CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Raka Acharya; Kirti Hargunani; Anjani Patibandla

Project Number

S1101

Project Title

The Effect of Anabaena inaequalis on Salvinia minima to Absorb Crude Oil in Freshwater

Abstract

Objectives/Goals

Although there are existing methods of cleaning up oil spills, many methods of cleaning the spill up, such as chemical dispersants, can harm marine wildlife or leave large amounts of oil in the natural environment. In our project, we attempted to test and improve upon a method to help solve these issues. We decided to use a combination of algae and superoleophilic plants to clean up oil in freshwater. We hypothesized that if we grew Salvinia minima in freshwater with Anabaena inaequalis, then the mass of crude oil absorbed by a S. minima leaf would be greater than the mass absorbed by a S. minima leaf not grown with A. inaequalis.

Methods/Materials

In our experiment, we filled four containers with equal amounts of freshwater medium and S. minima, and then added increasing amounts of A. inaequalis from 0 mL to 6 mL. After letting the containers sit for 48 hours, we poured the same volume of freshwater medium into another container and added 15 mL of crude oil. Using forceps, we removed one leaf from the control, measured its mass, and placed it in the container with oil. After 20 seconds, we removed the leaf from the container and took the mass of the S. minima leaf with the absorbed oil. By subtracting the masses, we figured out how much oil was absorbed. This process was repeated for 6 leaves per container.

Results

Overall, there is a direct relationship between the amount of A. inaequalis grown with the S. minima and the mass of crude oil absorbed by a leaf of S. minima, showing how adding A. inaequalis increases the ability of Salvinia minima to absorb crude oil. There was approximately 0.073 grams of oil absorbed in 20 seconds with 0 mL of Anabaena, 0.086 grams with 2 mL, 0.097 grams with 4 mL, and 0.119 grams with 6 mL. An increase of 1 mL of A. inaequalis-freshwater-medium mixture added to grow with the S. minima increases the mass of crude oil absorbed by the S. minima leaf by around 0.007667 grams.

Conclusions/Discussion

Our results supported our hypothesis because the mass of crude oil absorbed by a leaf of S. minima after 20 seconds was the greatest when the S. minima was grown in 6 mL of A. inaequalis for 48 hours. This is most likely due to the cyanobacteria#s nitrogen-fixing abilities that contribute to the overall health and growth of the Salvinia minima. The results show potential for a quick and effective method of remediation.

Summary Statement

We proved that growing Anabaena inaequalis with Salvinia minima increased S. minima's ability to absorb crude oil in freshwater.

Help Received

We came up and completed the experiment on our own. Our parents and Mr. Pallone, our STEM teacher, checked for accuracy and clarity.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Eric L. Andre, Jr.

Project Number

S1102

Project Title

Building a Cost-Effective Soil-Based Microbial Fuel Cell

Abstract

Objectives/Goals

The objective of this experiment is to test alternative, inexpensive materials to design a cost-effective microbial fuel cell (MFC) that can still produce usable amounts of energy compared to more expensive designs.

Methods/Materials

I built three different MFC prototypes. One was built inside a 1-liter plastic container using pond soil as both the substrate and proton exchange membrane, and a charred, cotton rag embedded with a 22 AWG stranded copper wire for the anode/cathode assembly (Group A). Another design was built in the same way with the exception of using a charred cellulose sponge instead of a cotton rag as the electrodes (Group B). The final design was built in the same way using garden soil as the substrate and proton exchange membrane and a charred, cotton rag as the electrodes (Group C).

Results

The best performing group was Group C, which produced an OCV of 412 mV, a current of 410.6 microA, a power density of 5.62 mW/m^2, a maximum power of 79.3 microW, and had an internal resistance of 470 ohms. Group A produced an OCV of 491 mV, a current of 142 microA, a power density of 1.46 mW/m^2, a maximum power of 20.1 microW, and had an internal resistance of 1000 ohms, and Group B produced an OCV of 356 mV, a current of 87.3 microA, a power density of 1.19 mW/m^2, a maximum power of 16.8 microW, and had an internal resistance of 2200 ohms. An ANOVA with Post-hoc HSD test showed that there was no significant difference in maximum power, current, and power density between MFC Groups A and B, but there was a significant difference between both Groups A and C, and B and C. This showed that Group C MFCs were more effective than both Groups A and B.

Conclusions/Discussion

The total cost of building this MFC was $1.24 using purchased materials or $0.07 using recycled materials. The power:cost ratio indicated that 64.0 microW of power was produced per dollar spent on materials. If all recycled materials were used, 1133 microW of power could have been produced per dollar spent. By combining multiple MFCs of this design in series and parallel, comparable OCVs and power can be generated for a fraction of the cost of producing just one MFC using premium materials.

Summary Statement

I designed and built a microbial fuel using alternative, cheaper materials that can produce a comparable amount of power to those built using premium materials.

Help Received

None. I researched, designed, built, and conducted the experiment myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Dominique Aranda

Project Number
S1103

Project Title
A Test on the Biodegradation of Polystyrene Foam by Mealworms

Abstract

Objectives/Goals
My objective was to test whether polystyrene foam (styrofoam) are able to sustain mealworms as represented by their weight gain or loss, as compared to wheat bran (a common dietary choice). The question I was focusing on was does polystyrene foam allow proper development in mealworms. I hypothesize that the polystyrene foam allows for proper development in a mealworm.

Methods/Materials
275 live giant mealworms, digital balance scale, standard styrofoam plates, and wheat bran. I measured the weight gain and weight loss of each individual mealworm before and after consuming styrofoam or wheat bran during a certain time period.

Results
I compared the weight changes of each food choice to determine a significant change in weight. The results showed that wheat bran and styrofoam were viable choices for the growth and development of the mealworms as both options allowed for significant weight gain.

Conclusions/Discussion
My experiment was able to support the notion to use mealworms to combat the plastic pollution. It showed that the mealworms gained weight both with the consumption of styrofoam and wheat bran.The mealworms were able to sustain themselves consuming styrofoam, as much or even more so than when consuming wheat bran, thus supporting my hypothesis.

