

Category BE L01 Arrange Your Brain

Abstract

The purpose of this experiment was to find out if the arrangement of data affected memory and what arrangement was most advantageous. It was predicted that the ease of memorization would be affected by the arrangement of data and that a square array of information would create the optimum conditions for memorization. In this experiment, forty subjects were tested on their ability to memorize pictures on cards arranged in different ways. Each subject was given a card with sixteen pictures on it. The subject then had thirty seconds to memorize the pictures. After time had concluded, the subject wrote down as many items as they could remember. The subject repeated this process for the remaining five cards. The cards had the following arrangements: Card I- random, Card II- 1x16 array, Card III- 16x1 array, Card IV- 2x8 array, Card V- 8x2 array, and Card VI- 4x4 array. Each subject was asked which card they found easiest and hardest and their strategy for memorization. The tests were then scored. Averages were found for each card and test overall. Averages were then found by age, grade, gender, and strategy type. Counts were then taken of the number of times each card was named easiest and hardest and had the best, outright best, worst, and outright worst score. Card VI, the square array, was the most advantageous arrangement. The average score for this card was 9.18 correct answers, higher than any other card. It was chosen as the easiest card to memorize the most times and the hardest card to memorize the least times. It had the most occurrences of being the best and outright best card for each subject and the least number of occurrences of being the worst and outright worst card. This experiment could have been improved by better controlling the noise level in the testing room. Also, testing more subjects could have allowed for better data to be collected on different groups of subjects (i.e. age, grade, gender, strategy types).

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Category BE L02 The Effects of Video Games on the Spatial Reasoning Skills of the Average Teen

Abstract The purpose of this project is to determine if playing a spatial reasoning-type video game like Tetris will have an effect on the performance of a typical teenager on a spatial reasoning IQ test.

I believe that the subjects who play Tetris for 15 minutes will score higher on the spatial reasoning test than the subjects who do not play Tetris. I also predict that the subjects who played Tetris for 30 minutes will score better than both those who played for 15 minutes and those who did not play at all.

Procedure: Prepare all necessary paperwork and solicit volunteers to assist with project. Administer spatial reasoning test to control group. Administer spatial reasoning test to test groups after each volunteer has played Tetris for the allotted time. Grade tests and enter all data into Excel spreadsheets and determine results and conclusion.

The control group scored an average of 74% on the spatial reasoning test. The group that played Tetris for 15 minutes showed a 12% improvement in scores with an average of 83%. The group that played Tetris for 30 minutes showed a minor increase of 13% with an average score of 84%.

My hypothesis was correct. The subjects who played Tetris for 15 minutes showed a 12% increase over the control group and the subjects who played for 30 minutes showed a 13% increase over the control group. It should be noted that the increase in playing time did not significantly increase the overall score leading me to conclude that even a short session of video game play will increase overall performance from a perspective of spatial reasoning.

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Category BE L03 An Investigation into the Color Preferences of Toddlers

Abstract

Color is an important determinant of how much a child likes a food, toy, or outfit and also influences a child's interest in an educational setting. If companies were aware of a common color liked by a majority of children, they could better market and sell their product. Similarly, educators can use a color scheme to their advantage when designing classrooms, to produce a more stimulating or relaxing environment. This experiment will investigate the color preference of toddlers. The hypothesis is that toddlers would most likely choose the colors red or yellow. American and Chinese children from 30-42 months old will be used. The child will be led to a quiet place or area. Then researcher will ask the child to pick one ball from six ping-pong balls that are painted red, yellow, green, blue, white, and black. The color of the ball they grab is representative of their favorite color. Without replacing the first ball, the researcher will ask the child to pick a second ball. This is representative of their second-favorite color. Ping-pong balls are used because they are all shaped the same and are small enough to grab easily. To avoid affecting the results, no ball will be presented first. At least sixty subjects, about half male and half female, will be recruited from nurseries and daycares in Michigan and Shanghai. It is hoped that through comparisons of the children's ages, gender, ethnicity, and parents' education level, a common color preference will be found.

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Category BE L04 Are Brands Worth the Bucks?

