Abstract: Science and Engineering Fair of Houston

1115

Clear Vision

Irem Bektas
Clear Creek ISD /Seabrook Intermediate School

Category

Chemical Engineering & Materials Science

Fog forms by the water vapor condensing because of the temperature difference and coming to the form of microscopic water droplets. For example, when in a hot day people go inside the cold pool, people's snorkel mask gets foggy. People can't see trough fog comfortably because of the light refracting and scattering because of the droplet formed fog. That makes light go through directions it is supposed to be not going for us to see clearly. This experiment was designed to test the hypothesis that if the shaving foam is used as an anti-fog coating, then the glass will get the least amount of fog. Glasses were coated with five methods, toothpaste, shaving foam, anti-fog wipes, saliva, and plus a control which was a glass with no methods applied to it. Then they were placed into the refrigerator in a box for at least twenty minutes. After that, they were placed in another box individually were a laser was placed on top and a photoresistor on the bottom, the photoresistor measuring the amount of light that straightly went down pass the glass. The anti-fog wipes got the least amount of fog by having an average of 423.2 Voltx5/1023, therefore the hypothesis was not supported since it was thought that shaving foam would reduce fog the most if used.

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Abstract: Science and Engineering Fair of Houston

1116

Sparks Fly: Testing Flammability of Baby Pajamas

Rowan O'Donohoe
Weis Middle School

Category

Chemical Engineering & Materials Science

Historically, pajamas for infants and children have had to have some degree of flame resistance in accordance with the Flammability Act. There has been a recent push for not using chemicals in baby clothes due to potential hazards leading to more products without the extra protection. These pajamas without added flame retardants are generally cotton or some form of it and often come with warnings to wear to sleep only if tight fitting. This project will explore which fabrics are the most and least protective in a fire. Specifically, which catches fire quickest, which burns the longest and which appears to cause the most/least amount of damage? This is important for any families with small children in the home. I predicted that the polyester would do the best overall during our testing because it is naturally flame resistant, and that cotton would do the worst, because it is high in flammability. To test the hypothesis, I gathered baby pajamas of various materials and placed a flame near them. I gathered information on how long it took to catch fire, how long the flames lasted (if they ever went out,) and which seemed to cause the most damage. In the end, the wool performed the best overall in my testing because it prevented flames from starting, and the flames that did start extinguished quickly on their own. The pajamas made of 97% Bamboo Rayon and 3% spandex had the next longest time until flames started. The 100% polyester pajamas had the next shortest time with burning flames. Overall, the pajamas made of 60% cotton and 40% polyester performed the worst during our experiment with flames that were quick to start, spread and burned for a long time before having to manually be extinguished.

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Abstract: Science and Engineering Fair of Houston

1117

Which Material Soaks up Motor Oil the best

Kura Faith Kulkarani
Lucy Wang
Stafford STEM Magnet Academy

Category

Chemical Engineering & Materials Science

We have noticed that oil spills are one of the biggest causes of pollution in America. We think that since dirt and sawdust have the ability to soak up oil. We will use this to our advantage and use large qualities to clean up oil spills. We will have set amounts of materials and oil that are tested in multiple trials. Our results will produce an answer to which material will be the the most efficient at soaking up petroleum. We can apply our research and data to make it easier to clean up oil off the road for potential oil spills. Our purpose is to make it easier to clean up oil spills. We will have 3 trials and test every material. We will combine the materials to to see if the mixture could effectively soak up the oil, then when the materials were separated. With our results we will compare the data and classify if the mixture did better then the other tests. We will also average the amount soaked up for each material. The average will allow us to compare the percents to the other materials. Our conclusion will be to see which material or mixture did the best in the tests.

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Abstract: Science and Engineering Fair of Houston

1118

Floating on Water

Eduardo Ramirez
YES Prep

Category

Chemical Engineering & Materials Science

Water pollution has become a significant environmental concern, with detrimental effects on ecosystems and human health. One often overlooked aspect of water pollution is its impact on the physical properties of water, such as surface tension. This experiment investigates how pollutants— such as salt —affect the surface tension of water. Using a simple setup involving two samples of water in a bowl and a surface tension test using paperclips, the study measures changes in water's surface tension when exposed to different types and concentrations of pollutants. Results suggest that salt aid in increasing the surface tension, potentially changing the behavior of water in natural environments and affecting organisms dependent on surface tension for survival such as the water spiders which is essential to maintaining a healthy ecosystem. This project highlights the importance of understanding how pollution can disrupt water's fundamental properties, contributing to broader environmental challenges.

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Abstract: Science and Engineering Fair of Houston

1119

Eco-Starch: Innovative Solutions for Oil Spill Cleanup

Karina DSouza
Conroe ISD /McCullough Junior High

Category

Chemical Engineering & Materials Science

According to research, oil spills can devastate marine life, including large-scale bird and sea turtle deaths, significant harm to marine mammals like dolphins and whales, and long-term disruption to fish populations. Minor spills can be cleaned in a few days, but major oil spills, typically from pipelines breaking, big oil tankers sinking, or drilling operations going wrong, can be lethal. Many of the procedures used currently to clean spills end up getting the oil out of the ocean but harm the wildlife. U.S. oil companies are required to have workers ready to fight oil spills, which is expensive at any time and also a harmful process. This project aims to create an oleophilic and hydrophobic, duckweed-starch-based absorbent that can effectively and safely clean up oil spills. Duckweed is an abundant resource that reaches 70% starch content. Duckweed was grown, harvested, and purified to get clean oleophilic starch. The starch was mixed under a heating stirrer with citric acid as a catalyst, glycerin for flexibility, and water to make a solid material. The mixture turned gel-like and was then baked at 375 degrees Fahrenheit until the water in the material evaporated to protect against molding. The fragments were then used in a spill model to determine the amount of oil it could absorb in a real-life scenario. The results suggest that the material could hold two times its weight in oil and last up to seven weeks after manufacturing, emphasizing its potential in the real world.

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Abstract: Science and Engineering Fair of Houston

1120

Bio-Wrap: Creating a biodegradable substance to reduce the use of plastic

Blake Fletcher
Tomball ISD /Northpointe Int

Category

Chemical Engineering & Materials Science

The purpose of this experiment was to determine which biodegradable material would be the best replacement for plastic. My hypothesis was that a biodegradable material created using gelatin and ground eggshells would exhibit the flexibility and elasticity required to act as a substitute for traditional plastic. I combined gelatin, distilled water, and vinegar. I then created individual samples by adding beeswax, ground eggshells, or cornstarch. I tested each sample by dropping a marble on them to determine the coefficient of restitution (COR). This shows how well each sample absorbs impact. I wrapped samples around an egg and dropped the egg to see how well the egg is protected. The control (gelatin, vinegar, and water) had an average COR of 0.41. The average COR of the cornstarch sample was 0.35. The average COR of the eggshell sample was 0.58. The average COR of the beeswax sample was 0.51. Also, I found cornstarch to be more flexible than the other samples because it did not crack when wrapped around an egg as the other samples did. In conclusion, I found my hypothesis to be wrong because the cornstarch sample was found to be the best plastic replacement based on the lowest COR. These results could impact the world because if we use a biodegradable material to replace plastic this can reduce pollution.

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Abstract: Science and Engineering Fair of Houston

1121

Effects of Food Additives on Germination of Seeds

Amy Lopez
Houston ISD /BCM Academy at James D Ryan - MS

Category

Chemical Engineering & Materials Science

My project is needed because it could help solve problems with companies and the production of food additives.This project will test how food additives affect the growth of plants. Food additives are used in many foods to improve taste and color. but there are concerns about how they might impact both health and the environment. We know little about how these additives affect plants, which are important for food production. In this experiment, I will use common food additives like aspartame, MSG, BHT, and FD&C Red #3 to see how they influence the growth of mung and lima bean plants. By comparing the growth of plants with and without additives, I hope to learn if these substances harm or help plant growth. i found out in my research that lima beans grew slower when exposed to substances like aspartame, MSG, and FD&C Red #3, but they still survived and keep growing, just at a slower pace. Mung bean plants, however, were more affected by these substances, especially BHT, which stopped their growth completely by Day 5 or 6. Overall, lima beans kept growing, but more slowly, while mung beans showed serious problems and some stopped growing altogether, especially with some additives. This research is important because it could show whether food additives affect plants in a harmful way. The results might help us make better decisions about the safety of food additives and their impact on both health and the environment.