Summary Statement
I studied the effects of styrofoam consumption by mealworms and concluded that mealworms are able to survive without issue.

Help Received
My science teacher, Riccardo Magni, assisted me in analyzing my data and how to interpret it.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Srinivas Balagopal

Project Number
S1104

Project Title
Amending Desert Soil to Reverse Desertification

Abstract

Objectives/Goals
This engineering project reverses desertification by constructing a lattice composed of biochar, basalt rock dust, and coconut coir. By reducing wind erosion, maintaining soil temperature, reducing water loss, and improving soil nutrition, this product allows crops to establish themselves in an arid area in a cost-effective and sustainable way.

Methods/Materials
The testing procedures included three experimental trials with and without the lattice. The experiments tested four specific characteristics. Wind erosion was tested by measuring the volume of sand blown downwind using a hairdryer. Moisture retention was tested by exposing sand to a heat lamp and measuring water infiltration, permeability, and evaporation. Soil temperature was tested by exposing sand to a heat lamp and measuring the soil temperatures. Soil nutrition measured the N,P, and K content by using the Rapitest soil kit after infusing degraded soil with the lattice and compared against the control. Plant growth was measured using a tape measure after growing a variety of plants in desert conditions for three weeks with and without the lattice.

Results
The product met the following objectives: the effect of wind erosion was reduced by 91%; water loss was reduced by 50%; topsoil temperature was maintained between 25C and 26.7C; NPK content of the soil increased to surplus; plant growth was maximized, and the per-unit cost of production was about $0.50.

Conclusions/Discussion
The product met the design goals. While the causes of desertification have been well researched, there is no single cost-effective and practical solution. This lattice cohesively combines three different components which reverse the effects of desertification. Coconut coir acts as a wind barrier, provides a moderating influence on temperatures, sponges nine times its own dry weight in water, is pH neutral, and acts as a transport medium. Biochar retains moisture and essential N, P, and K nutrients when pyrolyzed. Basalt rock dust provides essential minerals that are native to igneous rock. By mass-producing this lattice, the current per-unit cost of $0.50 will be dramatically reduced. This single, biodegradable, and easily transportable lattice, protects and revitalizes the soil and retains moisture while enabling farmers to cost-effectively grow sustenance and commercial crops, thus reversing desertification.

Summary Statement
I created a biodegradable and cost-effective lattice that reverses desertification by protecting against wind erosion, maximizing water retention, and increasing soil nutrition, enabling plants to grow.

Help Received
None. I designed, built, and performed the experiments myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Annie C. Benedict

Project Number

S1105

Project Title

Development of a Household Direct-Steam-Generation Solar-Powered Water Recovery System, Year II

Abstract

Objectives/Goals

Access to clean water is a pressing issue worldwide. Large-scale, solar-powered desalination systems are viable but the investment is too costly for developing countries or small cities. In Year I, an initial prototype of a novel multi-stage, solar-powered water recovery system for household use was designed, built, and tested. It used parabolic trough collector technology and evaporation, air flow, recirculation, and condensation stages. The objective this year was to make significant design changes to increase performance, efficiency, and operability, including full sun-tracking automation.

Methods/Materials

Improved insulation and heat concentration were incorporated. Two optimization studies were conducted to increase freshwater output. The first hypothesis was that increasing surface area within the condensation stage would provide greater output. The second hypothesis was that lowering the flow rate of the water, by changing pipe aperture, in the recirculation stage would create more vapor due to longer contact time and thus greater output. The sun-tracking system was automated to allow full range of movement, including return to the origin after sunset. Water quality tests were conducted.

Results

System temperatures were higher by at least 10°-13°C. Increasing surface area in the condensation stage yielded lower output, while reducing recirculation flow yielded greater output. Automation resulted in full-sun tracking to maximize sun exposure and improved operability. Freshwater output increased 60%, and prototype efficiency from 15% to 20%. Differences in output between years and within Year II were statistically significant. Through microbial and dissolved solid tests, water was proven safe for human consumption.

Conclusions/Discussion

Improved insulation and heat concentration yielded better system performance. The hypothesis of the surface area study was disproved, validating the prior design. The flow study hypothesis was supported; lowering the recirculation flow produced more vapor available for condensation. Full automation of the sun-tracking rotation mechanism improved performance and operability. The prototype currently produces 1.7 liters of fresh water per day. Further refinements and scale-up will provide enough drinking water for household use while minimizing climate change by using solar energy. Mass production could enable this system to be in households in many parts of the world.

Summary Statement

This Year II project is the modification and optimization testing to increase performance, efficiency, and operability of a novel, low-cost, multi-stage, solar-powered water recovery system for household use.

Help Received

Father provided support in system construction. My research advisor, Mr. Peter Starodub, provided guidance throughout the process.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Karina Bjazevic

Project Number

S1106

Project Title

Bio-Accumulation of Oil by Aurelia aurita Mucus

Abstract

Objectives/Goals

This project was designed in order to determine the ability of Aurelia aurita mucus to bioaccumulate different types of oils. The project stemmed from another study that determined Aurelia aurita mucus has the ability to bioaccumulate nanoparticles resulting in a clean supernatant.

Methods/Materials

Aurelia aurita mucus was harvested utilizing Cabrillo Marine Aquarium#s procedure for collecting mesoglea. Mucus was combined with phenolic microballoons and different concentrations of sesame and motor oil. The phenolic microballoons were used as a positive control to confirm A. aurita mucus had the ability to bioaccumulate. Sesame oil was tested at 100%, 50%, and 25% concentration. Motor oil was tested at 50% and 25% concentration. The supernatant of each treatment was analyzed using a scanning spectrophotometer test.

Results

The data collected exhibited a trend of decreased absorbance at 25% and 50% concentrations of sesame and motor oil when compared to the original absorbance of the oils alone at above concentrations. Sesame oil at 100% concentration combined with mucus had an increase in absorbance in comparison to the absorbance the sesame oil alone.

