Project ID: 681

Junior Division

Engineering: Energy, Materials, and Transport

Eva Allen
De Portola Middle School
Gr. 8

Which Homemade Glue Works Best?

AWARDS:

San Diego Chapter - American Society of Materials International - Junior Division 2nd Place

This project examines a variety of different types of homemade glue. The goal is to see how long and how much weight they can withstand. It is my hypothesis that glue number 1. The trials consisted of adding the glue in between a mainframe and 5 small pieces of wood, while adding weight to the wood to make it heavier. The glues that lasted the longest and with the most weight were the winners.

The results indicated that my hypothesis was both correct and incorrect, by proving that that glue did hold the longest, with a weight of 102 2/3 ounces, with more that could hold. The reason the results did not support my hypothesis is because glues number 1,3, and 4 all held on, providing a tie. The reason the glues held well was because of the ratio of liquids to solids. The glues that lasted the longest consisted of a good ratio. The reason the ratio is the most important part of the reason they stuck is because when the solids are mixed with a liquid, which all of the remaining glues had, caused the liquid to break the molecules into chains, which could link back together. When this occurred, the glue created a bond, or "links" between the two pieces of wood. This is why glues 1,3, and 4 worked the best!

Project ID: 682

Junior Division

Engineering: Energy, Materials, and Transport

Alexander Allport
The Children's School
Gr. 8

Can Coffee Grounds Save Homes? The Effect of Coffee Grounds on Mudbricks

AWARDS:

American Society of Civil Engineers - Junior Division 1st Place
San Diego Chapter – American Society of Materials International – Junior Division 2nd Place
CSEF Qualified

For our prototype, we were inspired by a traditional Native American recipe. We made twelve bricks out of 40% soil, 30% clay, 20% sand, and 10% pine needles.

We then made 14 bricks in which we replaced the sand with coffee grounds for our second prototype. We measured the vertical force needed to break each brick by slowly adding 1 Liter of water at a time into a container mounted onto a V-shaped metal rod. Each brick was placed directly under the metal rod. The sand bricks withstood an average of 19.2 kilograms after 12 tests. The coffee bricks withstood an average of 12.8 kilograms of downward pressure for the 14. We found that the sand bricks were the strongest. We calculated the percent of change and found that the sand bricks were 33.4% stronger than the coffee bricks.

The experiment that inspired us heated the coffee grounds at high temperatures before making concrete out of them. If we could redo this experiment, we would heat the coffee grounds before using it in bricks.

Project ID: 683

Junior Division

Engineering: Energy, Materials, and Transport

Lachlan Brooks
La Jolla Country Day School
Gr. 6

Cello Bow Grip Guide

The purpose of this project was to see if a bow grip guide could be designed to minimize incorrect hand posture for people who play the cello. The main goal was to find a way to help people like me early on who suffer from thumb and hand pain when playing the cello. The grip was designed so that a person could hold the mold for an extended period of time and when they transition to the real thing they keep that position. The subjects were tested by having them play a certain scale 3 times. The subjects were asked about their fatigue and comfort after playing. Then students were given the bow grip that was designed and held it for one minute. They played to the same scale and again rated their fatigue and comfort.

The results show that the device made the fatigue go down, and the comfort go up. But, since there were so few subjects, it cannot be determined how effective the device really is. Further testing is recommended for the current design. This could include more subjects, as well as using the grip over a longer period of time. The research could be expanded by designing multiple size grips. The current design is not a one size fits all because everyone has different hand sizes.

Project ID: 684

Junior Division

Engineering: Energy, Materials, and Transport

Samuel Day
De Portola Middle School
Gr. 8

How Increasing a Blade's Aspect Ratio Affects the Amount of Lift Produced

This experiment was conducted to learn more about aerodynamics and to test how changing the aspect ratio (the square of the span of a lifting surface divided by its area) of a helicopter blade affects its performance. It was hypothesized that a blade with an aspect ratio of around 25 would produce the most lift. This is because, traditionally, helicopters with an aspect ratio of around 25 were the helicopters that could lift the most weight.