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Abstract: Science and Engineering Fair of Houston

1122

What's Poppin'?

Isabella Rodriguez
Central Middle School

Category

Chemical Engineering & Materials Science

I bought 3 different brands of popcorn and popped them with an equal amount of time to determine which brand was the bed. After all of the bags were popped, I counted each kernel that wasn't popped to see which had the most and which had the least. When I finished counting I had determined that Great Value was the best brand since it had less kernels, meaning more popcorn had actually popped.

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Abstract: Science and Engineering Fair of Houston

1123

Identity Imprints

Anika Vijay
Likitha Pavuluri
Aiyana George
Fort Bend ISD /Quail Valley Middle School

Category

Chemical Engineering & Materials Science

This project investigates the impact if temperature on fingerprint clarity and evaluates the effectiveness of the different powders and how they all uniquely enhance the fingerprints visibility under different temperatures. The main purpose of this project is to inform the audience about the uses of fingerprinting while discussing the many advantages and disadvantages. The main objective was to figure out which temperature variations identify the powder which makes the fingerprints come out cleanest. The variables in this project are very crucial as the independent variable is the specific temperature of the surface and the dependent being the clarity of the fingerprint which was rated on a scale from one to ten. As the temperature increased the fingerprint clarity decreased which made them conclude that temperature significantly influences fingerprint clarity with lower temperatures resulting in clearer prints. Using the correct powders is also very important and can adverse the effects of higher temperatures and can improve the quality of the fingerprint. This is essential in investigations and can easily been done incorrectly so it is key to find the temperature which works best which would be the lower temperature and the correct powders. After experimenting through with this investigation, the end conclusion was that the pencil powder was the clearest due to its physical properties such as its fine powder and as it contained many materials and ingredients that normal fingerprint powders also contain. It was clearest at zero degrees and the most effective powder that we can find at home was the graphite lead powder.

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Abstract: Science and Engineering Fair of Houston

1124

Can Bioplastics be more affordable?

Alexis Galindo
Jeshmitha Puligundla
Central Middle School

Category

Chemical Engineering & Materials Science

Every year an estimated 19-23 million tons of plastic waste enters the environment and it is predicted to increase to 53 million tons annually by 2030, posing risks to human health and natural ecosystems. Therefore bioplastics are a better and sustainable alternative to conventional plastics, but due to their high cost many people are preferring traditional plastic instead. Therefore, it is necessary to develop a cost-effective alternative to traditional plastics. The aim of this study is to develop and characterize bioplastic films using various types of starches that are both environmentally friendly and economically viable. In this project we used 3 starches,namely arrowroot,potato, and corn. The other materials include water, vinegar, and glycerin. The procedure firstly, add starch to water and heat through vinegar and glycerin. Once the mixture is heated, it will form a gel-like substance. Once I get that, spread the mixture on to a flat surface and do the same for the other 2. After drying for 2-3 days at room temperature we got our samples, then we examined the characteristics of various starch and showed them in a graph. Our data analysis showed that arrowroot is the strongest, corn is fragile, and potatoes are the most flexible. Our conclusion is that starch-based bioplastics have the potential to be used as a replacement to conventional plastics at affordable prices.

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Abstract: Science and Engineering Fair of Houston

1125

No Shellfish Intentions: Creating Chitosan Bioplastics from Shrimp Shells as a Sustainable Alternative to Petroleum Plastics

Christian Chen
Kevin Choi
Aarav Saini

Category

Chemical Engineering & Materials Science

Conventional petroleum plastics are amazing right? They are considered the most cost-effective, versatile, and widely used materials produced in the past century, impacting many aspects of daily life. However, we must acknowledge the environmental implications these synthetic petroleum plastics have on our world. Approximately 400 million tons of petroleum plastics are produced annually, and 14 million tons of it end up in our water supply, making up 80% of ocean debris. As microplastics circulate in nearly every human's bloodstream, scientists are investigating the environmental and health impacts of petroleum plastics. In response, we strive to create an alternative to petroleum plastics that is affordable, accessible, and biodegradable. Since we like to eat shrimp and have an abundant supply of local wild Texas shrimp, we wanted to explore whether we could turn our shrimp shell garbage into a new type of sustainable bioplastic suitable for packaging applications. Through our rigorous experimental design, we created nine distinct iterations of two homemade prototypes: Shrimp Bioplastic and Shellfish Bioplastic. We tested the mechanical and physical properties of our homemade bioplastics, determining their tensile strength, flexibility, and temperature resistance to be comparable to petroleum plastics. Our Fantastic Shrimp-plastic Foam could be a sustainable replacement for nonbiodegradable Styrofoam insulation while our Fantastic Shrimp-plastic Film offers an eco-friendly alternative to single-use plastic bags and packaging. Best of all, after use, simply throw our Fantastic Shrimp-plastics in your yard as a natural fertilizer because it's 100% biodegradable.

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Abstract: Science and Engineering Fair of Houston

1126

Microbial Fuel Cells: Food Waste as an Electricity Source

William Kim
Anika Roy
Spring Branch ISD

Category

Chemical Engineering & Materials Science

A recent and pressing challenge the world is grappling with, one that becomes harder to ignore every day, is the escalating threat of climate change. The effects are being felt everywhere, from rising global temperatures to extreme weather events, melting glaciers, and disrupted ecosystems. At the same time, another growing issue is the massive amount of food waste generated globally. Every year, tons of food are discarded, contributing to greenhouse gas emissions when it decomposes in landfills. Adding to these challenges is the ever-increasing demand for electricity, as populations grow and technology advances. These problems are deeply interconnected, creating a cycle that puts immense pressure on our planet. This makes it critical to find innovative, sustainable solutions that address multiple issues at once. One promising technology that could play a role in tackling these challenges is microbial fuel cells (MFCs). Microbial fuel cells are an exciting and futuristic method of producing electricity. What makes them so fascinating is their ability to convert organic substances, like food waste, into electrical energy. Unlike traditional fossil fuels, MFCs generate power without releasing harmful greenhouse gases, making them an environmentally friendly option. They utilize microbes, which are tiny living organisms, to break down organic material and produce electricity as a byproduct. This process is not only clean but also provides a way to repurpose organic waste that would otherwise go unused. This research has the potential to create a ripple effect of positive impacts. A more efficient microbial fuel cell would make it possible to convert food waste into clean energy on a much larger scale, reducing the amount of waste that ends up in landfills while simultaneously addressing the growing demand for sustainable electricity. This could help mitigate climate change by providing a renewable energy source that doesn't rely on fossil fuels or produce harmful emissions. Furthermore, it would open up new possibilities for managing organic waste in an environmentally responsible way. Ultimately, this

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Abstract: Science and Engineering Fair of Houston

1127

Which Dog Toy Brand Is More Durable?

Aarya Prajapati
Conroe ISD /York Junior High

Category

Chemical Engineering & Materials Science

The purpose of this experiment was to answer the question, "Which Dog Toy Brand Is More Durable?". To answer this question two dog toy brands, Brand A and Brand B, were tested to see which was the most durable and the data was recorded in a data table and graph. During this experiment, a tool was made out of wood and nails that were hammered at the end of the wood board. Each dog toy was attached to a stable surface using duct tape. Both Brand A and Brand B each had three trials in which they were distressed with the tool and timed to see how many seconds they took before showing signs of wear. The results of the experiment went against the original hypothesis, "If 2 brands of toys are tested to see what is the most durable, then brand B will be the most durable." Brand A ended up being the most durable because of its strong polyester-fiber blend versus Brand B's standard polyester blend. The difference between both fabrics is that polyester is semi-strong by itself but by combining it with other fibers it becomes much stronger than standard polyester. In conclusion, this experiment found that textile testing is key to manufacturing products because when proper testing is used, it can help extend a products life and will save resources.