Conclusions/Discussion

My null hypothesis was rejected as a result of the decreased absorbance levels when the mucus was added to the oils at certain concentrations. The decrease in absorbance of the supernatants of the oils indicates that the mucus results in a clean supernatant. The knowledge gained from this project could provide a more natural solution to oil spills if Aurelia aurita mucus is synthetically developed.

Summary Statement

I discovered that Aurelia aurita mucus has the ability to bio-accumulate oils at certain concentrations, resulting in a clean supernatant.

Help Received

I designed and performed the experiment myself. I received help from Milinda Thompson and used equipment from Cabrillo Marine Aquarium.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Poppy Brittingham; Emma Freedman

Project Number

S1107

Project Title

Paperfuture: Engineering an Enzymatic Process for Paper Waste Management

Abstract

Objectives/Goals

Paper makes up 27% of municipal solid waste in the United States. Paper towels specifically are difficult to recycle, with 55% of all paper towels ending up in landfills. Paper, a cellulosic waste, is a potential energy source. This study aims to engineer an alternative solution to paper towel disposal, in the form of an enzymatic process using CTec2 (Novozymes), to divert paper towels and produce energy by means of a microbial fuel cell or ethanol.

Methods/Materials

Twenty three paper towel saccharification scenarios were tested in triplicate, with varying buffer types, temperatures, solution ratios, agitation frequencies, pretreatment methods, duration of incubation, and sample sizes. Sugar concentration (brix), pH, and appearance were recorded periodically. Success of each scenario was determined through increase in brix and visual degradation. An incubation and agitation appliance prototype was engineered as a possible commercial application for this digestion. Ethanol was produced through fermentation.

Results

Optimal digestion environment is at an approximate pH of 5.4 and temperature of 50 degrees C. Enzyme concentrations as low as 0.25% and agitation intervals as long as 2.5 hours were effective. Moreover, pretreatment with 0.1 molar sulfuric acid neutralization with chalk increases sugar production. A 56k ohm resistor optimizes power in the microbial fuel cell (MFC). When using the resistor, a mediator, and an electron acceptor, power output increased approximately 16 times. Ethanol can be produced using the sugar resulting from digestion.

Conclusions/Discussion

Ethanol and voltage from the MFC can be generated using the digested paper towel solutions. Furthermore, the use of carbon fiber brush electrodes increases voltage. The incubator prototype was tested successfully. To make this process competitive with other paper towel disposal methods, like composting or landfilling, efficiency must be further optimized by using lower concentrations of enzyme, and designing efficiency improvements for pretreatment and energy production.

Summary Statement

We engineered an enzymatic process as an alternative solution to paper towel disposal to divert paper towels from the waste stream and produce energy.

Help Received

Dr. David Bernick, UCSC, advised the project through weekly meetings. Kurt Meyer helped with constructing the incubator prototype. Heather Grant assisted with acid dilutions.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Kimy Alexi Buere; Sierra Franco; Kavish Loomba

Project Number

S1108

Project Title

Decontamination of Polluted H20 by Photocatalysis for Undeveloped Countries

Abstract

Objectives/Goals

The goal of our research was to develop a sustainable and economically viable device for water purification. Our innovative methodology integrates filtration with an enhanced photocatalytic process. We created spheres that helps purify the polluted water using Zinc Oxide, Portland cement, titanium dioxide (TiO2) and 3m glass bubbles . The ratio of ZnO:TiO2:3m glass bubbles: cement: was 1: 4: 25:100 by weight.

Methods/Materials

First build the frame by drilling the 23 and 24 inch SPF common BRD together to form a rectangle. Then take the 17 and 15 inch 1X3 white wood and create a stand by drilling the 17 inch piece vertically to the top right of the frame and the 15 piece horizontally connecting the bottom to the bottom corner of the frame. Repeat for other side. Drill the 4 reflectors 2.75 inches away from each other starting from the end of the top of the wooden frame. Attach the 4 inch PVC pipes into the corner PVC pieces (two corner pieces should not have a 4 inch pipe in them). Insert the corner pieces into the braided vinyl, putting the one corner pieces into the first and last braided vinyl. Put the first braided vinyl in the middle of the first reflector and drill the washers over it on the side of the frame. Repeat this 4 times on each side. Attach the shut off valve to the last corner PVC piece.

Results

The results collected in Experiment #1 indicated that.. 1.) Reduced the amount of E.coli colonies below EPA limits. 2.) Prevented the regrowth of bacteria unlike current SODIS methods. 3.) Did not wash off after several uses. 4.) The hypothesis was supported

Conclusions/Discussion

In conclusion, we have successfully introduced a design for a portable water purification unit that only relies on (photocatalysis) to achieve its goals. In the future we would like to investigate the inactivation of different types of pathogens (including protozoa and viruses); ii) study the feasibility of degrading different types of organics and pesticides; ii) study the feasibility of removing heavy metals and other inorganic water pollutants; and iv)characterize the size and its distribution; and v) evaluate the safety and performance of the composite filters over time.

Summary Statement

Decontaminating polluted water using photocatalysis for undeveloped countries.

Help Received

My parents helped us design the device but over all my group mates and I did the whole project.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Aurnov Chattopadhyay

Project Number

S1109

Project Title

Efficient Removal of Pb2+, Cd2+, and UO2+ from Water through Sustainable Nanocellulose Coagulants Derived from Biomass

Abstract

Objectives/Goals

Heavy metal pollution is a pressing global environmental threat and public health concern, responsible for several hundred thousand deaths annually. However, current methods to remove heavy metals are inefficient, too expensive for impacted regions, and produce harmful byproducts. This research sought to identify the application of one step modification, a new process to synthesized anionic cellulose nanofibers, to address the global demand for heavy metal remediation.

Methods/Materials

Raw biomass, jute fibers and spinifex grass, were treated with HNO2 and NaNO3 through a one-step modification to inexpensively and directly produce oxidized nanocellulose. The adsorption capacity of the nanofibers was analyzed through batch remediation studies measured using UV - visible Spectroscopy and ICP # ms (Inductively Coupled Plasma Mass Spectroscopy). Characterization of nanofiber mediated removal of metals was analyzed using FITR (Fourier Transform Infrared Spectroscopy) and SEM (Scanning Electron Microscopy).