Abstract

The goal of this experiment is to determine the effect of brand name recognition on the perception of taste. To conduct this experiment, subjects taste a brand name product, and then taste its Meijer brand equivalent. Subjects will be told to indicate which product they prefer. Each subject will taste five different sets of products: rice cereal, wafer cookies, crackers, potato chips, and bottled water. Before participation, each subject will complete a consent form and questionnaire. The questionnaire asks four questions. The questions relate to gender, age, time spent watching television, and experience grocery shopping. Three versions of the experiment will be given: Test A, Test B, and Test C. Each of the 150 subjects will participate in one version of the test. By this plan, there will be fifty participants for each test. Test A is the control group for this experiment. In this version, participants will simply taste each product, without knowledge of whether the products are or aren't brand names. In this version, I intend to find the general opinion of taste when it cannot be influenced by brand name recognition. In Test B, the containers for each product will be set up next to each product. In this version of the test, subjects will know whether they taste a brand name product or a Meijer product. In Test B, I will compare the results to those for Test A, with the intent to determine the effect of brand name recognition on the perception of taste. In Test C, containers will be next to each product, but with each container set up by the wrong product. For example, a box of Nilla Wafers will be set up next to the Meijer brand samples, and the Meijer box will be set up next to the Nilla samples. In this test, I intend to find out if the recognition of a brand name product will lead subjects to prefer what is actually a generic product. Experimentation will be conducted at the Northville Parks and Recreation building and at the Livonia YMCA.

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Category BI L05 A Yeast Powered Fuel Cell with Methylene Blue as a Mediator

Abstract

The purpose of this experiment was to determine if yeast could produce electricity in a Methylene Blue mediated fuel cell with NaCl in the cathode, and if the addition of Methylene Blue to the cathode in place of NaCl would enable the yeast to produce more electricity.

A fuel cell was constructed out of PVC with a salt bridge connection between the anode and the cathode halves. A solution of yeast (*Saccharomyces cerevisiae*), sucrose, and methylene blue was used in the anode. Multiple experiments were performed using either a methylene blue or a NaCl solution in the cathode. Control experiments were also run without any yeast in the anode.

When the fuel cell was in an open circuit configuration, voltage values indicated that yeast could indeed produce electricity in the presence of a methylene blue mediator. When methylene blue was also used in the cathode of the fuel cell, in place of NaCl, a higher voltage value was observed. In a closed circuit configuration, with a load of 2.64 k Ω , the yeast produced measurable voltage and current. However, the presence of methylene blue in the cathode caused a reduction in observed voltage.

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Abbie Groff's Microbial Fuel Cell Research Page
http://www.geocities.com/abigail_groff/

Harvesting Energy From Wastewater in a 2 Chamber Microbial Fuel Cell
<http://www.engr.psu.edu/ce/enve/logan/bioenergy/pdf/MFC-Sikander.pdf>

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http://www.engr.psu.edu/ce/enve/logan/bioenergy/MFC_QandA.pdf

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Category BI L06 Investigating Drug Resistance in MCF7 WT and MCF60 Breast Cancer Cell Lines

Abstract Breast cancer is the second most common cause of death for women worldwide. Every year in the United States, 200,000 women and men are diagnosed with breast cancer. Arsenic trioxide (As₂O₃) is currently used to treat many types of cancer such as acute promyelocytic leukemia, and the probable curative application of As₂O₃ to breast cancer is being researched. Currently, cancer cells' drug resistance to arsenic poses as a major obstacle in the treatment of cancer.

The purpose of my project was to identify the arsenic transport systems present in both wild type and arsenic resistant breast cancer cell lines (MCF7 and MCF60 cell lines respectively). This project also investigated the biochemical properties of the MCF60 arsenic resistant cell line in comparison to the wildtype MCF7 line and determined the rate of uptake and efflux of arsenic in both cell lines. MTT assays, transport experiments, RNA isolation, and RT-PCR were all methods that were used to investigate drug resistance and uptake. MTT assays were conducted to determine cell counts after other cancer treating drugs such as doxorubicin and etoposide were added to the cells for several days. EC₅₀ values were used as a comparison between the two cell lines and greater viable cell counts were found from the MCF60 resistant cell line in comparison to the MCF7 wild type cell line when treated with arsenic, antimony, and pretreated with a BSO inhibitor. Transport experiments on the MCF7 cell line were conducted to determine the cell's rate of uptake at certain time intervals. RNA was also isolated and reverse transcribed into cDNA, so that the genes and proteins involved in arsenic resistance/efflux and uptake were determined. The aquaporin protein AQP9 was found to possibly play a role in arsenic uptake and efflux.

