Abstract
Our lab was focused on finding the effects of commercial de-icers on grass growth. We chose this topic because of how often de-icers have been in the news for their effects on the underbodies of cars. That led us to the question: What could these chemicals be doing to our grass? We tested the effects of two different de-icers: rock salt and potassium chloride de-icer. Those two de-icers were chosen because the rock salt is used by the Connecticut Department of Transportation on the highways and state roads, and the potassium chloride de-icer is similar to what is used by our town. We thought that the potassium chloride de-icer would have the greatest effect on the grass because it contained the most chemicals. We tested the growth of the grass over a two week period. At the end of our test, we found that both deicers caused the growth of the grass to have a slower rate of growth and eventually the grass completely stopped growing. This effect happened the fastest in the potassium chloride de-icer grass plot, which proved our hypothesis to be correct. Even though only a small amount of grass comes in contact with de-icers, that small amount can add up to a large amount of damaged grass, considering how many and how often states apply de-icers. After seeing our results, we propose that extreme caution be used when applying de-icers and alternative environmentally friendly de-icers should be considered when applying near grass, trees or plants.

Biography
Abstract
Are you gluten-intolerant or gluten-sensitive? Do you know someone who has celiac disease? If so, then you probably know the challenges of finding food that won’t make you ill. The purpose of my experiment was “What flour has the most gluten in it?” My hypothesis was “If Pasta Flour, All Purpose Flour, and Whole Wheat Flour were tested to find the amount of Gluten in each, I think the Whole Wheat Flour will have the most gluten because people with celiac disease are affected by wheat, barley, rye, and oat.” I tested my hypothesis by weighing out 8 ounces of each type of flour on a food scale. During each trial, I added 6 ounces of water to the flour, stirred it and kneaded the dough for 5 minutes to form a dough ball. After allowing the dough to rest for 10 minutes, I ran the ball of kneaded dough under cold water until all the water-soluble parts (carbohydrates) washed away. A ball of gluten remained. I learned that the Whole Wheat Flour had 31.84% gluten, the Pasta Flour had 34.47% gluten, and the All-Purpose Flour had 25.29% gluten in it. The results did not support my hypothesis. The Pasta Flour had the most gluten rather than the Whole Wheat Flour. I wondered if I tested gluten-free flour, would the same results occur. Through testing potato flour (GF), I discovered that it truly was gluten-free because nothing washed away from the dough ball and the measurements proved it.

Biography
Investigation of the Antibacterial Properties of Various Ethanolic Plant Extracts

Abstract

Bacterial resistance to conventional antibiotics is a growing problem in today’s society. Penicillin, Azythromicin, and Methicillin among other antibiotics are becoming less effective in treating human bacterial infections. The usage of plants as antibiotics is innovative and desirable because they are a widely available, potentially inexpensive treatment. Plants could potentially exhibit less side effects than antibiotics as well. The purpose of this experiment was to discover a solution by investigating the antibacterial properties of various plant extracts as a novel replacement for conventional antibiotics. This study focused on Cinnamomum cossia (cinnamon), Curcuma longa (turmeric), Camellia sinensis (green tea), Allium satvium (garlic), Zingiber officinale (ginger), and Cuminum cyminum (cumin). The Kirby-Bauer disk diffusion method was used to test several ethanolic plant extracts on Escherichia coli (E. coli). The minimum inhibitory concentration (MIC) was found by diluting each extract with deionized water to achieve 100%, 75%, 50%, and 25% concentrations. The zones of inhibition were measured after 24 hours of incubation, and all six plant extracts demonstrated antibacterial properties. Cinnamon, measuring at 19.5 millimeters, and cumin, at 16.5 millimeters, had zones of inhibition that were significantly larger than the other plants, making them of key interest. It is evident that a notable amount of bacteria was eradicated by cinnamon and cumin, even in comparison to the control, 100% pure ethanol, which had a zone of inhibition of 9.5 millimeters. Plants such as cinnamon and cumin have the potential to be a solution to the current problem of antibiotic resistance.