Results

The anionic nanofibers coordinated with cationic metals form visible flocs which can be removed using a simple 1.0-micron filter. SEM characterization of the flocs confirmed the coordination of metals on the nanofiber surface indicating the precipitation of heavy metals following nucleation. FTIR characterization of the flocs indicated shifts in chemical groups corresponding to metal cations binding to carboxyl groups. Batch removal experiments, measured with ICP # MS and analyzed using Langmuir isotherm models, assess jute nanofiber#s Pb2+ removal capacity as 2,270 mg/g and spinifex nanofiber#s Cd2+ removal capacity as 2,550 mg/g.

Conclusions/Discussion

The nanofibers are the most effective adsorbent of Cd2+ and Pb2+ reported to date, 15% more efficient than the most effective Pb adsorbent and 70% more efficient than the most effect Cd adsorbent. The nanofibers perform optimally at neutral pH, are recyclable, and cost effective enabling widespread use in impacted regions of developing countries.

Based on this work, I am coauthoring three papers for publication in scientific journals. My research has also been incorporated into a patent. Further studies based on my work are being conducted by graduate students, and the Hsiao Lab hopes to translate this research towards commercialization in several years.

Summary Statement

I identified the novel heavy metal remediation application of inexpensive, efficient, and green carboxy cellulose coagulants by characterizing and quantifying the agent's capacity to promptly remove lead, cadmium, and uranium from water.

Help Received

I designed, performed, and analyzed most of the research independently, receiving technical assistance with advanced characterization techniques and guidance in organization of my research plans.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Emily O. Htway

Project Number
S1111

Project Title
Microbial Biodegredation of Used Motor Oil on Concrete Surfaces

Abstract

Objectives/Goals
The objective of my project was to investigate the ability of Pseudomonas aeruginosa to biodegrade used motor oil on concrete surfaces.

Methods/Materials
Used motor oil was collected from the Conejo 76 union station on T.O. Blvd and analyzed for composition using infrared spectroscopy. Pseudomonas aeruginosa, cultured in tryptic soy broth, and used oil dried on six 6x6 inch concrete pavers were used for a pilot study. 128 concrete pavers with dried used motor oil, as well as Pseudomonas aeruginosa culture, were used in the experimental phase (independent samples t-test). Modified EPA Method 1664, Revision A used to quantify oil and grease content in simulated rainwater runoff samples.

Results
The mean PPM of oil and grease content in water for the Control [No Exposure to P. aeruginosa] samples [M = 205.36, SD = 168.75, n = 49] was higher than that for the Cases [48 hrs. Exposure to P. aeruginosa] samples [M = 201.90, SD = 160.64, n = 42]. Due to humidity error, 39 samples were lost and results are not statistically significant, however, the use of P. aeruginosa did show a positive result.

Conclusions/Discussion
P. aeruginosa has shown to have positive environmental implications for removal of unwanted automobile fluids. The small difference detected in the oil and grease in the water runoff will be amplified in a major metropolitan setting. Additionally, the visual oil stain and residue was lessened in the days following P. aeruginosa exposure. These findings may be of significant interest to environmental scientists.

Summary Statement
I investigated the ability of Pseudomonas aeruginosa to biodegrade used motor oil on concrete surfaces.

Help Received
I designed the project myself, my instructor helped me with editing my manuscript, my lead mentor oversaw my lab work and helped me with biostatistics, and lab technicians helped me in cell culture and chemistry equipment, including IR.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Lucas O. Huang

Project Number

S1112

Project Title

Blue Energy: A Novel Miniature Osmotic Power System Based on Pressure between Differing Water Salinities

Abstract

Objectives/Goals

In modern times, the demand for more environmentally-friendly and clean energy is booming around the world. Besides wind, solar, and nuclear power, there is a developing source of energy generation that has not been fully explored, namely osmotic power. Osmotic pressure between freshwater and saltwater or brine solution can be harnessed for electricity. The goal of my project was to build a functional osmotic power generation system and test its efficacy in enabling water flux, generating power, and creating electric potential.

Methods/Materials

A novel cylindrical apparatus was brainstormed and designed using a commercial semipermeable membrane made of thin-film composite (TFC) material, affixed with Gorilla glue and tape, and cut off bottoms of water jugs. Equal volume of water was set on both sides of the membrane, with salt dissolved inside the apparatus to facilitate pressure-retarded osmosis (PRO). A multimeter was wired to a micro-hydroelectric generator in order to test efficiency of generating power and voltage.

Results

The efficiency of the membrane apparatus was measured by modifying water salinity. I observed that an increase in concentration of salt was positively correlated with voltage generated and power density. I also found that salt concentration was negatively correlated with time taken to raise the volume of the saltwater solution.

Conclusions/Discussion

In this project, a miniature novel osmotic power system was successfully built. The system's functional efficacy in generating power and electric potential has been demonstrated. Relationships between salt concentration and voltage or power density appear to grow logarithmically. Based on my results, I suggest that ratios established by power density between power production and membrane surface area can be used to model trends of osmotic power productivity scaling with size. Osmotic power could provide a vital emergency power source in case of emergency, e.g. with potential applications in submarines or households, to light LED bulbs and charge mobile devices.

Summary Statement

A miniature osmotic power system based on a thin-film composite membrane apparatus was individually built, and tested for efficiency and power production.

Help Received

This project was conducted independently. All research, experimental design, and tests had been performed by myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Jackson J. Humphrey

Project Number
S1113

Project Title
Effects of YO12N Exposure on Chlorella vulgaris and Daphnia magna

Abstract

Objectives/Goals
The purpose of this study was to see if YO12N can be used in reducing impacts from eutrophication.Eutrophication is the process by which a body of water becomes rich in dissolved nutrients from fertilizers or sewage.

Methods/Materials
To conduct this study the Chlorella vulgaris and Daphnia magna were divided into 15 specimen each and then exposed to the YO12N solution. The control group was not exposed to the YO12N solution. The YO12N solution was made by combining distilled water to a % solution then added to the test subjects. The solution added was a 0.50%, 1.00%, and 2.00% of YO12N. A spectrophotometer was used to assess the Chlorella vulgaris, readings were recorded every 2 days for 15 days. The Daphnia magna were exposed to the YO12N solutions, then mortality was observed and recorded for 48 hours.