Overall, the results of this study suggest that the presence of AQP9 plays a role in the cell's resistance to arsenic, as well as other drugs such as antimony. It also concludes that the protein MRP is not involved in the extrusion system of the MCF60 cell. This knowledge can help to solve the problem of drug resistance and help continue the treatment of breast cancer cells using heavy metals such as AsIII.

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Category BI L07 South African plants for skin hyperpigmentation disorders

Abstract The purpose of this project was to determine whether certain plant extract could inhibit tyrosinase production in the skin. I first prepared the extracts that were used in the experiments, dissolved them in dimethyl sulphoxide, and tested them against different concentrations of tyrosinase to see if they had any inhibitory effects. 70 µl of each extract dilution was combined with 30 µl of tyrosinase in triplicates in microtitre well plates. Kojic acid was used as a positive control in the experiment. Optical densities of the wells were then determined at 492 nm with the BIO-TEK PowerWave XS multi-well plate reader. The IC50 value was then determined by the use of MSTATC software. The best results for tyrosine testing went on to DOPA testing.

DOPA testing allowed me to determine the IC50 values of each extract. The IC50 is a measure of the effectiveness of a compound in inhibiting biological or biochemical function. Then I went on to antioxidant testing. I also found the EC50 value through this process. By performing these experiments, I concluded that *Greyia sutherlandii* was the most active plant extract for inhibiting tyrosinase formation in the skin.

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Category BO L08 Some Fava Beans and a Nice Summer Savory: Sustainable Hydroponic Horticulture

Abstract In the experiment, "Some Fava Beans and a Nice Summer Savory: Sustainable Hydroponic Horticulture," summer savory (*Satureja hortensis*) and fava beans (*Vicia faba*) were grown hydroponically. Fava beans were chosen to be grown in the experiment due to the fact that they are a healthy food source, and summer savory was chosen because it is a useful spice. No specific reference was found for growing these particular plants hydroponically.

Eight PVC pipe tubes were suspended above the ground by a wooden frame. Fluorescent lights were hung from the ceiling from chains directly above these tubes, and buckets were placed under each of the tubes' drainage holes. Each bucket was filled with a different nutrient solution mixture, and water pumps were placed in each bucket. Each water pump was connected to clear tubing which lead its assigned nutrient solution mixture to the head of its respective PVC testing tube, and the nutrient solution was allowed to travel through the testing tube and to drain back into its assigned bucket. Specimens of both species of plants were placed into holes in each of the tubes.

Commonly, when hydroponics is practiced commercially, the hydroponic solution is discarded weekly and is replaced by fresh solution in order to ensure the correct levels of the nutrient salts within the solution, which are necessary for the development of the plants. This wastes water and nutrient resources, and the excess nutrients, which can escape into local waterways, cause pollution and eutrophication. In the project, the water used for the nutrient solution was not be disposed of weekly, but was tested for proper pH and nutrient salt concentration, and was adjusted accordingly.

The hypothesis stated that if an attempt was made to grow fava beans and summer savory hydroponically, using a tube system and the proper nutrients and recycling the water used in the nutrient solution, the resulting plants would be of as good a quality as those grown in soil, or hydroponically without recycled nutrient solution components. Although neither the plants grown hydroponically nor the plants grown in soil lived up to the expectations of the tester, the hypothesis was supported by the data gathered.

The point of this experiment was to avoid wasting water resources and causing pollution, while still successfully growing crops hydroponically. So, in a continuation of this experiment, the water used for each of the nutrient solution mixtures would continue to be recycled. PVC tubing with a larger diameter would be used to grow the plants, in order to prevent clogging via plant roots. Also, more hardy plants would be grown, and the need for electricity would be eliminated because solar powered water pumps would be used and the system would be set up outside, in full sunlight.