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Abstract: Science and Engineering Fair of Houston

1128

Prickly Stickers

Sibley O'Haver
Central Middle School

Category

Chemical Engineering & Materials Science

Sticker burrs have been a long-term problem constantly sticking to peoples' legs and clothes. So, this year for my science fair I decided to test how sticker burs stick to different fabrics. I first researched sticker burs to learn more about how and why they attach to things. Then, I studied the fabrics that I used prior to doing the experiment. As I researched, I came up with my hypothesis that Vinyl would have the least and tulle would have the most. With my hypothesis set I started working on my experiment. After seeing the result my hypothesis was incorrect. Vinyl did have the least, but Rayon had the most. After some more research I found that the reason tulle did have a lot of sticker burs stuck was because the gaps were too large for sticker burs to hook onto. Knowing this information will be good for developing clothing material that can withstand sticker burs, so they don't attach to people's shoes and clothes. This could be beneficial for people who research sticker burs so they can collect them in a more natural way or for people who work outside and need them not to stick. If I could do something different with my experiment, I would want to grow my own sticker burs so I know that they would all be the same age so that the thorns are not more brittle on one than the others.

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Abstract: Science and Engineering Fair of Houston

1129

Can't Tell the Difference: Using Plant-based Milk as a Viable Yogurt Base

Korason Jade
Houston ISD /BCM Academy at James D Ryan - MS

Category

Chemical Engineering & Materials Science

Have you ever wondered how yogurt would taste with different probiotics ? Probiotics are useful bacteria and yeasts that give you health benefits and are also used to boost the bacteria on milk and dairy products. These probiotics may also be used in making dairy products and already exist in your body.The proteins and fats in yogurt make it thick and creamy. The protein in the yogurt also known as (casein) clusters in the yogurt creates a mesh or something thick and creamy while culturing the yogurt. Brod & Taylor. (Brod & Taylor. (n.d.-b). The Science of Great Yogurt. Brod & Taylor. https://brodandtaylor.com/blogs/recipes/the-science-of-great-yogurt) So it is necessary for yogurt to have protein to make it thicker and creamier or give the yogurt a nice texture.I took some probiotics and added it to my yogurt while I was making it.I then used the respective amount and types of yogurt according to my testable question.I also hypothesized that animal-based milk will taste better than plant-based milk.

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Abstract: Science and Engineering Fair of Houston

1130

Acidic Effects on Invert Sugars.

Logan Manning
Clear Creek ISD /Westbrook Intermediate School

Category

Chemical Engineering & Materials Science

I am fascinated by both the worlds of culinary arts and the sciences, so I did a project that combines them, the creation of an edible balloon. I wanted to explore the topic further, which led me to the research of Invert Sugars and how they are affected by pH to refine the recipe of this project. After some research, I hypothesized that the higher pH levels formed by lemon juice allowed for the sugar to more easily form. To experiment, I made several batches of balloons with changes in the pH levels and tested the strength, viability and endurance of the mixture. The balloons formed best in the higher pH levels, particularly 6, which allowed for more natural balloon formation. I learned that the pH of the acid solution is important to Balloon formation, which upheld my hypothesis and allowed for more affective balloon formation.

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Abstract: Science and Engineering Fair of Houston

1131

Development and Characterization of Hydrogel Systems for Encapsulation and Controlled Release of Model Compounds

Madeleine Melancon
Houston ISD /T. H. Rogers MS

Category

Chemical Engineering & Materials Science

Hydrogels are interesting materials for drug delivery because they can hold a lot of water and are safe to use in the body. In this project, I studied alginate-based hydrogels to see how well they could hold and release two different dyes: rhodamine B (which has a positive charge) and trypan blue (which has a negative charge). At first, the dyes came out of the hydrogels very quickly. For small hydrogels, over 61% of the rhodamine B and 47% of the trypan blue were released in just 2 hours. For larger hydrogels, the release was slower, with 40% of rhodamine B and 25% of trypan blue released in the same amount of time. After 3 days, almost all the dye was released, no matter the size of the hydrogel. To fix this, I coated the hydrogels with different combinations of four polymers: alginate, chitosan, PAA (polyacrylic acid), and PEI (polyethyleneimine). I hypothesize that combining polymers with opposite charges (like positive and negative) would slow down the release of the dyes. I used a UV-Vis spectrophotometer to measure how much dye came out over time. For rhodamine B, the coatings with chitosan+alginate and chitosan+PAA didn't help much, as about 84% of the dye was still released after 4 days. But with PEI+alginate, the release dropped to 61%, and PEI+PAA slowed it down the most, with only 6% of the dye released after 4 days. Trypan blue behaved differently—it released much slower with all the coatings. Without any coating, 49% of the trypan blue was released in 4 days. But coatings like chitosan+alginate, PEI+alginate, chitosan+PAA, and PEI+PAA reduced the release to 34%, 19%, 16%, and 7%, respectively. These results show that polymer coatings can make hydrogels release dyes (or drugs) more slowly. This could be really useful for creating drug delivery systems that release medicine at just the right speed. With more work, we could make these hydrogels even better for specific medical uses.

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Abstract: Science and Engineering Fair of Houston

1132

Bioplastic Bags

Madeline Mark
Clear Creek ISD /League City Intermediate School

Category

Chemical Engineering & Materials Science

With the everyday use of plastic bags and the many issues with them, many companies attempt to create better solutions. Many corporations have discovered that bioplastics work as a better replacement and do not take hundreds of years to decompose. Bioplastic or, in some cases, biopolymers still need more research to become as commonplace as plastic bags. In this experiment, all the bags dissolved in under thirty minutes, significantly faster than most bioplastics. A shortcoming of this is that no liquids or items that were even slightly wet could be placed in the bag. If the bag was placed on a damp counter, it would begin to decay and no longer function properly. The dampness of a fridge or freezer would also render the bag unsuccessful. While these bags were successfully dissolved in simulated ocean water, further modifications to improve their durability for use will be necessary to incorporate bioplastic bags of this composition into practice.

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Abstract: Science and Engineering Fair of Houston

1133

materials best to maintain a fire

Alex Forde
Greyson Jeck
Weis Middle School

Category

Chemical Engineering & Materials Science

Why which one works better for making a fire? Which material is best to create a fire for an emergency? By testing various materials and their burn rate, we came up with this project thinking of people out in the wilderness. Or after a devastating disaster like hurricanes, blizzards or floods. Many people do not have access to their belongings, but may be able to use easily accessible materials like we are testing.

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Abstract: Science and Engineering Fair of Houston

1134

Lipid-Alginate Hydrogels as a Novel Approach for Biofilm Disruption in Wound Care

Riya Singhal
Tomball ISD /Grand Lakes JH

Category

Chemical Engineering & Materials Science

Chronic wounds, affecting millions globally, are often exacerbated by biofilm formation that leads to antibiotic resistance and delayed healing, necessitating innovative solutions for effective management. This study developed a novel hydrogel-based topical drug delivery system using lipid and alginate carriers to optimize drug release for biofilm disruption. A skin-mimetic hydrogel comprising methylcellulose, hyaluronic acid, glycerin, and gelatin was formulated to ensure structural integrity, hydration, and bioactivity. Red dye was used as a surrogate drug marker to monitor release dynamics, enabling effective assessment of the burst and sustained release phases. Drug release patterns were evaluated under simulated wound conditions (pH 5.5, 38°C) across four experimental groups: (1) plain hydrogel (control), (2) lipid-loaded hydrogel, (3) alginate-loaded hydrogel, and (4) combined lipid-alginate hydrogel. Lipid carriers provided a rapid initial burst, simulating the release of concentration-dependent antibiotics, while alginate carriers enabled sustained release, supporting time-dependent pharmacokinetic needs. Together, this system aligns with the recommended pharmacokinetic/pharmacodynamic (PK/PD) parameters for biofilm management by delivering an initial high-dose antibiotic exposure, followed by consistent therapeutic levels. This optimized PK/PD can minimize treatment failures. Results demonstrated that the combined lipid-alginate hydrogel achieved an ideal release profile, providing a rapid burst release followed by sustained drug delivery over 72 hours, effectively meeting the therapeutic demands. These findings highlight the potential of this hydrogel system for advancing chronic wound care. By enhancing biofilm penetration, minimizing systemic toxicity, and improving patient comfort, this dual-phase hydrogel system offers safer, more effective, and sustainable solutions for chronic wounds, surgical sites, and burn management.

