival rate, pedestrian crossing rate, and number of parking spaces were held constant, while only the traffic design and pedestrian crossing location were varied.

Results indicate that the two-lane parking configuration, combined with a staff assistant positioned at the end of the parking area to manage pedestrian crossings, produces the most efficient outcome. This design reduces average vehicle waiting time by more than 40% compared to the current layout.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project)   ET 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
2026

Title: A Comparative Analysis of Load Capacity in Warren, Pratt, Howe, and K Truss Bridges

Student Name(s): Y. Nemlaghi

Abstract:

The purpose of this project is to figure out which truss bridge design can hold the most amount of weight. This is a crucial part of the project because we need to know the strongest truss bridge out of the four (Howe, K, Pratt, Warren). Once we figure out which truss bridge is the strongest we can then use this instead of the other weak bridges. The method I will be using is to build different types of truss bridges out of popsicle sticks and hot glue. Then I will test the strength by applying weight gradually to the bridge. The data I need to collect while researching and testing my project is the weight of the load I will be applying to each of the bridges until it reaches their breaking point. One of the difficulties I will encounter is trying to ensure all of the bridges, with their different designs, weigh the same. I anticipated that the Warren Truss bridge would hold the most amount of weight out of all of them. The reason that I anticipated before the project is because of the downward facing triangle in the middle of the bridge. The downward facing triangle is a compressed part of the bridge.

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

CSEF Official Abstract and Certification
2026

Title: Investigating the effect of tire type on robot performance

Student Name(s): T. Baltrukonis

Abstract:

Automobile tires differ in the type of rubber they are made out of, the depth and pattern of the tread, and their sidewalls. This allows drivers to select tires based on how they want their car to perform. As part of the St MIchael School Robotics Team I have built robots and programmed them to complete missions in the annual First Lego League competition. Sometimes the robot will slide or skid resulting in poor performance despite the programming being accurate. I hypothesized this poor performance may be due to tire selection. This project tests the effect of different tires on robot performance. A robot was designed that could be used with 5 different tire types and the accuracy of driving straight at various speeds was tested with and without the robot's internal compass (gyro) as well as how accurately the robot turned left and right. Across all the tires the most accurate speed for moving in a straight line was 50%, and the least accurate speeds were 10% and 100%. The best performing tires for driving straight were the small blue tires, and the small rounded tires. On turning left and right the small tires were accurate, while the larger tires were not consistent. For the robot design the small tires worked best. However, this project shows that speed, height, and weight should all be taken into consideration when selecting tires.

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

EE

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: How does Microplastics in Water Affects Cymatics?

Student Name(s): J. Praveen

Abstract:

Background: Microplastics are found everywhere including food, water, and even human brains. Their consumption can cause various diseases, like cancer and heart disease. I wanted to raise awareness about microplastic contamination and investigate whether cymatics, the visualization of vibration patterns, can detect differences between clean water and water contaminated with microplastics. I hypothesized that microplastics would act as impurities and change the cymatics patterns seen in pure water. Methods: To generate vibrations, I taped a small motor to a plastic champagne glass that produced visible ripple patterns in water samples. A fixed light source and camera were used to photograph the cymatic patterns. To be consistent across all tests, I used 120 ml of liquid, motor at 5V and camera shutter speed at 1/125s. I examined three factors: density, microplastic concentration, and environmental conditions. I tested density using water, saltwater, oil, and milk. To introduce different concentrations of microplastics, I boiled varying amounts of a Ziploc bag in water for 10 minutes. Finally, I tested bottled water under hot, cold, and shaken conditions. I photographed each cymatic pattern and overlaid it for visual comparison. Results: While the central circular pattern remained consistent, outer wave patterns became less defined depending on density, microplastic particles, and environmental changes compared to plain water (control). As the amount of microplastics in water increased the alterations also increased. Conclusion: These findings show that microplastics alter cymatic patterns, suggesting that cymatics is a potential visualization method for detecting microplastics in water.