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Williams, John. Bolton, David. Hydroponics [Video recording]: An Introduction to Soilless Agriculture. Approximately 30 minutes in length. ©1991 AA VIM: American Association for Vocational Instructional Materials, Athens, GA.

Category BO L09 The Development of Fluorescently Tagged Organelles in *Arabidopsis thaliana*

Abstract Currently, a set of tools is lacking for the stable localization of proteins and protein complexes in *Arabidopsis thaliana*. The development of a set of tools available for mutant lines, such as Non-race specific disease resistance 1 (*ndr-1*), and wild-type Columbia (*Col-0*), would make protein co-localization experiments more sensitive. This would lead, for example, to a better understanding of the protein to protein interactions inside the plant cell associated with defense-related signaling, such as the protein trafficking of Actin de-polymerization 4 (*adf-4*). In particular, organelles such as peroxisomes, plastids, vacuoles, endoplasmic reticulum, and the Golgi have been tagged with three different fluorescent proteins (FP) (green, yellow, and cyan) in three different plasmids, *Col-0*, *ndr1*, and *adf-4*, for kanamycin and basta selection for flexibility purposes. This set of tools should be an asset to the plant community for protein co-localization studies in plant defense.

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Category BO L10 Antibacterial activity of S.African plants against *P. intermedia* & *A. israelii*

Abstract

Abstract:

The purpose of this project was to determine whether or not the selected plants in the study could inhibit the growth of the periodontal bacteria *Actinomyces israelii* and *Prevotella intermedia*. The plants tested were *Euclea natalensis* (leaves and roots), *Leucosidea sericea* (leaves), *Pelargonium luridum* (leaves), *Pelargonium reniforme* (leaves and roots), and *Sansevieria hyacinthoides* (leaves). This was tested by preparing extracts of the selected plants and placing them (in different concentrations) in the individual wells of microtitre plates containing the two bacteria and a control. The bacteria were grown in Tryptone Soy Agar and kept alive in the plates by feeding on Tryptone Soy Broth. The plates were sealed and incubated under anaerobic conditions for 48 hours at 37 °C. P-iodonitrotetrazolium (INT) was used as the detection reagent for the Minimum Inhibitory Concentration. This was determined where no pink occurred in the wells. After another 48 hours, INT was added to the untouched wells to determine the Minimum Bactericidal Concentration. The color intensity was measured using an Elisa plate reader to get the dose response curve. All but two plants showed activity against the two bacteria. The plant *Leucosidea sericea* provided the best results by killing most of the bacteria. The concentration of the bacteria in the wells that tested the activity of this plant was 0.097656 for the MIC and 3.125 for the MBC.

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Category EV L11 A Recapitulation on the Redress of Riparian Residences

Abstract

Purpose: To determine point sources of pollution on the Kalamazoo, Muskegon, and Shiawassee rivers through the analysis of common pollutants and heavy metals and to compare the water quality of the three rivers.

Hypothesis: Horton will be a point source of agricultural pollution and Battle Creek will be a point source of industrial pollution in the Kalamazoo River. Davisburg will be a point source of agricultural pollution on the Shiawassee River which will have high concentrations of industrial pollution throughout. Roscommon will be a point source of agricultural pollution and Muskegon will be a point source of industrial pollution on the Muskegon River. The Muskegon River will have the best water quality and the Shiawassee River will have the worst water quality.

Procedures: Water was collected from five collection sites on each river, including the point where the mouth of each river meets one of the Great Lakes, for five consecutive weeks. The water was analyzed for arsenic, biochemical oxygen demand, cadmium, chromium, dissolved oxygen, lead, nickel, manganese, nitrates, pH, phosphates, temperature, turbidity, and zinc.

Conclusion: The results of the experiment partially supported the hypothesis. Horton was a point source of pollution in the Kalamazoo River, Muskegon was a point source of pollution in the Muskegon River, and the first collection site in Bay City was a point source of pollution in the Shiawassee River. The Muskegon River had the best water quality, and the Muskegon River had the poorest water quality.

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Category EV L12 Water Quality: An Analysis of City Water in Bay City, Michigan

Abstract

The purpose of this study was to evaluate causes of the poor water quality in Bay City found during the previous year's study of water quality in the Saginaw Valley. What was determined to be poor water quality in Bay City may be due to the type of piping in the home from which water was sampled. Contaminants from the piping could have been released into water. Therefore, it was hypothesized that the specific home previously tested is the source of the conclusion that the water quality in Bay City is poor.