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Abstract: Science and Engineering Fair of Houston

1135

Using Edible Polymers to Preserve Food

Joshua Ghattas
Nelson Tang
Kevin Liu
Spring Branch ISD

Category

Chemical Engineering & Materials Science

After testing for shelf life, our data showed that every polymer helped with food preservation in the long run. Many of the polymers yielded similar results - however, according to our graphs, many polymers involving starch consistently gave positive results that were distinguishable from the others. In particular, starch, xanthan gum + starch and egg white + starch had better-than-average results, while the others were consistent but didn't perform as well. Starch had the least weight loss, and xanthan gum + starch had overall the most penetration.

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Abstract: Science and Engineering Fair of Houston

1136

Applications of A.I. and Ferromagnetic Elements to Detect and Remove Microplastics from Water

Vincent Mughal
Ronit Chheda
Fort Bend ISD /Fort Settlement Middle School

Category

Chemical Engineering & Materials Science

Microplastics are a major threat to marine life and human health, linked to many diseases. These particles of <5 mm in water are challenging to detect and remove from water bodies. This project presents a novel approach utilizing ferromagnetic elements in the form of ferrofluids to remove microplastics and uses images to train machine learning to detect the effectiveness of this removal method. Firstly, a machine learning model was developed using a custom database of microplastic images, achieving 98% accuracy during training. In real-life tests, accuracy was around 92%, regardless of the amount of microplastics present. Turbidity tests were performed to simulate debris in the water and showed a decreased accuracy of 74%. Next, a novel method using ferrofluids was developed to extract these microplastics from water. Ferrofluids were prepared by suspending Fe3O4 in a carrier fluid like edible oils. Among the different carrier fluids (base oils), Vegetable and Canola oils (>90%) showed significantly higher efficiencies compared to Corn oil (87%). Additionally, increasing concentrations of Fe3O4 in the ferrofluids were tested that demonstrated higher removal efficiencies (>90%). This method was also applied to salt solutions (simulating ocean water) which showed no difference in removal efficiency. In conclusion, this work demonstrates an effective and novel water treatment process which utilizes machine learning methods (AI) to detect and uses ferrofluids to remove microplastics. Process improvements can be achieved by using cheaper oils like used cooking oil demonstrating recyclability of ferrofluids for a continuous and cost-effective process.

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Abstract: Science and Engineering Fair of Houston

1137

Temperatures in 3d!

Seth Le
Clear Creek ISD /Seabrook Intermediate School

Category

Chemical Engineering & Materials Science

A news story recently reported that 3D printed houses were destroyed by a storm. This raised the question: How do 3D printed houses fair in different climates? This experiment tested how the 3D-printed material can be affected by the temperature. The hypothesis was that if the 3D-printed material was subjected to cooler temperatures, it will become stronger. This experiment was involved with doing compression tests on 3D-printed models that were kept at various temperatures. A 3D modeling software was used to design a rectangular model, and sixty parts were 3D printed using the PLA filament, which is a commonly used 3D-printing material. Groups of 10 parts were stored at the following temperatures for 2 hours: 4°F, 44°F, 78°F, 120°F, and 170°F. The parts were then compressed at each temperature on the testing machine. The maximum compression load for each part was recorded. The data showed that the parts could withstand higher compression loads as the temperature got colder; however, they became more brittle. On the flip side, parts lost strength as the temperature got warmer, but they also became more flexible and did not break apart into small pieces. The experiment demonstrated the hypothesis is correct that colder temperatures would strengthen the 3D-printed material. The increase in the strength of the material could be due to the cold temperature reducing the movement of the molecules of the 3D material. In conclusion, if you ever want to have a 3D-printed house, you should usually build it in colder temperatures.

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Abstract: Science and Engineering Fair of Houston

1138

How Temperature Affects Different Magnets And Their Strength

Kara van de Rijt
Conroe ISD /McCullough Junior High

Category

Chemical Engineering & Materials Science

I thought an interesting project to do would be how temperature impacts different types of magnets because of the impacts of heat on earth. My background research showed that magnets lose strength when they come in contact with heat. As a result of my research, my hypothesis is that a magnet loses power in proportion to the strength of the magnets. My results support this hypothesis. The way I collected my data was by heating the magnet up for a specific amount of time in boiling water. Then I took them out and recorded the distance at which it could attract a paperclip. This was to measure the power that the hot magnets had. I think a wider variety of magnets and longer exposure to heat will make this experiment better.

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Abstract: Science and Engineering Fair of Houston

1139

Graphene Innovation: Energizing the Future

Young Lim
Conroe ISD /McCullough Junior High

Category

Chemical Engineering & Materials Science

Graphene, a newly discovered material, shows significant potential to enhance battery performance. This research dived into how graphene improves the electrical conductivity of graphite, revealing a 267% increase in conductivity when comparing samples ranging from 100% graphite and 0% graphene to 0% graphite and 100% graphene. The results supported the hypothesis that electrical conductivity increases as graphene content rises and graphite decreases. In the experiment, materials were weighed, mixed, and formed into pellets, with conductivity measured using a four-point probe. By analyzing the data collected, it revealed a strong positive correlation between graphene content and conductivity. If I were to repeat this experiment again, I would focus more on addressing errors to improve accuracy.

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Abstract: Science and Engineering Fair of Houston

1140

How will the different types of sole materials affect how high you jump?

Patricio Aranda
Conroe ISD /McCullough Junior High

Category

Chemical Engineering & Materials Science

My project question is "How will the different types of sole materials affect how high you jump?". It is about testing my vertical with different types of sole materials to see which one is good for jumping and which one is not. I first started off getting the right camera angle so I can make sure I can get all my data that I need to do this experiment. Then, I put my rubber sole in my shoe and did 5 standing vertical jumps to get an accurate result. Then, I moved on to Rabbit Foam sole did 5 standing vertical jumps looked at how high I jumped and went on to the next sole. Next, I did Memory foam stop the video from recording and looked at my data and moved on. After that I did Carbon Fiber 5 jumps you know the deal stop recording looked at my data got my results and moved on. Then, it was Leather again 5 jumps stopped recording got my data and moved on. The last sole was the Eva foam sole put them in did 5 jumps stop recording looked at my data and moved on to the calculations. After collecting all my data, I did my calculation to find my average height/jump. Put it on my table and finished.

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Abstract: Science and Engineering Fair of Houston

1141

Red Hot, White Hot, How Hot?

Dara Deransburg
Alief ISD

Category

Chemical Engineering & Materials Science

The purpose of this experiment was to figure out which color absorbs the most heat, and what are the main reasons behind why it absorbs the most heat. This included three trials of placing differently colored cloths into clear containers and then outdoors in the sun to measure the amount of heat each cloth would absorb into their container. This was done with each color 3 times for each trial in a different area. To sum up the trials, they'll include averages of each cloth's temperature for their container. For the first experiment, the white cloth had an average temperature of 97.9°F after the three trials. Then the bright colors of the spectrum, red, yellow, and orange had averages ranging at 99.3°F to 101.5°F after the trials. Next, the darker colors of the spectrum, dark blue, dark green, and dark purple had averages ranging at 101.6 to 102.5 after the trials. Lastly, the black cloth had an average temperature of 103.4°F after the three trials. Out of all the locations' trials, black had the highest temperature in every one.