This was tested by designing and 3d printing 4 propellers, varying only the width of the propeller, not the span. These propellers were then placed on top of a small motor, which was placed on a small kitchen scale. The start weight and the minimum weight reached after a minute were recorded.

This hypothesis was found to be incorrect, at least for the propellers tested, as a propeller with an aspect ratio of 13.3 was instead found to be best. It was found that it produced 1.05 grams of lift on average, 3.765% its own weight, compared to, at most, 1.03 grams by the other 3 propellers, including the propeller closer to an aspect ratio of 25, resulting in the rest only reaching, at most, just over 3% of the original weight being reduced. In conclusion, the hypothesis was found to be incorrect after testing. It would, however, be recommended to perform a more professional test with better materials to prevent defects in smaller items to cause this result.

Did Not Attend Judging

Project ID: 685

Junior Division

Engineering: Energy, Materials, and Transport

Aiden Dignan
Nazareth School
Gr. 7

Which Sunglass Lens is the Most Protective Against UV Rays

First I want to talk about my hypothesis and statement of problem. My hypothesis is about which sunglass lens is the most protective for your eyes against UV rays. My hypothesis was somewhat supported because actually three out of the four lenses were 100% UV protective. Next, my statement of the problem is how many people can damage their eyes from not wearing sunglasses so I wanted to find the most protective sunglasses so your eyes don't get damaged from UV light.

My procedure was to get four different types of sunglass lenses (trivex, polycarbonate, high index, and non-UV protective lenses). Then I had to test each lens in a dark room so the UV light would work with the UV meter. After that I made the science fair notebook and powerpoint presentation. And that is my summary of my procedure.

Now onto the results. From the data I collected it shows that polycarbonate, trivex, high index lenses are all 100% UV protective.The only lens that is not 100% UV protective is the control (non-UV protective lens).

In conclusion, according to my data my hypothesis was supported and trivex, polycarbonate, and high index lenses are all 100% UV protective.

Project ID: 686

Junior Division

Engineering: Energy, Materials, and Transport

Eli Hauser

The Children's School

Gr. 8

HydroSurf

The Hydro Surf is a wetsuit with a back pocket that holds a water bladder similar to a Camelback. This allows surfers to lower the potential risk of dehydration when out in the water. The first prototype was made by stitching a neoprene pouch with a plastic zipper to the back right shoulder of the wetsuit. The tube from the water bladder is strung from the back of the shoulder to the front where it could be easily accessed. After testing this method, it was discovered that having the water bladder on one side of the body created instability and also made it harder to paddle due to the lack of mobility in the shoulder. Due to these results, the second prototype was adjusted by relocating the zipper pouch and turning it 90 degrees to lay horizontally across the lower back. The size of the pouch was reduced to fit a smaller water bladder to reduce the weight and possibility of unevenly distributed weight. These adjustments improved the comfortability of the suit from 6/10 to 8/10 points, the effects on surfing from 3/10 to 9/10 points and the water quality from 2/10 to 5/10 points and made the Hydro Surf more successful. To make this project the pouch was glued on the first prototype and sewn on the second. In conclusion, the final design that lay horizontally on the back of the surfer allowed for more comfortability, less effects on surfing, and better water quality leading to less of a risk of dehydration.

Project ID: 687

Junior Division

Engineering: Energy, Materials, and Transport

Maverick Jacka

Mt. Helix Academy

Gr. 8

Hydraulic Elevators

It just about how Hydraulic elevators can be better used for today's society

Project ID: 688

Junior Division

Engineering: Energy, Materials, and Transport

Jackson McGrath
The Children's School
Gr. 8

Energy Saving Roofing Tiles

AWARDS:

American Society of Civil Engineers - Junior Division 1st Place

This project examined the effect that the color of a roofing tile has on the temperature of a house. This study is in the interest of lowering the cost of heating/cooling, which is extremely high in California; therefore, innovations such as these are necessary to lower heating/cooling costs. First, a box was created to model a house, with a wooden exterior and bubble wrap added as insulation. Second, a roofing tile with the dimensions 42cm x 29.5cm x 1cm was created for the experiment, which was white on one side and black on the opposite side. For the experiment, the box was placed into a controlled environment where no light could reach it other than a 120-watt heat lamp to simulate the sun. The results demonstrated that the experiment was a success. The trial with the black side up resulted in consistently hotter temperatures inside the house compared to the control. Normally, the temperature was 0.5°C higher than control when the roofing tiles were black side up versus the opposite. Also, the average temperature was 3.4°C lower than the control when the roofing tiles had the white side up versus the opposite. The average difference in temperature between the black and white roofing tiles was 4.0°C. This is because black color absorbs all wavelengths of light while white reflects them. This absorption versus reflection of light led to higher versus lower temperatures inside the model house when applying the black and white tiles, respective

Project ID: 689

Junior Division

Engineering: Energy, Materials, and Transport

Danielle-Elizabeth Mensah-Baah
Nazareth School
Gr. 7

3D-Printed, Accessible, and High-Quality Shoes to Replace Environmentally-Damaging Alternatives

AWARDS:

American Academy of Pediatrics Climate Change and Health Committee - Honorable Mention
Society of American Military Engineers - San Diego Post - Junior Division 2nd Place

This project examined whether a shoe, made of another material, that is not commonly sold in stores, can be as flexible as a regular store bought shoe. It was hypothesized that a 3D-printed shoe, made of Thermoplastic Polyurethane, or TPU, which can be mass-produced, and environmentally friendly, can still be as high quality, or as flexible as a regular store bought shoe. Trials were set up, where 4 shoes; a Control shoe- 1 left foot and 1 right foot shoe made of leather, and an Independent Variable shoe- that is 100% made of TPU. The shoes underwent a flexing test, by using a flexing tester, or an articulated/motorized leg, and foot to determine their flexibility by bending it to a specific number of degrees of angles: 30°, 45°, 60°, and 75°; by adjusting the eccentricity of the servo. A protractor was also used to measure the deformation of the shoe. After it was placed in its specified degree of angles, these changes were analyzed and recorded in a data log. As a result, the data shows that a 3D-printed shoe was more flexible than a regularly store bought shoe. These results would lead to a better environment, as this shoe is biodegradable, and made of an environmentally friendly material that can be reused.

Project ID: 690

Junior Division

Engineering: Energy, Materials, and Transport

Aviv Nahumzon

San Diego Hebrew Day School

Gr. 8

Resistance of Different Buildings Against an Earthquake

AWARDS:

American Society of Civil Engineers - Junior Division 2nd Place

This project tested the resistance of different building designs against an earthquake simulated on a shake table. Triangle-foundation, triangle-brace, and cross-brace were the buildings tested. It was believed that if building designs were tested on a shake table, then the triangle-shaped building design would be the strongest because it would add more resistance to twisting and swaying motions. However, this was not found to be true. The hypothesis was tested by making a shake table to simulate an earthquake on each building made of popsicle sticks. Fifteen trials were run for each building showing the time it took for each building to collapse. The results were that the triangle-brace building resisted the longest against an earthquake. The triangle brace on average, was 0.47 seconds longer than the cross brace building and lasted on average 1.25 seconds longer than the triangle foundation. The triangle brace building may have lasted longer than the triangle foundation and the cross-bracing building because, on each of the three squares of the building, they were supported better by the corners. On each end, there was a little bit of a popsicle stick sticking out so the squares stacked on top of each other perfectly which made it more stable

Project ID: 691

Junior Division

Engineering: Energy, Materials, and Transport

Jack Pacente
Mt. Helix Academy
Gr. 8

Improving Impact Strength of Polyethylene Terephthalate Glycol (PETG) Through Annealing

AWARDS:

Society of American Military Engineers - San Diego Post - Junior Division 1st Place
CSEF Qualified