Biography
Plants on Other Planets: The Effects of Gravity and Atmosphere

Abstract
Will the production of plants change if they are grown at five times the force of gravity on earth and with an added amount of carbon dioxide (5,000 ppm or 0.50%) compared to the regular force of gravity and CO2 level on Earth? If so, what will they look like and what will their growth patterns turnout like? There are two different parts to our project, the first part was to experiment with gravity and how it affects plants. We spun plants at 5.5 meters per second creating a force of gravity five times the force on Earth. The second part tests how atmosphere (specifically CO2 affects plants). The independent variable is the plants and the dependent variable is the gravity for part one and the CO2 for part two. Our results concluded that plants spinning did not grow as well as our control group, and plants in normal atmosphere grow better than plants with extra CO2. This experiment can be applied to the real world because as global warming continues, people on Earth may have to move to other planets where the gravity and atmosphere will be different. Our experiments’ show that humans will be able to survive on a planet with five times the force of gravity on Earth or less, also plants will continue to grow with the rising amount of CO2 in the atmosphere.

Biography
Worthington Hooker Middle School, New Haven, CT

Removal and Recycling of Phosphate from Water using Various Methods: A Sustainability Project

Abstract
Municipal and industrial water effluents contain high phosphate levels, which must be removed by Environmental Protection Agency (EPA) mandated standard to <0.5 ppm. The purpose of my project was to investigate if and how various renewable and biodegradable resources, such as chitosan (chitin derivative), eggshell and sawdust, can remove phosphate. In part 1, I treated 1 gram of eggshell with vinegar and put it in 200 ppm phosphate solution and put another 1 gram of eggshell directly into phosphate solution. In part 2, I created a sawdust filter, by cutting a plastic bottle, tying a cheese cloth on one end, packing sawdust in, washing it and passing 133 ppm phosphate solution through it. In part 3, I treated 60 milligrams of chitosan with vinegar and put it in 133 ppm phosphate solution and compared with just chitosan in phosphate solution. I found that vinegar treated eggshell and vinegar treated chitosan (it forms a gel) both brought phosphate levels to <10 ppm, but just eggshell and chitosan (without vinegar) did not work. Surprisingly, washed sawdust also brought levels to <10 ppm. I had tested the remaining phosphate levels in solution using phosphate test strips. Possible applications of this project: 1) This could be useful for inexpensively removing phosphate from water effluents 2) vinegar treated eggshell (calcium acetate) could serve as a phosphate binder for kidney patients 3) I further did an experiment to stop precipitation of calcium phosphate, by varying pH and phosphate levels, which can be used for parenteral fluids.
The Investigation Of The Presence Of Plastic Microscopic Fibers In Effluent Sewage Water And The Long Island Sound

Abstract

When synthetic clothes, clothing made of polyester, fleece, nylon, spandex, acrylic, and rayon, get washed they release microscopic plastic fibers into the water supply, (Browne et al., 2011). Wastewater treatment plants do not have the necessary equipment to remove microscopic plastic pollutants from the water. The polluted water ends up in our aquifers and oceans contaminating the world’s water ecosystems. An experiment with samples of effluent water from a household washing machine, the Long Island Sound, The Newtown Wastewater Treatment Plant, and the Pootatuck River was conducted in search of microscopic plastic fibers. The samples of effluent water from the washing machine had micro-plastic fibers in different colors. The other water samples were examined to find fibers that looked similar to this baseline. The experiments consisted of filtering the water in each sample through Millipore filters with a porosity specification of 0.05 mm. The filters were dried, weighed and examined under a dissecting microscope. The filters had grids of 0.3 mm square which enabled classification and counting of fibers into short and long fibers. A camera attached to the dissecting microscope was used to view, count and classify the fibers that were collected onto the filters. Because this was a controlled experiment using synthetic clothing in the washing machine, the washing machine had the most contamination. The contamination in the samples from the Pootatuck River and the Newtown Waste Treatment Plant were found to be significant compared to the L.I.S and the tap water.