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Abstract: Science and Engineering Fair of Houston

3112

The Effects of Graphene on Composite Material's Thermal Conductivity

Richard Chen
Clear Creek ISD /Clear Lake High School

Category

Chemical Engineering & Materials Science

Effective thermal management is important in technologies and industries today such as with electronics and aerospace, where too much heat could reduce performance and durability. Epoxy resin, a material usually used with adhesives and coatings in these cases has low thermal conductivity, which limits its use in applications requiring effective heat transfer. I researched how adding graphene, a material with special thermal properties, to epoxy resin could improve epoxy resin's thermal conductivity in this experiment. The goal of my project was to find how different graphene concentrations of 0, 1, 5, 15 percent would affect the resin's ability to transfer heat. First, I mixed resin and hardener together with exact amounts of graphene powder. Then, I poured the mixtures into molds and allowed them to cure and harden in the same environment. I then applied heat to one side of each sample and measured the temperature difference between the centers hot and cold sides using an infrared thermometer. Through my testing, I found that adding graphene improved heat transfer, with the greatest improvement occurring at 15% graphene concentration. Each concentration had increased heat transfer temperatures compared to smaller concentrations. This data shows that epoxy resin with graphene can be a solution for applications needing better thermal management. This experiment not only shows the potential of graphene-epoxy composites, but also the importance of improving properties of materials for real-world applications. I believe these findings could lead to advancements in areas like electronics with heat transfer and thermal conductivity.

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Abstract: Science and Engineering Fair of Houston

3113

Fabrication of radiopaque and drug-loaded resorbable polymer for medical device development

Sophie Melancon
Houston ISD /Kinder HS for the Performing and Visual Arts - HS

Category

Chemical Engineering & Materials Science

Resorbable medical devices function during use and degrade into safe byproducts afterward. One application is in pulmonary embolism (PE) prevention. Patients with contraindications to anticoagulants often require inferior vena cava filter (IVCF) placement to trap thrombi. Absorbable IVCFs eliminate retrieval needs but are limited by radiolucency and clotting risks. IVCFs were fabricated by hand using resorbable polymer poly-p-dioxanone (PPDO) sutures braided using cork and nails as guide. Gadolinium nanoparticles (GdNPs) with average diameters of 35.76 ± 3.71 nm were synthesized using a solvothermal method. GdNPs along with dipyridamole (DPA), an anti-clotting agent, were infused within the PPDO IVCFs. There were no significant differences observed between PPDO, GdNP- and DPA-infused PPDO devices in terms of melting temperature (103.32-105.90°C, $P > 0.05$) and load-at-break (4.39-5.38 kg, $P > 0.05$). Micro-computed tomography (CT) imaging showed that GdNP-PPDO had increased radiopacity (2,713 ± 105 HU for PPDO-Gd and 1,516 ± 281 HU for PPDO-Gd+DPA) while PPDO had -130 ± 38 HU and PPDO-DPA had 135 ± 172 HU. IVCFs coated with GdNP showed gradual decrease in radiopacity over 6 weeks. There was no evidence of hemolysis or in vitro cellular toxicity between groups. The IVCFs were also effective in capturing clots in vitro and CT imaging showed enhanced radiopacity. In conclusion, a novel radiopaque, resorbable IVCF made up of PPDO infused with GdNP and DPA was successfully fabricated. The addition of GdNPs improved the radiopacity while DPA prevented clot formation without untoward effects on device mechanical strength, clot trapping efficacy, and cellular toxicity. Fabricated GdNP- and DPA-infused PPDO allows for routine monitoring of absorbable IVCFs.

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Abstract: Science and Engineering Fair of Houston

3114

Novel Glycine-Functionalized Graphene Oxide-Enhanced Silk: A Breakthrough in High-Performance and Multifunctional Fiber Engineering

Aaditi Godse
Emma Xi
Houston ISD /DEBAKEY HIGH SCHOOL FOR HEALTH PROFESSIONS - HS

Category

Chemical Engineering & Materials Science

Silk is a natural protein polymer spun by silkworms and, in recent decades, researchers have explored enhancing silk with carbon nanomaterials such as graphene to create functional fibers with superior mechanical properties. These carbon-enhanced silks are twice as tough as natural silk and withstand 50% more stress before breaking. However, graphene, not being a metabolically required substance, limits the incorporation and the structural transformation within silk fibers. This study addresses these limitations by utilizing glycine-functionalized graphene oxide (GO-Gly) to enhance silk fibers. Glycine, a small non-polar amino acid comprising 44% of silk fibroin, was chosen for its compatibility with silk's crystallization process and its role in the nutritional composition of mulberry leaves. Four-instar silkworms were divided into control and GO-Gly-fed groups (30 silkworms per group). For the first time, we observed the transformation of GO-Gly into ribbon-like structures (~1 μM width) within silk fibers without compromising their integrity. Our findings reveal silkworms ingest flake-form GO-Gly, which self-assembles into ribbons within the silk fibers, resulting in a significant enhancement of mechanical properties. The toughness modulus increased from 22 MPa to 46 MPa, marking the first structural insights into GO-Gly-modified silk with superior strength and toughness. Interestingly, the ribbon-like GO-Gly structures are approximately 1 μM wide, compared to the 5 μM diameter of natural silk. This research sheds light on previously unknown mechanisms underlying graphene's contribution to silk's performance and the scalable production of high-performing, multifunctional materials.

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Abstract: Science and Engineering Fair of Houston

3115

Translation Between the Opacity of Photochromic Dye and UV Index

Carter Collison
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

The Ultraviolet Index (UVI) is a measure of the likelihood of getting sunburned while outside. Its only limitation is that the UVI is entirely predicted by satellites and is not measured at an individual's specific location. The purpose of this project was to build a portable UV indicator apparatus capable of accurate, localized UVI reporting. An apparatus based on the color change of a photochromic pigment was engineered and built to measure the UVI. UV flashlight tests and data collected during the night served as positive and negative controls, respectively. Programming allowed semi-automated measurement of more than 15,000 images that were converted into UVI values. Data analysis compared the outputted UVI from the apparatus and the reported UVI from https://open-meteo.com under varying weather conditions. Results indicate that the apparatus was accurate in predicting the UVI for both sunny and cloudy days, and more accurately reported the UVI on days that had a mix of sun, clouds, and rain. This apparatus accomplished my engineering goal of making a device that could accurately measure the UVI of an individual's location. Expanding this study could include adding a machine learning model to better calculate the UVI. The usefulness of the apparatus is broad and could include measurement of the UVI where such data is not available or in remote locations, especially for sun sensitive populations.

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Abstract: Science and Engineering Fair of Houston

3116

Development of Biodegradable Flame Retardant PLA Using Phytic Acid-Lysine Amino Acid Salt Compound

Luke Liu
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

The ongoing Los Angeles wildfires, which have caused over $250 billion in damage and claimed 27 lives, along with the ongoing challenge of climate change, highlight the urgent necessity for flame-resistant materials that are both effective and environmentally sustainable. While traditional flame retardants can reduce fire risks, they often rely on harmful chemicals, creating a demand for safer, environmentally friendly alternatives. Polylactic acid (PLA), a biodegradable polymer, offers sustainability benefits but lacks inherent flame resistance, limiting its use in innumerable fire-critical applications. This project addresses these challenges by enhancing PLA's flame retardance by incorporating phytic acid-lysine amino acid salt (PALys) and epoxidized tannic acid (ETA) as additives. PLA/ETA/PALys composites were synthesized at various loading percentages and evaluated for thermal stability, flame resistance, and residue formation. Testing included thermogravimetric analysis (TGA), microcalorimetry (MCC), and UL-94 vertical burn tests. Results demonstrated substantial improvements: a 95% reduction in derivative weight loss during decomposition, a 475% increase in residual weight at 385Â°C, and a V-0 rating in UL-94 testing, revealing an exceptional improvement in fire resistance. This project introduces a novel, flame-retardant material that reduces environmental impact and establishes a framework for addressing other weaknesses in polymers, such as mechanical and chemical limitations. With applications ranging from construction and consumer goods to 3D printing, this work bridges the gap between fire safety and sustainability, offering a holistic solution for mitigating the increasing risks of fires and climate change in contemporary life.