This project aimed to improve the impact strength of Polyethylene Terephthalate Glycol through annealing. The hypothesis was that annealing with a soak time of 60 minutes would produce a more structurally stable sample with less deformation than other batches. 50 rocket sleds were printed and placed into 5 batches: Control Batch, Batch 1, Batch 2, Batch 3, and Batch 4. The Control Batch was not annealed at all so that the effects of not annealing could be observed. Batch 1 was annealed at 100℃, with a soak time of 30 minutes. Batch 2 was annealed at 100℃, with a soak time of 60 minutes. Batch 3 was annealed at 100℃, with a soak time of 90 minutes. Batch 4 was annealed at 100℃, with a soak time of 120 minutes. After annealing the samples, they were tested. To test the rocket sleds a D12-7 model rocket motor was used to propel the rocket sled down the cable into a steel plate. To see what the maximum velocity of the rocket sled was, I used Rocksim which is a rocket simulation program. The velocity of my sled during burnout was 210 meters per second. I calculated the force using the estimated velocity, which was 33.6 Newtons. After testing, and gathering the data, the main observation was that the annealed batches were weaker than the control batch. The hypothesis was wrong because Batch 2 was not the strongest of all batches. Batch 2 also had a significant amount of deformation.

Project ID: 692

Junior Division

Engineering: Energy, Materials, and Transport

Jeyanth Narayan Parthasarathy
Pacific Trails Middle School
Gr. 8

Reducing Motion Sickness Caused By Regenerative Braking Systems

AWARDS:

CSEF Qualified
Thermo Fisher Scientific Junior Innovators Challenge Nominee

Purpose of the Investigation: This project results from different regenerative braking methods used in electric cars and their effect on motion sickness. The goal was to find a regenerative braking design that would cause minimal motion sickness by avoiding the 0.1 to 0.5-hertz range.

Engineering Design: Different wheel prototypes, ranging in size and thread style, were created to be used as a regenerative brake. The initial wheel mount prototype and syringe system were flawed, with the mount being fragile and the syringes needing to be stronger.

Testing of Initial Design & Redesign: The efficiency of the brake was measured by the number of vertical oscillations per second it caused. The frequency of vertical oscillations per second was determined by picking a point on the car and using a slow-motion mobile camera to determine visible up-down movement when the regenerative braking system was applied. The durability of the regenerative brakes was also tested, and more robust materials, such as wood, were used to handle higher speeds.

Final Design Success: Smaller tires with aggressive threads caused more vertical oscillations. Meanwhile, more extensive tires with smoother threads tended to cause fewer vertical oscillations. Using tires that are farthest away from the motion sickness range of 0.1 to 0.5 hertz will be the most effective; it is safe to conclude that the small aggressive thread style tire will be the least likely to cause motion sickness, if used as a regenerative brake, as it oscillates higher on average.

Project ID: 693

Junior Division

Engineering: Energy, Materials, and Transport

Chloe Schuh
The Children's School
Gr. 7

Portable Boat Desalination Device

This experiment was to test if it was possible to make a water filter that could hang off the side of a boat. The idea was to test the prototypes on different boats and see how well it worked on them. This project was a success, but it did not work on one boat. To build this you would need all the materials. Assembly of the box was the first part. The next step would be to Velcro the next box. Afterwards would be to drill the holes in the designated spots. Then add the QuenchSea and hooks. After building the prototype the next step would be to test it. The results made it very clear to see how well the device worked on each boat. Overall, the Boston Whaler was the boat it worked best on with a score of 9.3. The C420 had the lowest score of 3. The Boston Whaler had these results because the device fit well on the inside and outside of the boat. The C420 got the lowest results because it was in the way of the rudder. Overall, this experiment was successful, and the device worked on two out of the three boats and the water that the QuenchSea made was drinkable (according to the TDS-3 Water Quality Testing Device used to determine that there was less than 500 PPM in the filtered water). Further research would have shown data on other boats. There would also be a separate water filter invention instead of a QuenchSea.