Biography
Gabriel Mesa, Grade 8

Canton Middle School, Canton, CT

Graphene Enhanced Piezoelectric Generator for Environmental Energy Conservation

Connecticut Science & Engineering Fair Awards

- Dominion Nuclear Connecticut Physical Sciences Awards --- 1st Place- Physical Sciences 8th Grade Ind.- $300 & trophy, invite to compete Broadcom MASTERS
- Connecticut Science Teachers Association's Marty Tafel Student Research Award --- Physical Sciences 8th Grade - $500 and invite to CSTA Award Banquet
- Connecticut Invention Convention --- $50 gift certificate & invitation to present at CT Invention Convention as “CIC Next Step Inventors”

Abstract

The purpose of this experiment was to create an environmentally neutral battery for generating electrical energy through mechanical instead of chemical means taking advantage of a new and promising material, graphene. The result was a piezo-electric battery enhanced with graphene for use in personal use situations such as lighting a home in a rural area during monsoon season where alternative green energy such as solar is not feasible. The first step was researching graphene properties and piezoelectricity. The next step was to determine a method by which the graphene could be combined with a piezoelectric crystal, thus giving it additional strength and conductivity. Many methods of combination were tried including various concentrations of graphene as well as the development of graphene films in different conditions. The next step involved building a device that fit the criteria needed to justify producing and manufacturing it. The device had to be environmentally green, produce sufficient energy for the cost, and work to effectively translate mechanical energy. Then the device needed to be tested for electrical output and durability through mechanical stress testing. Next the battery was evaluated for environmental disposal through soil and water degradation. Finally the battery was put into a live application for demonstration purposes, in this case a light that works without external electricity during a rainstorm. In conclusion, the possibility of having small scale devices self-contained devices that turn mechanical energy into electrical energy is very real with the application of new materials such as graphene to the problem.

Biography
Maryam Moghul, Grade 7

Madina Academy, Windsor, CT

To Design A Self-Sustained Wind-Microbial Hybrid Device that will Generate Clean Hydrogen for Energy

Abstract

Our world is facing many problems today; pollution, depletion of resources, energy and water crises, just to name a few. I aimed at designing and improvising an energy-efficient, self-sustained device which when used at a large scale or individual level could solve some of these problems. The purpose of the device is to produce hydrogen fuel from renewable resources. Hydrogen is the simplest element with the highest energy content by weight. To be used as a fuel, it can either be burnt directly, or used in a fuel cell. Currently most H2 is being produced by reforming the hydrocarbons in natural gas or by electrolyzing water powered by fossil fuels. The use of H2 as a fuel would improve air quality by decreasing greenhouse gases. Scientists have tried combining renewable resources to make self-sustained devices. I combined energy from mud and wind in a hybrid device to run the electrolysis of water. Various household liquids were added to water to test if any of them would increase H2 production, if any. Hydrogen-Peroxide, Vinegar and Ammonia were used in 3 separate experimental groups for this purpose. All the experimental groups did produce more H2 than water alone. Confirming my hypothesis; the Ammonia Electrolysis Cell produced the most H2. An added benefit of this device was the purification of sewage water in the Microbial Fuel Cell. This Wind-Microbial Hybrid Device can produce H2 for fuel, using no external voltage, depending only on 2 renewable resources for electricity, purifying water in the process.

Biography
Using Wettability to Develop Reusable Freezer Bags

Abstract
Plastic freezer bags always get disposed after one use, creating negative environmental and economic impacts. A reusable freezer bag for food storage/transport that can alleviate these problems is not readily available on the market. The purpose of my experiment is to design an environmentally and economically friendly reusable freezer bag with low wettability, satisfactory freezer food preservation, and easy decontamination. Cloth was used because it is natural and not harmful to food, unlike plastic. My hypothesis is that from regular cloth, wax-coated cloth, moisture-absorbent cloth, and silicone-cloth bags, silicone-cloth would be the best choice due to its hydrophobicity and resistance to large temperature variations. The experiment involves the measurement of the bags’ wettability through contact angle, food preservation in freezers, and decontamination of the bags to determine bacteria presence after many uses. My data showed that the silicone-cloth bag had the least wettability with contact angles approximately 150°, best food preservation, and minimal bacteria growth following decontamination. I concluded that silicone-cloth was the best material at the given criteria. New cloth can be reinserted after few uses. But, the same silicone bag can be used for 10 years, decreasing the overall cost and the amount of bags going into the landfills. Further experiments I would carry out include finding materials that can withstand deep freezing for long periods of time, finding materials that can withstand a freezer as well as a microwave, and finding materials that will not yield any bacteria growth after decontamination following freezer food preservation.