Results
The Chlorella vulgaris results were: The control had a 90.1%, the 0.50% YO12N a 91.5%, the 1.00% YO12N a 92.3%, and the 2.00% YO12N a 92.5% light transmittance rate.
The Daphnia magna results were: The control had 43.3%, the 0.50% YO12N a 50%, the 1.00% YO12N a 61.7%, and the 2.00% YO12N a 100% mortality rate.

Conclusions/Discussion
Per my results, my hypothesis was correct.It stated that when compared to the control, the 2% YO12N solution test group would have the least amount of Chlorella growth, and the .5% YO12N solution test group would have the lowest Daphnia mortality rate, when compared to the control.
The goal of this study was to find a treatment that simply reduces algal growth to limit eutrophication impacts on fresh water sources with little or no harm to the aquatic life. Using a commercial product for remediation, such as Dawn Dish Soap# used to clean oil-spill covered fowl, has been done in the past with much success.

Summary Statement
With our need for food increasing and our clean water supplies decreasing, pursuing a study of YO12N as a remediation application for eutrophic impacted sites shows promise.

Help Received
Mr. Aalto trained me to use the spectrophotometer and helped me with my data analysis.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Isabella U. Hurvitz

Project Number
S1114

Project Title
How Can Adsorbent Materials Be Utilized for Pesticide Elimination?

Abstract

Objectives/Goals
The objective of the project was to evaluate how well activated carbon, graphene oxide, and Mag-PCMAs serve to adsorb pesticide contaminants, in order to ascertain the potential of using the materials to remove pesticide agents from agricultural runoff and contaminated surface water.

Methods/Materials
The experiment tested the efficiencies of the selected adsorbents against 14 unique pesticide agents. The initial pesticide concentration was varied 4 times, and each sample had a constant 10 mg of the adsorbent material added. Two duplicates were created for each solution, and each initial concentration had a sample labeled as control with no added adsorbent. After mixing, the final concentrations were measured using a Liquid Chromatography-Mass Spectrometer. The removal efficiencies of each adsorbent at the different initial concentrations were found, by comparing the sample to the tested controls, then these removal efficiencies were averaged and the results were analyzed.

Results
The data demonstrates that all three additives had an effect on the pesticide agents which caused a reduction of the pesticide content, and therefore supports that they are all particles with adsorbent properties. On average all 3 adsorbents were able to reduce at least 15% of the pesticide content of the solution, however, the large std. deviations of the graphene oxide and the Mag-PCMA indicate that the efficiencies were not consistent for these adsorbents, meaning that some of the pesticide were more resistant than others. The granular activated carbon had consistently high removal efficiencies with lower standard deviations, indicating that the activated carbon was highly efficient on the majority of pesticides with less variation, compared to the other adsorbent materials.

Conclusions/Discussion
Overall, it was found that the activated carbon was the most efficient adsorbent particle of the majority of pesticide agents. Future steps that could be taken to improve this research would be to expand the range of adsorbent materials to a broader comparison of carbon based adsorbent particles, and include analysis of the removal efficiencies under varying physical and chemical conditions. The ultimate implications of the investigation would involve engineering a system containing the adsorbent particles, specifically the activated carbon, to allow for the adsorbent particles to remove pesticide content directly from the environment.

Summary Statement
The objective was to evaluate how well activated carbon, graphene oxide, and Mag-PCMAs serve to adsorb pesticides, in order to ascertain the potential of using the materials to remove pesticide agents from contaminated water.

Help Received
My mentor for this project is Dr. Arturo Keller, a professor of biogeochemistry at the UCSB Bren School of Environmental Science. Dr. Keller has contributed by allowing me access to his lab and equipment, as well as, answering my supplemental questions.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Suzanna S. Kussman

Project Number
S1115

Project Title
Holding It All Together: A Study of How Efficient Plants Are at Decreasing Soil Erosion

Abstract

Objectives/Goals
The goal of this study was to provide greater insight in terms of which aspects are most capable of reducing soil erosion utilizing a natural, practical method such as planting vegetation. Once research of plausible benefits of vegetation as well as various issues continuing to arise due to erosion was performed, it was hypothesized that: if dark star zucchini, catnip, cherry radishes, and rye grass are planted on slopes, then these slopes will exhibit less water erosion than a comparable hillside that is unvegetated.

Methods/Materials
10 trays total, 2 for each plant type, 2 for bare soil (control), sun-lit environment for sprout growth, watering can with spout allowing full area coverage as if it were rainfall, scissors to create an opening for soil to erode from, protractor to form a 55° angled slope, stopwatch to end pouring after 10 seconds, strainer to measure runoff, measuring cup and scale to weigh eroded soil, ruler to find root length. Measured whether vegetated slopes decreased water erosion during the trials and if so, by how much. Two trials performed with 14 days inbetween to understand if time impacted erosion levels.

Results
When observing the amount of soil eroded in grams, percent of soil eroded, average root length in millimeters, runoff levels in cups, and total differences between the slopes with and without sprouts overall, it was apparent that the vegetated slopes eroded significantly less soil. Each aspect improved for the sprouts between the 14 days, while the bare soil only worsened with time.

Conclusions/Discussion
Overall, the experiment's data supported the hypothesis as the vegetated slopes decreased soil erosion by almost 90% compared to solely soil, and continued to reduce it given more time. The catnip and cherry radishes were especially successful as they eroded only 10 g in trial 2 compared to 40 g in trial 1, perhaps due to the ability to effectively shield the soil, absorb the most water, and because the root systems became increasingly complex and stable. Runoff levels for the slopes with sprouts also improved as the growing plants required more water over time, while the control slope weakened as it could contain less. From this project's outcomes one can recognize that planting even a simple ground cover such as catnip is preferable to bare, vulnerable soil that can be easily displaced in mere moments to further contaminate important waterways or even entire ecosystems.