Twelve houses, three from each of four different quadrants of the city, were tested for eleven contaminants. Contaminants tested for during this study included alkalinity, ammonia, total coliform/E. coli, carbon dioxide, chloride, dissolved oxygen, nitrites, pH, supersaturation, total dissolved solids and total hardness. All of the tests, except total coliform/E. coli, supersaturation and total dissolved solids, were conducted three times to ensure accuracy of the results.

Following analysis of the data, it was concluded that the original hypothesis was incorrect. Although the quadrant that the house is located in had the highest values for several contaminants, the individual house did not have higher values than any of the other houses tested.

Based upon the findings of this study, future research is planned related to the water quality in Bay City. It is recommended that additional testing be performed to determine the cause of the poor water quality of an individual home, be it the piping of the home or the pipes leading up to the home from the water treatment facility. Additional testing may also be performed to evaluate leaching that occurs with different types of pipes at different temperatures.

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Category EV L13 The Effect of Pain Relievers Polluting Water on *P. caudatum* and *L. variegatus*

Abstract As people take medicine, not all of the medicine is metabolized by the body, some of it is excreted. People also commonly dispose unused medications down the drain. Recent investigations reveal that these medications end up polluting natural bodies of water and affecting wildlife living in the water. However, the effects of these medications on wildlife are relatively unknown. This project was to determine what effects do the pain relievers that are found in natural bodies of water have on the behavior of unicellular and multicellular organisms. *Paramecium caudatum*, and *Lumbriculus variegatus* were used as biological indicators and were exposed to non-prescription naproxen, ibuprofen, aspirin, and acetaminophen to determine their behavior when pain relievers are released into the water.

P. caudatum were exposed to pain relievers dissolved in water at various concentrations. After 48 hours, the swim speed (mm per sec) and number of direction changes (turns per sec) of *P. caudatum* were recorded. The results revealed that as the concentration level increased, there were more direction changes and slower swim speed.

Lumbriculus variegatus were exposed to pain relievers dissolved in water at various concentrations. Their heartbeats were recorded after 24, 48 and 72 hours under a microscope. As the concentration increased their heartbeat increased and many died.

The lowest concentrations that were tested were in the parts per billion. The results show that even low concentrations of pain relievers in water can greatly affect the behavior of aquatic organisms.

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Category EV L14 Photovoltaic vs. Solar Thermal Energy Efficiency

Abstract Abstract

Photovoltaic vs. Solar Thermal Energy Efficiency

The purpose of this experiment is to compare the efficiency and power output of photovoltaic cells and solar thermal cells in warmer and colder climates. In this experiment, the light intensity and temperatures of Saginaw, MI and Tampa, FL are used as test sites.

Photovoltaic is a process of solar energy where, using light from the sun, electrons are knocked loose become able to move freely through semi-conducting material, creating electricity. This is called the photovoltaic effect. In this experiment, silicon solar cells are used.

Solar thermal energy is another type of solar energy where the heat from the sun is used in the form of energy. In this experiment, evacuated tube solar thermal cells are used.

After preparing the PV cells for testing, the cells were taken to the solar simulator, which flashes light on the cell that is approximately the same light intensity as the sun for 70 nanoseconds. Once results are received using calculations and the computer software, record the results. Next, the solar thermal cells are tested. In both cases, efficiency and power output is found and calculated.

After results are found, record and graph them. The hypothesized result was that the PV cells would prove to be more efficient than the solar cells in colder climates, but the solar thermal cells would prove to be more efficient when the light intensity of a warmer climate is used.

After experimenting, the results show that the hypothesized result was proven mostly correct. The data shows that, overall, the photovoltaic cells performed better for the light intensity and temperatures of Saginaw, but the two types of cells both performed well in separate parts of the year in Tampa. The solar thermal collectors worked well in the summer months, following the temperature curve. The photovoltaic cells work at a steady rate throughout the year. In further studies, it would be desirable to look at cost effectiveness in both forms of solar energy. Also, I would like to look at finding ways to try to improve the photovoltaic cell.