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

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

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☐ Yes   ☒ No

Word Count

251

CSEF Official Abstract and Certification
2026

Fair Category

P8

Project Number

5520

Title: The War of Energy Efficiency

Student Name(s): A. Gomes

Abstract:

The purpose of this experiment was to observe how the type of light source (LED/Incandescent bulb) utilized in traffic signals affects energy efficiency. The incandescent bulb-powered traffic light operates for 12 hours, consuming 3 kWh of electricity. At an average rate of $0.12 per kWh, the daily operating cost is $0.36. In contrast, if the LED light operates for 12 hours, it consumes only 0.6 kWh of electricity. At a rate of $0.12 per kWh, the daily operating cost is only approximately $0.07. A light‑to‑voltage detection setup was built that consisted of a power supply, a multimeter, an LED connected through a driver, an incandescent bulb, and a light‑to‑voltage converter to measure how much light each bulb produced compared to how much electrical power it used. Voltage, electrical input, and light output were recorded several times, and consistent methods, including a linear normalization factor, were used to measure efficiency and ensure results were accurate even when the distance between the light source and the sensor changed. The results showed a huge difference between the two technologies. The LED achieved an average wall plug efficiency of up to 91%, while the incandescent bulb fell to just 3.27%. The incandescent bulb was placed much farther from the sensor; about 23.1 cm compared to the LED's average distance of 2.97 cm, just to match the LED's much more efficient reading. This demonstrates that LEDs convert electrical energy into optical light more effectively, while incandescent bulbs waste most of their energy as heat.

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

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☐ Yes ☒ No

CSEF Official Abstract and Certification
2026

Title: Fire detection using Dual Cameras Fusion and Computer Vision to Reduce False-Positives

Student Name(s): M. Shinohara

Abstract:

Most modern fire detection systems are prone to false negatives, true negatives, or are expensive enterprise hardware. With the recent advancements in computer vision and machine learning, a cheaper, faster, and more accurate alternative could be proposed. The purpose of this project is to craft a computer vision pipeline that utilizes an infrared detector that detects fires more accurately and precisely with a more dynamic false-positive prevention. The bounding boxes for the model have 2 classes: Fire, and Controlled fire, such as candles, to detect fires and visually reduce false positives. A 5000 image dataset was picked with a 70/15/15 train/test/val split which was annotated. By using Bayesian optimization, a 49% fire recall, a custom measurement affected by the numbers of false negatives for specifically the fire class, was able to be achieved on the base yolo11n, compared to the 38% recall without enhancements. The highest recall level is at confidence 0%, where the model reached 82% recall, however for precision, the maximum of 100% precision at 80% confidence. This large mismatch in confidence is what the secondary IR gate aims to facilitate; while traditional hard confidence boundaries have trade-offs between recall and precision, implementing an IR detection system is flexible and does not have a hard boundary. This system can be further improved through a more comprehensive dataset or feedback with IR and RGB data to check the recall and precision of the entire pipeline, not just the individual parts.

Technical Disciplines Selected by the Student
(Listed in order of relevance to the project) CS EV 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
2026

Title: Which shapes are the best for making the most aerodynamic car?

Student Name(s): D. Esposito

Abstract:

People constantly are complaining about how their F1 team would be winning more if they had better aerodynamics. Every F1 team is trying to improve their aerodynamics and reduce drag. To test which shapes would make cars more aerodynamic would greatly help a team with aerodynamics. I set the shapes up in a wind tunnel and observed the air displacement as the smoke machine glided over it. If the oval has the most smooth thin shape then it will be the most aerodynamic because airflow has the least change flowing over the shape. To build it get your wind tunnel shell and add the fan, plexiglass, smoke machine and diffuser and put them in a room with low airflow. Then put your shape in and turn on the smoke machine. While running, take pictures of how the smoke is flowing over your shapes. Analyze the pictures for the most smoke dispersion. The oval maintained the best smoke stream, therefore it was the most aerodynamic. Comparing all of the airflows to the control group of just regular airflow unimpeded the oval shape went around and reformed the best. My hypothesis was correct, the oval shape had the least smoke dispersion meaning that it was the most aerodynamic shape

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

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

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Word Count

252

CSEF Official Abstract and Certification
2026

Fair Category

P8

Project Number

5523

Title: Built to last: aluminum integrity by design

Student Name(s): j. keeler

Abstract:

My science fair project, Built to last: Aluminum Integrity by Strength, is a series of tests to test the ways that design affects aluminum durability. The reason I chose aluminum is because aluminum is one of the commonly available and versatile metals. This experiment consisted of 3 different tests,a resistance test, an elasticity test, and a fatigue test. Two out of three tests require a commercial grade metal bender. The resistance test requires you to take the first copy of each of your samples, insert them into your metal bender, and bend the metal until you feel resistance from the metal. Then, for the second test, you take your now bent metal samples, trace them, and leave them in a common environment for a 24-hour period. This is to observe any changes which would be caused by its elastic properties, if any. Then, repeat for another 24 hours. The tracing helps with noticing changes which might not be visible to the naked eye. Then, with the second copy of the sample, perform the third test. To do this, you insert your sample into the bender and bend the sample as far as you can. Then repeat bending the sample the exact same way up to four times or until it snaps, whichever happens first. I had hypothesized that Sample 3 would outperform the others because of its design, and it was proved correct. This sample had the most bend ability and showed the least fatigue after all of the tests.

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

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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Word Count

204

CSEF Official Abstract and Certification
2026

Fair Category

P8

Project Number

5525

Title: Smart Plant Care: Using Automation and AI

Student Name(s): P. Sharma

Abstract:

Many people like growing plants at home, but taking proper care of them can be challenging. Overwatering or underwatering can cause plants to become unhealthy, especially when the warning signs are not noticed early. To solve this problem, I made Smart Plant Care, which combines an automatic watering system and an AI disease detector. For the first part of my project, I built a system that uses a soil moisture sensor and a water pump to water the plant only when the moisture level is under a certain threshold of 600. I tested the watering system 10 times, and it correctly turned on the pump every time when the soil was dry. For the second part of my project, I used VS Code and python to create a convolutional neural network (CNN) and trained it using a dataset that I found on kaggle of 62,500 total images of healthy and diseased plant leaf images across 35 different classes. After training, I tested the AI using 37 images it had not seen before and added short treatment suggestions to help users cure their plants. My model ended up with a final accuracy of 90%, which is good if you consider how small my dataset is.

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

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CSEF Official Abstract and Certification
2026

Title: Comparative Analysis of CO2 Reduction by Common Houseplants Using an Arduino-Based Environmental Monitoring System

Student Name(s): V. Shkabarnya

Abstract:

Indoor air quality significantly affects human health and cognitive performance. Studies have shown that carbon dioxide (CO_2) concentrations above 1,000 ppm can impair decision-making and complex thinking skills. Because people spend approximately 90% of their time indoors, identifying cost-effective methods to reduce indoor CO_2 levels is increasingly important. This project investigated whether common houseplants can measurably reduce CO_2 concentrations under controlled conditions.A custom Arduino-based environmental monitoring system was designed and constructed to continuously measure CO_2, oxygen (O_2), temperature, humidity, and light intensity inside an airtight 11-quart chamber. Measurements were recorded every five minutes over a 24-hour period using a programmed 6-hour light and 6-hour dark cycle to simulate day and night conditions. Four plant species were tested: English Ivy, Janet Craig Dracaena, Purple Waffle Plant, and Snake Plant. Total leaf surface area and foliage mass were measured to evaluate the relationship between plant structure and gas exchange.Results showed that English Ivy and Dracaena demonstrated the greatest daytime CO_2 reduction and oxygen production, with rates strongly correlated to total leaf surface area. Nighttime respiration rates were more closely associated with total foliage mass. The Snake Plant exhibited a distinct gas exchange pattern consistent with CAM photosynthesis. These findings support the hypothesis that leaf surface area significantly influences daytime CO_2 absorption and demonstrate how engineering and environmental science can be integrated to address real-world indoor air quality challenges.

Technical Disciplines Selected by the Student
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EV EE AT

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CSEF Official Abstract and Certification
2026

Word Count
169

Fair Category
P8

Project Number
5528

Title: Solar Powered Car vs Battery Powered Car Science Fair Project

Student Name(s): R. Daley

Abstract:

The purpose of my science project was to learn more about the differences between solar energy and battery energy. First, I started by gathering information about solar energy like the differences between them and how similar they are. Some key similarities and differences I found were that solar energy exerts much less energy than the battery powered car. A similarity is that both energy sources can be saved for later. Next, I started to get the materials I needed and got to the building. I began to test things like how fast each car goes and how long they run for. Also, what sources of light are better for solar panels. Finally, I thought about what was more sustainable or efficient: a solar powered car or a battery powered car. At the end of my project, I concluded that a battery powered car is faster than a solar powered car, but a solar powered car lasts longer. Lastly, I found that solar powered cars are more sustainable or efficient.

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

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