Summary Statement
It was observed that the average individual is capable of aiding the environment by combatting the serious issue of erosion using a natural and feasible method of planting vegetation, rather than solely expensive, extravagant practices.

Help Received
I designed the project myself once researching water erosion on slopes & growth methods; my Anatomy and AP Physics teachers reviewed my results.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Ritika Parvatikar; Isha Saldhi

Project Number
S1116

Project Title
Bioplastic: Which Food Waste Produces the Best Bioplastic?

Abstract

Objectives/Goals
The objective of this study is to create an alternative for plastic that holds the same properties such as flexibility and tensile strength, but is much better for the sustainability of our environment.

Methods/Materials
Banana peels
Potato peels
Coffee grounds
Orange peels
Cinnamon
Vinegar
Honey
Thyme leaves
Water
Pan
Plastic container
2 spoons
Measure cup (milligram)
Blender
Filter
Stove
Oven
Baking sheets
Steel tray
CO_2 Emission Tester
Laptop
10-500g weights
Protractor
Milligram Balance

Results
The potato peel bioplastic was the best bioplastic as it passed the flexibility, buoyancy, and strength test. It also released the least amount of carbon dioxide at only -65 ppm. This result was surprising as orange

Summary Statement
Bioplastics are plastics that are made from carbon and renewable resources, which are a better alternative to current plastic. Current plastic contributes to mass amounts of drilling and hazardous activities that could be harmful to our bio

Help Received
Mr. Lancaster helped us gather materials needed for experiments and testing, and taught us how to use the equipment.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Anokhi Patel; Saloni Patel

Project Number

S1117

Project Title

Follow the Green Brick Road: Developing Viable Polystyrene Infused Bricks with Heightened Insulation Capabilities

Abstract

Objectives/Goals

This project sought to answer the question of whether or not plastic pollution could be reduced by integrating polystyrene into bricks while maintaining structural stability and heightening insulation capabilities. The objective was to create bricks with these properties and an effective chamber to test the insulation properties of them.

Methods/Materials

The polystyrene (styrofoam) blocks that would be integrated into the concrete bricks were created by condensing polystyrene in acetone (releasing the trapped air) and pouring the viscous polystyrene into molds in time spaced layers with a lengthy drying process. These blocks were made in heights of 1.5 cm, 3 cm, and 4 cm. Subsequently, concrete bricks were made with the polystyrene blocks in the middle. The insulation chamber was made with a styrofoam cooling box, aluminum ducting insulation, aluminum tape, and a reptile heating lamp, among other materials. The chamber had two air-tight compartments separated by a wall with a space to insert a brick. There were thermometers in both compartments to test the amount of heat that transferred through the brick over time. Strength testing was done with a concrete testing machine and pressure was applied until the bricks reached failure.

Results

The results showed that we had accomplished our objectives. The insulation chamber proved effective and the average chamber compartment temperature disparity was 6 degrees celsius higher in the polystyrene infused bricks than the solid concrete controls. Every brick supported pressures that were thousands of pounds above the 4000 psi industry standard for concrete bricks. This means that polystyrene infused bricks are structurally viable and have heightened insulation properties.

Conclusions/Discussion

These findings are significant because they open up the possibility of integrating condensed polystyrene into building materials. The heightened insulation properties mean buildings would be using less electricity for heating and cooling which is not only financially responsible but environmentally responsible. Implementation of this concept would mean a large-scale reduction of styrofoam waste.

Summary Statement

We created a structurally viable, condensed polystyrene infused concrete brick with heightened insulation properties and an effective chamber to test those properties.

Help Received

Dr. Panahandeh, an engineering professor at Diablo Valley Community College, allowed us to use his concrete testing machine and advised us on the testing process.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Kaitlyn A. Russo

Project Number
S1118

Project Title
The Remediation of Water Loss in a Vertical Garden

Abstract

Objectives/Goals
When using vertical gardens, there always seemed to be one problem, they don't hold moisture very well.The purpose of this experiment was to find an effective and efficient way to keep moisture in the soil for a
longer period of time.

Methods/Materials
For this experiment, I set five vertical gardens, each with a different method to hold moisture in the soil. One with mulch, second with clear plastic sheeting, third with water crystals, fourth was the control and fifth with sponges. Then the gardens were watered and moisture levels were taken for two weeks. Then a second experiment was performed with using six vertical gardens. One with a clear plastic sheet, the second with water crystals, the third with a mycorrhizal fungus, the fourth with water crystals and a clear plastic tarp, fifth with water crystals and mycorrhiza; fungus, and the sixth was the control. After set up, the gardens were watered and moisture levels were measured for two weeks.

Results
After the completing experiment, I found that my hypothesis that the clear plastic sheeting would help the most, wasn't supported and the water crystals actually helped retain moisture the most.

Conclusions/Discussion
Vertical Gardens today are becoming more useful because we are running out of room on earth to have big plots of land. This was a helpful experiment because it shows effective ways to keep moisture in the soil and help the plants. Because of the vertical gardens lack of depth, the soil is not deep enough to hold moisture, methods like using water store crystals help keep the soil moist for a longer period of time

Summary Statement
As measured through 5 different methods, the most effect way to keep soil in a vertical garden moist for a longer period of time is the water storing crystals.

Help Received
The vertical gardens I used came from a grant given to my school Clovis High and I conducted my experiment at Clovis High with the help from my science fair adviser Carolyn Mendonca.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Vedha Santhosh

Project Number
S1119

Project Title
The Effect of Using Biodegradable Coagulants on Domestic Wastewater Treatment to Promote Water Conservation

Abstract

Objectives/Goals
The objective of my study was to determine the optimal biodegradable coagulant and the optimum pH for clarification and repurposing of graywater for domestic irrigation.

Methods/Materials
-Household Graywater
-Aluminum Sulfate (Alum)
-Corn Starch
-Tapioca Starch
-Corn Maltodextrin
-Tapioca Maltodextrin
-Total Dissolved Solids Meter
-pH Meter
-Pea Plants
I use coagulation (removal of colloidal substances from water) to determine the optimal biodegradable coagulant and pH for repurposing of graywater. Coagulation is widely used to treat industrial/domestic graywater to remove suspended particles from water. My method tests effectiveness of biodegradable coagulants against the industrial coagulant, aluminum sulfate (alum). Untreated graywater and tap water are controls. Treated graywater solutions are used to water pea plants (sensitive to pH) and optimal coagulant is determined based on plant height and health.