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Abstract: Science and Engineering Fair of Houston

3117

Color Additives Test

Juan Andrade
Pasadena Memorial High School

Category

Chemical Engineering & Materials Science

The main purpose of my research is to find out if celery can survive while being put together with different types of color dyes. The research was conducted by collecting and putting different types of color dyes in each of their own beakers/cups. Then put celery in the beakers with the color dyes and wait a couple of days to see the effects that would take place. The results that were observed were most except for one celery did not survive being put together with color dye and some celery grew leafs. In conclusion most celery cannot be put together with different types of color dyes because they will dye after a couple of days.

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Abstract: Science and Engineering Fair of Houston

3118

Pipeline transportation for critical minerals mining: effect of pipe- and particle- properties

Aditya Hariprasad
Seven Lakes - HS

Category

Chemical Engineering & Materials Science

Critical minerals (such as nickel, zinc, and iron) are in great demand for next-generation energy technologies that produce, transmit, store, and conserve energy thereby reducing carbon intensity. However, without maximizing the efficiency and minimizing the energy needed to transport critical minerals, the carbon intensity of critical minerals transportation will increase. Currently, semi-empirical correlations that predict the minimum flowrate for critical minerals transport (such as Mantz correlation and Oroskar & Turian correlation) exist in open literature. However, each of these empirical correlations have only been tested against and proven for a range of experimental parameters and hence, have over-predict or under-predict (by an unknown margin) for real-world industrial conditions (appropriate for critical minerals mining and transportation). The objective of this project is to determine minimum fluid velocity needed to transport solid particles with varying properties (size, density, & concentration) in different pipeline sizes (that are representative of real-world industrial conditions). With new data collected, this project benchmarks existing correlations and validates if the correlations can be applied reasonably for critical minerals transport and/or identifies potential gaps that may need to be addressed. The study concludes that critical transport velocity for particles generally increased with particle density & concentration and pipe diameter. The predicted critical velocity from Oroskar & Turian correlation fares reasonably well against experimental observations compared to those from Mantz correlation.

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Abstract: Science and Engineering Fair of Houston

3119

Efficient Cooling Systems for Data Center Servers

Claudia Zinngrabe
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

In recent years, data centers have become important to process large quantities of information. Because of this, energy consumption is rising, and data centers will soon require more energy and will take up a larger portion of energy demand within the United States. One area with capacity for efficiency improvement is cooling the server chips. This project finds the amount of energy consumed in watts and compares it to the temperature dropped every 15 seconds. Using more electricity to power cooling systems tends to make them cool faster instantly but loses efficiency and effectiveness over time. Depending on the cooling conditions, this may be more effective than lower watts, but it depends on the situation of the server chips' temperature. Overall, this project will increase knowledge about different cooling options for efficiency and energy consumption, along with progressing the field with possible solutions when trying to combat high energy usage when used unnecessarily.

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Abstract: Science and Engineering Fair of Houston

3120

Engineering a Novel Biodegradable Colorimetric Sensor for the Selective Detection of Diphenhydramine Hydrochloride with Integrated Microbial Decomposition Assessment

Elena Martinez
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

The use of date rape drugs to facilitate sexual assault on college campuses is a major issue that is often undermined. Although researchers have attempted to engineer sensors to detect highly regulated drugs, they fail to acknowledge that students are more likely to abuse the over-the-counter medication diphenhydramine hydrochloride (DPH), primarily known under the brand name Benadryl, which is more accessible and frequently used in college campus sexual assault. Preexisting sensors are heavily reliant on plastic structures, which encourage the desecration of the earth's oceans and marine life. This study utilizes a true experimental research method and fluorescent quenching to develop a biodegradable sensor that detects DPH in neutral substances (pH level 7), and substances of varying pH levels (2-3, 5.0, 8-9, 12-13). Sixteen trials were conducted where eight sensors were presented with distilled water containing DPH , and the other eight sensors were presented with substances absent of DPH. Each sensor presented with DPH were presented with a different concentration (0.100 M, 0.500 M, and 0.700 M). A separate group of eight sensors tested the effect of varying pH levels with constant DPH concentrations and found that the addition of $NaHCO_3$ or C2H4O2 to neutralize the sensors results in 100% success rate. In successfully engineering a biodegradable coaster to detect DPH in liquid substances utilizing fluorescent quenching, this project bridges the gap between environmental sustainability and sexual assault on college campuses.

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Abstract: Science and Engineering Fair of Houston

3121

Football Pads for the Future

Anthony Bankston
Trenton Plaster
Nathan Garcia
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Chemical Engineering & Materials Science

The iconic sport of American football has been around for over 150 years dating all the way back to 1869. Along with it came with tons of different types of iconic equipment seen everywhere including the thigh pads. The padded pants had many slight alterations in its design as the years went by but never a true remake. The football padded pants can usually be really good quality or pretty low quality depending on the fact if you're in the NFL or a student in highschool. Either way, the design has been consistent and lacked many types of advancements needed for the pads to be worn for football players to participate to their full potential without issues. Many of the problems revolving around the pad are easy to fix but have never been thought about. The thigh padding needs different ways of correction to help with three main problems; Stability, Protection, & Comfortability. This project will highlight and experiment with the possible changes that could be made to remove most of the issues coming from the main category of problems. This paper will show if completely rebuilding a more tight and sturdy spot on the thigh pad can keep the padding material from becoming loose and problematic or if measuring and fixing the amount of force the padding material can take to protect the football players' upper thigh from intense exercise can really help improve the mobility and functionality of the thigh padding along with having experienced players compare the two.

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Abstract: Science and Engineering Fair of Houston

3122

Additive Manufacturing for Orthopedic Biomedical Research

Noor Al-Ramthan
Ali Al-Ramthan
Clear Creek ISD /Clear Lake High School

Category

Chemical Engineering & Materials Science

Additive manufacturing, also known as 3D printing, has been rapidly developing in recent decades due to open-source technologies. Fused Deposition Modeling, also known as FDM or Fused Filament Fabrication (FFF), is one of the most commonly used 3D printing technologies due to its low costs, availability, simplicity, and environmental friendliness. There are many great benefits to 3D printing technology such as producing complicated composite-material parts. However, its uses are limited as the mechanical properties of 3D printed parts have yet to be thoroughly studied. The main focus of this research is centered around investigating the influence of the 3D printing parameters on the mechanical properties of the tested material: PLA. The materials will be 3D printed into a dog bone shape to meet the required standard set up by the American Society for Testing and Materials (ASTM) to perform tensile tests. The effect of the angle at which the angle is printed (printing orientation) on the young modulus (modulus of elasticity), toughness, and other mechanical properties will be explored. The results of this research will allow for proper identification regarding which material 3D printing orientation has the best mechanical properties for additive manufacturing needs, such as developing orthopedic prosthetics.