Biography
Owen Petno, Grade 8

Greens Farms Academy, Greens Farms, CT

The Effects of Antioxidants on cell regrowth and regeneration in Lumbricus variegatus

Abstract
The debate over antioxidant use has been a recurring theme for many years. Though advertised and thought to be great for the immune system and the body’s cells, antioxidants have also been proven to be potentially dangerous. Previous research has stated that the free radicals that invade and infect human cells, and influence antioxidants instead of being destroyed by them, damage the body to a potentially large extent. These antioxidants are called rogue antioxidants. Although antioxidants have dangers, do its healing and supporting benefits of the immune system and cell strength outweigh its possibility of harming the body? This project tested whether or not antioxidants really do help cells regenerate and heal when damaged, or if they slow the healing process in general. The use of the Lumbricus variegatus or black worm represented a cell, as their bodies can regenerate segments, and they are very sustainable and influenced by their environment. If cut into four even pieces and placed in a centrifuge tube with antioxidant filled water, the worms regenerating will be affected by the antioxidant variable. Based on the data collected, this project showed that the worm segments in the control grew back segments significantly faster and to a larger extent. Two of the worms inhabiting the Bilberry solution died, and the other two grew extremely slowly. Out of all of the antioxidants, Vitamin C grew the fastest and the most efficiently; however, none of the worms grew as fast as the worm segments on the control.

Biography
Abstract
What kind of treats can a horse with risk factors for Equine Metabolic Syndrome (EMS) have? Owners give treats as rewards for training, tricks, or socializing. Last year, a horse at my barn foundered and was diagnosed with EMS. It was a costly and life-changing problem for the owners. My hypothesis: If treats are tested for sugar content and soaked, the simple sugar content should decrease. Using water as a solvent, I knew that hay could be soaked to remove simple sugars. I wanted to see if that process would work with other treats. I tested 15 samples individually by putting each into a 15 ml beaker with distilled water and 10 drops of Benedict’s solution. The beakers were placed in a 170° F bath for 5 minutes. This step was repeated with new samples that had been soaked for 15 minutes and again for 30 minutes. First, I recorded the initial color and then recorded the color after heating the beaker. By changing colors, Benedict’s solution would show if an item had simple sugar. My hypothesis was correct for 5 out of 15 experiments-including the control. Finally, I tested the water that each item had been soaked in to see if sugar had dissolved: 12 out of 15 tested positive for sugar content, showing some sugar was removed. If I were to continue this experiment, I would test for non-reducing sugars using hydrochloride acid, sodium carbonate solution, Benedict's solution, and then quantify the amount with a colorimeter.

Biography
Fossil fuels are a large pollutant to Earth’s environment. In addition, they are a limited source of energy. However, this problem could be solved by using alternative energy sources. A new and upcoming source of green energy is bio-gas. Bio-gas is any organic matter that can be turned into fuel for energy. Additionally, it is renewable and less dangerous. In this experiment, corn and wheat were tested to see which plant will produce the most bio-gas, therefore producing the most energy. This was done by allowing corn and wheat to decompose in Erlenmeyer flasks connected to airline tubing. This tubing was inserted into a gas trap that was inverted into a beaker full of water. The water being displaced showed the volume of gas produced. During the experiment, wheat showed more bio-gas production when measuring the gas trap. It displaced all of the water while corn only displaced a few centimeters every few days. Determining the plant that abundantly produces bio-gas is important because it can lead the United States to be more knowledgeable about which plant will have a better outcome when looking for alternative energy sources.