Results
Tapioca starch and tapioca maltodextrin were the best biodegradable coagulants. The pea plants watered with graywater treated with tapioca starch and tapioca maltodextrin grew the most (21 cm and 18.5 cm over 1 month respectively) and were the healthiest (strong stalks, no breakages) while the plants watered with alum-treated graywater grew the shortest (6.16 cm over 1 month).

Conclusions/Discussion
Biodegradable coagulants were the most effective in repurposing graywater for sustainable irrigation of plants. Alum, the leading industrial coagulant, is expensive. Alum-treated water seems clean - however, I proved that this alum-treated water isn't healthy to plants. Untreated graywater kills essential microbes in soil, preventing nutrient cycling and harming soil, which inhibits growth and reduces yield.

Summary Statement
Long term drought management can be achieved by repurposing graywater through coagulation using the optimal biodegradable coagulants, tapioca starch and tapioca maltodextrin, as opposed to the currently used industrial option, alum.

Help Received
My project was conducted entirely at my home without any assistance from teachers, institutions, or any other facilities.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Jose Shen Santos

Project Number
S1120

Project Title
Physical Presences in Soil and Their Effects on Soil Erosion

Abstract

Objectives/Goals
The objective of this science experiment is to show how the contents in soil are in relation to water erosion inflicted upon the soil.

Methods/Materials
Soda Bottles, plants, dirt, barks and rocks, a cup measuring to 16 fluid ounces, coffee filter, small container, and a scale. Pour 16 fl oz into each of the soda bottles, measure the remaining dirt that would appear on top of the coffee filter. Compared the weight of the dirt with each test subject.

Results
The containers that lacked either an adequate surface protection for the soil or had no intricate root system within the soil were the most affected in water erosion. The container that had both was the least affected from soil erosion.

Conclusions/Discussion
Soil erosion is mainly dependent on two factors that are present within the soil that is not the soil itself. Erosion is affected by how much the top of the soil is covered and if there is an intricate system of roots within the soil to keep the soil compact. It is also alright to have one or the other, but if there is both factors present, then there will be little to no affect from soil erosion.

Summary Statement
I made an example of how the content in soil can either protect or encourage water erosion that can take place upon the soil.

Help Received
My science teacher helped me with this project, but I did most of the work designing and executing this scientific environmental activity.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Savhanna L. Silva-Hicks

Project Number

S1121

Project Title

Surviving Disaster: Purifying Contaminated Water Using Only Junk and Debris in the Aftermath

Abstract

Objectives/Goals

The objective of this project is to save lives in the aftermath of disaster by building a water filter using junk & debris that produces safe water for varied family sizes. Central Valley residents are spread out far more than a dense, metropolitan area thereby presenting a challenge for emergency services to locate them. The body can go 3 days without water and less, if subjected to sweltering Valley temperatures. FEMA's average response time is 3-4 days.

Methods/Materials

Materials were scavenged from the surrounding area consisting of 5.5 miles. Prototypes were designed and built from materials that would be available following disaster. Wood was collected and burned to make charcoal. An Egyptian well was constructed to pre-filter river water. Contamination levels were tested with an EPA approved test kit. It was hypothesized that the filter with the cleanest water would produce the least amount of liters per hour.(LPH)

Results

Round One testing rejects the hypothesis because all prototypes tested positive for bacteria. Design adjustments aimed to improve filtering and flow rate. Each Round Two filter was flushed with one liter of pure rain water. It was poured back through each filter 3 days in a row. The Egyptian well was left to fill overnight so the sediment could settle. After Round Two samples were collected, one model was boiled at 100 Degrees Celsius. This model produced the least amount of LPH and tested safe for drinking with a flow rate capable of supplying 1-4 people per day. Therefore, the hypothesis is accepted for Round Two.

Conclusions/Discussion

The goal of purifying safe water was fulfilled by the filter that produced the least amount of LPH. One filter could sustain a family of 4 until assistance arrives. However, multiple filters, or a scaling up of this model would be necessary for larger families. While this filter could save lives, further research & testing is paramount regarding the varying environmental factors that could alter results in different circumstances. These include the heavy rainfall between testing rounds, the area being crop dusted right before the disaster, the presence of algae in summer months and the possibility of animals inhabiting the water upstream from the collection site. If these factors can be eliminated through further testing, the model will, in fact, save the lives of families in the aftermath of a disaster.

Summary Statement

This project aimed to design, build and test a water purification system using only junk & debris found in the aftermath of a natural disaster thereby possibly saving the lives of Valley Families.

Help Received

Earned money for test kits by babysitting. Charcoal was burned at a friend's ranch. Nathan Olson, Lemoore Public Works Director & his son explained how to figure LPH. Grandmother paid for board materials. God, because without Him, I'm nothing.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Isabel W. Sperandio

Project Number

S1122

Project Title

A New Solar Panel Design: Producing Electricity Day and Night Using Photovoltaic, Seebeck, and Thermal Elements

Abstract

Objectives/Goals

Over the past 3 years, I have conducted 3 experiments to improve the efficiency of photovoltaic cells, and I realized that they have 3 major flaws: they do not generate electricity at night, get less efficient as they heat up, and do not use thermal energy. Instead of trying different methods to prevent these problems, this year, I am trying to use these problems to my advantage.

Methods/Materials

I constructed a three layer device with a photovoltaic cell on top, Seebeck elements in the middle, and a water tank with a small pump on the bottom.

1.At daytime, the sun heats up the photovoltaic cell, and cold water runs through the tank, creating a temperature gradient for the Seebeck elements to generate electricity.

2.The cold water in the tank also helps to cool down the photovoltaic cell, making it more efficient.

3.Throughout the day, the water then goes through a solar water heater, and the hot water is then stored in an insulated tank.