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Abstract: Science and Engineering Fair of Houston

3123

ChitoSphere: Revolutionizing Eye Care Through Sustainable Coacervate Ophthalmic Drug Delivery

Grace Yuan
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

The world is going digital. The increasing prevalence of digital technology has led to higher screen usage, contributing to eye strain and retinal damage in adult populations. The CDC predicts that the number of Americans with uncorrectable vision impairment will double by 2050, exceeding 8 million. Current in vivo drug and antibody delivery methods for treating eye diseases are invasive, imprecise, and often associated with adverse side effects. This study aimed to develop a sustainable and biocompatible ocular drug delivery system using bio-based polymers that is non-invasive, efficient in delivery, and utilizes controlled drug release. The proposed system employs a coacervate—a liquid droplet with phase-separated properties resembling membrane-less organelles—formed from chitosan (a biopolymer derived from crustacean shells) and hyaluronic acid (a biopolymer derived from bacterial sources). The coacervates' efficiency was assessed by encapsulating fluorescent dyes to evaluate their capacity for containment and release in a hypertonic solution that mimics the ocular environment. Dyes with varying properties, including positive and negative charges and hydrophilic and hydrophobic characteristics, were used to simulate antibodies and proteins. The bio-based coacervate was also compared to its synthetic counterpart, a coacervate made of polyacrylic acid and PolyDADMAC. Results indicate two of five dyes with a partition coefficient of 9.4 and 33.8, indicating over 90% encapsulation of the dye. The coacervates were also investigated under increasing ionic and salinity strength. The bio-based drug delivery system exhibits an efficient and noninvasive approach to combating ocular diseases and can help transform future sustainable biopolymer-based medical applications.

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Abstract: Science and Engineering Fair of Houston

3124

Engineering surfaces that mimic the brain environment to study fibril formation in vitro

Anika Harpavat
St. Agnes Academy - HS

Category

Chemical Engineering & Materials Science

This study aims to understand the formation of fibrils, which are abnormal stacks of protein that aggregate in a variety of human diseases. To investigate fibril formation in Alzheimer's disease specifically, we engineered an in vitro system for fibril growth that mimics the brain environment. This involved creating a scaffold by attaching azide-terminated thiols to a gold surface, along with varying amounts of a phospholipid-like thiol similar to the phospholipids found in neuronal cell membranes. The alkyne-containing peptide β-6 was then connected to the scaffold through the azide-alkyne "click" reaction, after which formation of β-6 fibrils was assessed. Using total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR), we found that our technique successfully led to scaffolds which contained neuron-like phospholipids and fibrils could form on these surfaces. Further, using atomic force microscopy (AFM), significant differences in fibril length and height were found with changes in the concentrations of the phospholipid-like thiol. We conclude that surfaces for fibril growth can be modified to be biologically relevant, and that changes in phospholipid bilayers such as those that could occur with aging in Alzheimer's disease may play a role in modulating fibril formation.

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Abstract: Science and Engineering Fair of Houston

3125

Biodegradable Balloons Pt. 2

Anabella Wilems
Clear Creek ISD /Clear Lake High School

Category

Chemical Engineering & Materials Science

What is the effect of Biodegradable balloon material on how much air it can hold? Did you know that most "biodegradable" balloons are not actually safe for the environment? Companies add chemicals to the balloon in order to make it less brittle, last longer, and increase the elasticity. This project is step 2 in a 4-step endeavor to create a biodegradable balloon that is healthy for the environment. It was hypothesized that the material made from Sugar Kelp would be able to hold the most air and hold it for longer. Two types of algae (Sugar Kelp and Red Dulse) were blended with 3 different percentages of natural latex (50%, 33%, and 10%) and tested to see how much air the material could hold. It was found that the Sugar Kelp material with 50% latex held the most air. The materials created with 10% of latex were unable to be taken of the mold and were not tested. It was hypothesized that the material made from Sugar Kelp would be able to hold the most air and hold it for longer. During this project the hypothesis was proven correct. To be more specific the Sugar Kelp material made with 50% latex held the most air, holding an average of 2.2 PSI.

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Abstract: Science and Engineering Fair of Houston

3126

Mom, I Need a New Phone!

William Lee
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

The purpose of this project is to identify whether a silicone-based "soft" phone case would protect a phone better than a more traditional polycarbonate-based "hard" phone case. While polycarbonate-based phone cases protect phones by prioritizing material strength and durability, silicone-based phone cases focus more on absorbing impact shock. The experiment was conducted within a constructed cardboard-plexiglass rectangular box. Glass panes with the dimensions of a smartphone were then placed and dropped inside the box within either a polycarbonate-based phone case, a silicone-based phone case, or dropped without any protection (control tests). While the results for the guided drops supported my hypothesis, the results for the freefall drops opposed. The prime suspected cause was the omission of weight tests, for the freefall tests weighed significantly more than the guided drops due to an attempt to better simulate an actual phone. This research can be applied to various situations, primarily those involving unwanted impact.

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Abstract: Science and Engineering Fair of Houston

3127

Effect of Alternative Insulation Materials on Interior Temperature of Barns

Jonathan Zwart
Clear Creek ISD /Clear Lake High School

Category

Chemical Engineering & Materials Science

Farmers want to put animals in the coolest barns or other enclosures as possible. There are lots of options to insulate a roof, such as mineral wool, Styrofoam, and other porous materials. I chose 6 different materials to test how well they lowered the interior roof temperature. I hypothesized that closed-cell foam would work the best because it lets less air circulate. That would mean it insulates better. I made a simulated barn with 7 separate 3-wall stalls out of plywood. I attached a sample of each of the 6 insulators to the ceiling of each stall. Each sample was 1 inch thick to make the experiment consistent, and the densities were all taken for each 1x1x1 sample. After it stabilized the roofâ€™s temperature (getting up over 109 degrees) in the sunlight, I measured the interior temperature of the insulated roofs in each stall. The reflective foil bubble wrap lowered the temperature an average of 33.5 degrees compared to the uninsulated, bare wood in the â€oecontrolâ€• stall, which was the best one overall. The metallic bubble wrap was one of the most- dense materials. This could matter if weight of many square yards were applied to the roof. But in the end, the experiment showed that farmers looking for exposed-barn insulation should consider a variety of materials.

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Abstract: Science and Engineering Fair of Houston

3128

SLA 3D-Printed Bioresorbable Nanocomposite Flow Diverter Stents with Enhanced Mechanical Strength, Radiopacity, and Optimized Hemodynamics: A Novel Approach to Cerebral Aneurysm Treatment

Krushal Panda
Jan Jaeng

Category

Chemical Engineering & Materials Science

Cerebral (brain) aneurysms lead to the restriction of blood flow in the brain, causing hemorrhages and severe health complications. To prevent this, flow diversion stents (FDSs) are utilized to divert blood; however, clinical, metallic FDSs can cause blood clot formation, artery narrowing, and interfere with imaging assessments such as CT scans. In order to provide a cost-effective, personalizable, and fast-yielding method of creating bioresorbable flow diverter stents (BRFDs), the student researchers utilized stereolithography (SLA) 3D printing. By leveraging bioresorbable resin along with the integration of nanoparticles, the project aimed to explore a novel approach to creating BRFDs with increased radiopacity and mechanical strength. Using standard tensile testing methods, the tensile strength of the control test specimen without silica nanoparticles was compared with specimens composed of 0.5 wt. % silica and another composed of 2 wt. % silica. The control specimen exhibited an ultimate tensile strength of 20.99 MPa, while the 0.5 wt. % and 2 wt. % specimens exhibited ultimate tensile strengths of 22.15 MPa and 25.56 MPa, respectively, indicating that the silica nanoparticles improved the tensile strength of the bioresorbable resin. Using a CT scan, the radiopacity of a control stent without zirconium nanoparticles was compared with a stent composed of 5% zirconium and another composed of 10% zirconium. The control stent possessed a radiopacity of 63 Hounsfield units (HU), while the 5% and 10% nanoparticle stents possessed radiopacities of 132 HU and 176 HU, respectively, indicating that the nanoparticles improved the radiopacity of the stents.