Biography
Biography

**Abstract**

Fertilizers used in agriculture sometimes enter watersheds in run-off, resulting in algae blooms and even dead zones along coastlines. They help the plants grow of course, but did you know that sometimes the fertilizers enter bodies of water in ways such as run-off? These fertilizers may be good for the plants and crops for farmers, but very bad for watersheds. One thing that is affected by the fertilizers entering the watershed is algae. Fertilizers can result in higher algae levels than the watersheds can handle, resulting in problems. One of those problems are dead zones, or places that cannot sustain life due to low oxygen levels because of decomposing algae blooms. For my experiment I exposed cultured algae to three different hydroponic fertilizers. I thought that the fertilizer that contained the most nitrogen would cause the biggest algae bloom because nitrates are often used as the main ingredients in fertilizers to encourage growth. I measured the transmittance of green wavelengths of light through sample to determine the concentration of algae in each trial on day one of project and day ten. I found out that the FloraGro hydroponic fertilizer grew the most algae out of all samples. This was not what I hypothesized. The Flora Gro fertilizer had all three N-P-K components, so I think that the biggest alage bloom could be caused by the presence of all three elements, and not just one.
Connecticut Science & Engineering Fair

2014 Connecticut Science & Engineering Fair
(Student information as of April 2014)

Jonathan Wu, Grade 7

Middlebrook School, Wilton, CT

Solar and Wind Power

Connecticut Science & Engineering Fair Awards

- Dominion Nuclear Connecticut Physical Sciences Awards --- 4th Place- Physical Sciences 7th Grade Ind. - trophy, invite to compete Broadcom MASTERS
- EnergizeCT/CL&P/eesmarts Sustainable Resources and Practices Awards --- 2nd Place Middle School - $300 Cash and Trophy

Abstract

An average family needs 20,000 kWh of electricity per year, equivalent to 45 solar panels or a 10-kW wind turbine. For the experiment, solar panels were placed on the blades of a wind turbine to determine if it is a viable idea to make the blades of a wind turbine out of solar panels to utilize both wind and solar power. First, a wind turbine was assembled and produced an average of 0.92 volts of electricity. Next, solar panels were acquired. The average electricity produced under a steady light source by a single solar panel was measured at 0.89 volts. Finally, the same solar panels were installed on the blades of the wind turbine. The average electricity produced by the wind turbine and a single solar panel was 1.57 volts. The experiment demonstrated combining solar panels and wind turbines produced more electricity than using solar panels or wind turbines alone. However, the solar panels affected the aerodynamics of the blades and the rotation of the blades reduced the surface area of solar panels facing the sun, so both systems are less effective when combined than if they were installed separately. Additional research was performed to find other options of combining wind turbines and solar panels. A prototype was constructed with 2,800 square feet of solar panels arranged around a 20’x20’x10’ WindCube. The prototype reduces installation costs and effectively uses both wind and solar energy. This experiment confirmed it is possible to combine wind turbines and solar panels into one unit.

Biography
Humza Zaidi, Grade 8

Talcott Mountain Academy, Avon, CT

The Efficiency and Durability of Piezoelectric Generators

Abstract

The point of this present study is to test the efficiency and durability of a quartz piezoelectric generator and lead magnesium niobate-lead titanate (PMN - PT) to create a new piezoelectric generator that takes traits from both generators. Piezoelectricity is an effect where energy is produced when mechanical stress is placed on certain objects. After extensive research, I have decided to test these piezoelectric generators. I took into account the cheapness, durability, and efficiency of each material. I believe there will be a significant difference in the electrical output from the commercial piezoelectric generators with respect to a piezoelectric generator that uses hydraulic pressure to increase pressure, and therefore increase the energy output. The reason that the world needs a more efficient and cleaner source of energy is because our world is currently based on using gasoline as the main energy source. However, gasoline is extremely harmful for the environment. By creating a new piezoelectric generator, the world will be able to collect energy from a cleaner source without losing efficiency. I believe there will be a significant difference in energy output with respect to quartz piezoelectric generator and lead magnesium niobate-lead titanate (PMN - PT). From the results of the experiment, shown on the diagram; it can be concluded that using lead magnesium niobate-lead titanate (PMN - PT) as a piezoelectric generator is better.

Biography