4.At night, the photovoltaic cell cools down, and the hot water made during the day will be pumped back through the tank, creating an inverse temperature gradient for the Seebeck elements to generate electricity.

I tested my device using a Vernier Stream analog to digital converter. I took measurements every 30 seconds for multiple 24 hour blocks using Logger Lite on my computer.

Results

At 12-3 PM in the beginning, the Seebeck elements steadily produced 10-12 milliwatts, because of the temperature gradient between the hot solar panel and the cold water. By 4 PM it dropped to 4 milliwatts. At night (8 PM- 8 AM), it produced 0.5-4 milliwatts because of the opposite temperature gradient. In the morning (10 AM-2PM), it produced 7.5-11 milliwatts.

Conclusions/Discussion

My prototype succeeded in my overall goal of using three major limitations of a photovoltaic cell to my advantage: decreasing efficiency due to heating up, lack of energy during the nighttime, and not using thermal energy. My new solar panel design generated electricity both during the day and night because it used visible light in the day, and stored thermal energy in the day, releasing the thermal energy during the night and generate electricity. This could have a big impact because solar panels are getting more popular and are a good way to produce electricity without harming the environment, and improving them would help many people.

Summary Statement

I designed a three component solar panel consisting of photovoltaic, Seebeck, and thermal elements, that generates electricity both day and night using visible light and thermal energy.

Help Received

My industrial tech teacher Mr. Booth at JLS (my former middle school) let me use his machine shop and taught me soldering and brazing techniques to build my water tank. My Dad helped with safety, getting materials, and advised me when I ran into problems.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Alexandra N. Vizents

Project Number
S1123

Project Title
Can a Natural Filter Maintain Stable and Safe Water Chemistry Levels for a Salt Water Aquarium?

Abstract

Objectives/Goals
This project was conducted to determine if a homemade, non-commercial, sump/refugium style filter system could effectively maintain safe water chemistry levels for marine fish. As well, one goal was to create an organic filter that would provide a natural way to maintain water chemistry levels, reducing the negative impact of the production of the filter on the environment, and mimicking more natural systems of filtration for the benefit of the health of the fish.

Methods/Materials
Two 55 gallon acrylic tanks held in a wooden frame were used in this project. The top tank housed up to a dozen reef fish with a sand substrate, and the bottom tank served as the filter. Filter media was completely organic, containing rocks, sand, mud, gravel, and mangrove plants. 12 fish (Chrysiptera cyanea and Pterapogon kauderni) were added and integrated into the top tank. Water chemistry levels were monitored weekly for 101 days using the API Saltwater Aquarium Master Test Kit, testing Ammonia (ppm), Nitrites (ppm), Nitrates (ppm), Salinity (ppt), Temperature (C), and pH.

Results
Over the course of four months water chemistry was monitored. pH, salinity, and temperature were consistent for the duration of the experiment (pH 8.2, salinity 32.3 ppt, and temperature at 27.8 degrees Celsius). Ammonia levels were reduced from 0.25 ppm at the beginning of the experiment to 0.00 ppm, nitrites reduced from 5 ppm to 0.00 ppm, and nitrates reduced from 60 ppm to 5 ppm. Once the filter was properly established no fish died, and all showed normal healthy signs and regular eating habits. No diseases emerged although algae growth was noted which did not harm the fish or impact water chemistry.

Conclusions/Discussion
The filter was able to maintain water chemistry levels in which no fish died and all fish remained healthy. My hypothesis that the organic filter could maintain safe water chemistry levels was strongly supported by the results. I conclude that an organic filter is a viable alternative for a commercial bought filtration system for a salt water tank of 55-gallons housing 12 marine fish.

Summary Statement
I created a filter made of completely organic and natural components that effectively controlled and stabilized water chemistry levels of ammonia, nitrites, nitrates, and pH, for a 55-gallon salt water tank housing twelve reef fish.

Help Received
I designed and performed the experiment myself, but got help from my teacher in building the wooden structure that held my two tanks.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Anthony Y. Zhou

Project Number

S1125

Project Title

Development of a Non-Tracking Solar Thermal Concentrator Using the Simultaneous Multi-Surface Design Method

Abstract

Objectives/Goals

The main issue associated with solar power is its high costs, caused by the expensive tracking systems required for solar energy systems to remain efficient. Furthermore, current solar concentrators have been shown to be intrinsically flawed, resulting in huge opportunities to improve on current technology by developing an intelligent non-tracking concentrator that can accept indirect sunlight while offering higher levels of energy efficiency.

Methods/Materials

An efficient, novel, non-tracking design is created using principles of optics and the Simultaneous Multi-Surface (SMS) Design Method. The design method is applied to create a point-by-point calculation of two surfaces that redirect light from varying angles to an absorber. Information gained from the design of one surface facilitates the design of the other until the entire concentrator is established. From there, the concentrator's unique shape is derived using ray tracing, the edge-ray theorem, and the law of reflection. To test the design, a prototype was built using aluminum sheet metal and reflective film, along with a parabolic trough as a control. Due to adverse weather, experiments were conducted with a heat lamp to mimic the sun. The incoming angle of light to the concentrators was varied and the temperatures of the absorbers were recorded.

Results

The parabolic trough outperformed the designed concentrator slightly at direct sunlight (0° deviation), but the designed concentrator vastly outperformed the parabolic trough in angular deviations from -13° to 13°. This data suggests that the designed concentrator will be able to concentrate light from varying angles while remaining stationary and reach similar efficiencies to a tracking parabolic concentrator. Calculations based on experimental data revealed a theoretical conversion efficiency of 20.9% from incoming solar energy to electricity.

Conclusions/Discussion

Cost analysis based on experimental data suggests that using this non-tracking system will allow for a significantly lower cost per watt than traditional solar power systems. The non-tracking concentrator efficiently redirected light from various incoming angles and offers an exciting alternative that outpaces current solar energy systems.

Summary Statement

A novel non-tracking solar concentrator is designed, built, and tested, offering a significantly improved cost and efficiency than current systems.

Help Received

None. I designed, built, and tested the non-tracking concentrator myself.