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Abstract: Science and Engineering Fair of Houston

3129

Essential Oils on Cotton

Kayla Hoang
Pasadena Memorial High School

Category

Chemical Engineering & Materials Science

The experiment looks at how long the essential oil scent stays on cotton shirts after it is washed. Cotton shirts were soaked in rose, lavender, orange, eucalyptus essential oils for 30 minutes, then dried. After drying, the shirts were washed with unscented laundry soap in cold water. The scent strength was rated on a scale of 1-10 right after washing and again at 1 hour, 3 hours, and 6 hours. The results were recorded to compare how long each essential oil's scent lasted. The goal of this study is to determine which oils keep their fragrance the longest on fabric

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Abstract: Science and Engineering Fair of Houston

3130

Energy Efficient Radiative Cooling via Asymmetric Emissivity on Vertical Wall Corrugations

Maan Patel
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

The gradual replacement of fossil fuel produced energy with expensive renewable energy infrastructure is widely insufficient in the fight to combat global warming and its branching effects. Buildings consume 40% of global energy due to large HVAC systems needed to offset warm climate. Radiative cooling, a passive form of energy conservation, has the potential of modulating building walls to release more thermal energy than received from the environment, lowering the energy needed to cool buildings. A corrugated model with asymmetric emissivity was designed as a way of applying radiative cooling to vertical wall structures, a current challenge in the construction industry. Vertical wall models with various corrugation, layering, and chemical coating characteristics of the asymmetric model were derived from cost-effective materials and mounted on trays to replicate closed building systems. The internal, middle layer, and external temperatures for all folded and coated models exhibited statistically significant cooler temperatures when compared with the flat vertical wall control over multiple testing days ($p < 0.05$). The dual painted emissive and reflective aluminum models outperformed the control and the single layered corrugated model ($p < 0.05$). The asymmetrically coated model performed the best among all three measurements out of all models with a mean 4°C reduction in temperature when compared to the control, having the potential to effectuate an estimated 11.3% annual decrease in U.S. carbon dioxide emissions ($p < 0.00001$). The energy efficient asymmetric model may continue to inspire using the materials of today to create a more sustainable future.

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

☐ human participants ☐ potentially hazardous biological agents

☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

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☒ yes ☐ no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

☐ yes ☒ no

4. This project is a continuation of previous research.

☐ yes ☒ no

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☒ yes ☐ no

Abstract: Science and Engineering Fair of Houston

3131

Cool Turf: Investigating the Impact of Different Infills on Reducing Artificial Turf Temperature

Jay Holliday
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Chemical Engineering & Materials Science

This project provides sports facilities with valuable information regarding how they might be able to reduce the temperature of their turf using alternate turf infills. The hypothesis suggests that artificial turf fields with alternate filaments will be cooler when compared to Artificial turf fields with regular black rubber infill. Four separate 1 by 1 meter plots were built, in areas with full sunlight, where the different products of infill were set to be recorded. Four times a day, everyday, for a span of 2 weeks each plot´s temperature was recorded along with the time of day, ambient temperature, weather, and 4 readings of each plot including natural grass. The lowest and highest recorded temperature for each plot, for each recorded session, were thrown out, with the remaining two averaged to get the raw temperatures. Days that received sunlight on average made artificial turf with no infill 16°F warmer than a day not receiving sunlight.The hypothesis was supported, as both silica sand and crushed walnut shell infills were on average cooler than the artificial turf with crumb rubber infill. The study also confirmed that synthetic turf, particularly with crumb rubber, becomes significantly hotter than the surrounding ambient temperature with increases of up to 37°F. The results indicate that solar radiation exposure is a more significant factor in turf temperature increases than ambient temperature itself. Natural grass proved to be the most sustainable option in terms of mitigating extreme temperature rises. This research highlights the potential benefits of alternative infills for reducing turf field temperatures.

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Abstract: Science and Engineering Fair of Houston

3132

Polyolefin Plastic Waste Chemical Recycling by Hydrocracking: Conceptual Process Design and Techno-Economic Analysis

Emma Qiu
Fort Bend ISD /Austin High School

Category

Chemical Engineering & Materials Science

Plastic waste has been rapidly accumulating with the increasing demand for a variety of plastics. Only 9% of plastic waste was recycled and the rest was landfilled, released into the environment, or incinerated, resulting in a threat to the environment and economic loss. Mechanically recycling tends to lead to low-quality products due to contamination and mixtures. Chemical recycling routes are considered promising and versatile by converting plastic wastes into value-added products. Currently, chemical recycling routes include pyrolysis, gasification followed by the Fischer-Tropsch (FT) process to produce automotive fuels and catalytic conversation. Extensive research has been conducted on effective catalysts in recent years. However, very little of these research works have been commercialized due to the lack of process design and techno-economic studies. This project presented the conceptual design for one 80,000 tons/year capacity of fix-bed reactor-based continuous polyolefins hydrocracking process to produce gasoline- and diesel-range fuels. The process is comprised of raw materials preheating, hydrocracking reaction, and product separation. The process can be tuned to produce other range fuels. A preliminary techno-economic analysis of this process was conducted.

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Abstract: Science and Engineering Fair of Houston

3133

Optimal Conditions for the Degradation of Biodegradable Plastics in Composting

Ieva Chekmen
Conroe ISD /AST: Academy of Science and Technology

Category

Chemical Engineering & Materials Science

This project aimed to determine the optimal conditions for the degradation of biodegradable plastics in home composting. Plastic utilized in everyday life is often used only several times and then discarded, leading to large amounts of it accumulating in landfills and damaging the environment. The chemical structure does not allow for natural and safe degradation to occur, which is why biodegradable plastics are a promising alternative. Made of organic compounds, their structure allows for safe, efficient degradation in certain environments, and two common types are polylactic acid (PLA) made from biomaterials like plant cellulose and starches, and polyhydroxyalkanoates (PHA) made from bacteria fermenting organic materials. Three composts were set up, one as a control, one with pH additive, and the third with compost accelerating nutrients to test different soil conditions. It was hypothesized that in testing, the pH additive and compost accelerating nutrients would result in faster degradation. Both types of plastic were tested for 28 days, with soil pH, moisture, temperature and observations being recorded. The results showed that the PHA plastics degraded in all three groups, while the PLA plastics did not experience significant degradation, and the group with compost accelerator resulted in the most degradation out of the three, partially supporting the hypothesis. Plastics like PHA could potentially increase soil quality during degradation, so a further application could be developing home composting environments optimal for the plastics while simultaneously creating better soil.

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Abstract: Science and Engineering Fair of Houston

3134

PLA-Chitosan Composites as Sustainable Alternatives for Menstrual Pads

Elisa Feng
St. Agnes Academy - HS

Category

Chemical Engineering & Materials Science

PLA-Chitosan Composites as Sustainable Alternatives for Menstrual Pads Polyethylene-based menstrual pads take centuries to biodegrade, contributing significantly to environmental waste while posing health risks for users. Fortunately, alternative polymers are available to replace polyethylene in menstrual pads. This research focuses on creating a composite of two promising polymers, Polylactic Acid (PLA) and Chitosan, as an alternative material to polyethylene-based menstrual pads. Both polymers are biodegradable and biocompatible, with chitosan being uniquely antimicrobial, presenting them as ideal materials for eco-friendly menstrual pads. The method of polymer blending, solvent blending, was utilized to achieve the research's goal. Solvent blending was executed through the mixing of emulsified PLA and Chitosan solution in four different ratios, resulting in dried PLA and Chitosan powders. The powders were then processed through an Injection molding machine to form small test samples for the purpose of performance testing. A comprehensive analysis was conducted to assess the potential of these materials for use in menstrual pads. The findings demonstrated improvements in flexibility and tensile strength. Meanwhile, the water absorption of the material significantly increased, enabling better fluid retention essential for effective menstrual pads. In comparison to polyethylene-based menstrual pads, our menstrual pad material can degrade in a few years, drastically improving the biodegradability period. These results offer valuable insights into the feasibility of PLA-chitosan composites for sustainable and health-conscious menstrual products. More importantly, a PLA-chitosan-based menstrual pad allows women to use a safer, eco-friendly product without concerns about health risks from synthetic materials.

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