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Category *EV* **L15** Blow Your Stack

Abstract In this project, I utilize the stack effect in order to create an updraft powerful enough to be used to generate electricity. By utilizing the stack effect, I can produce wind energy by heating the air under the stack. I first had to have the base professionally made. Once the base was made, I began riveting duct work together. Once the stack was assembled, I covered three sides of my stack with black plastic and used a concave mirror to heat the air in the bottom of the cone. This heat created a draft, which I measured using an anemometer. I then recreated this wind speed to test the energy output with a turbine I made from salvaged parts. At the top of the stack, the anemometer gave a highest reading of 20.1 mph or 8.985 m/s. When I recreated that wind speed, the turbine produced 3.1 volts without the resistor, and produced 1.2 volts with a 10 watt, 10 ohm resistor attached. Calculations show that my turbine is 24% efficient, I also found that my turbine would make .12 amps and .144 watts of power with a 20.1 mph wind. Based on my findings, I know that by utilizing the stack effect, I can produce electricity and I believe solar stacks would be a great option for electricity production both because of their low operations costs, and their sustainability.

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Category EV L16 Fuel from Waste

Abstract

The purpose of this experiment was to determine if composting leaves produced enough methane for substantial fuel use, and which leaves would produce the most. To start the experiment, I gathered three different types of leaves from Houston and tore them into small shreds. I then placed the shreds inside three different water coolers. Then I drilled a hole in the side of the water coolers and fed the syringe that would distribute the readings to the gas pressure sensor. I then hooked up the pressure sensor outside of the water cooler and sealed the hole by the syringe with silicone sealant. Then, to close off the top of the water cooler, I took a thick sheet of rubber and pulled it over the top of the container and sealed it with two double-lock cable ties. Then I was able to measure the change in pressure in the container with the sensor and its reader. I also was able to measure the temperature for any change in gas pressure that would be proportional to the pressure changes. I was able to approximately calculate the methane produced by these leaves and determine if the energy potential of this gas can be used as fuel in today's society of dwindling fossil fuels.

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Category ME L17 The Role of Regulatory T Cells in Experimental Autoimmune Encephalomyelitis

Abstract Multiple sclerosis (MS) is an autoimmune disease of the central nervous system affecting about 400,000 people in the US. MS is studied through a mouse model, experimental autoimmune encephalomyelitis (EAE), which causes symptoms similar to those of MS in humans, including paralysis. However, some humans develop MS while others are healthy, without disease. Likewise, some mouse strains are susceptible to EAE induction while others are resistant to it. By understanding why certain mouse strains can resist EAE development, the underlying mechanisms of disease development can be deciphered. It is thought that one factor influencing the response to EAE lies in the activities of a population of T cells known as the regulatory T cells (Treg). It is proposed that resistant mouse strains have a higher Treg activity and hence lower disease-causing (effector) activity. SJL.B mice, when immunized with the neuroantigen MOG, develop EAE. In contrast, no disease is induced when the mice are immunized with another neuroantigen, MBP. Analysis with of lymphoid cell populations with a powerful machine called flow cytometry, it is possible to distinctly separate the disease-causing T cells (effector cells) from the regulatory T cells (Treg cells). In this project, SJL.B mice were immunized with the two neuro-antigens, MOG and MBP. T cells were then sorted by flow cytometry into effector cells expressing high levels of surface CD4 molecule (CD4^{hi}) and Treg cells expressing CD4 and CD25 surface molecules (CD4⁺CD25⁺). Comparing the frequencies of Treg cells in MBP-immunized mice (resistant) versus Treg cells in MOG-immunized mice (susceptible), results showed that EAE resistant mice did have a higher frequency of Treg cells than did EAE susceptible mice. These findings establish the significance of Treg cells in the modulation of EAE and possibly MS. Targeting Treg cells in MS should allow the development of new therapeutic approaches that can help control the symptoms of MS.

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Category ME L18 Natural Cure for Breast Cancer

Abstract

Breast cancer is the second leading cause of cancer deaths in women today and is the most common cancer among women. Epigallocatechin gallate in green tea has antioxidant properties. The aim of my project was to find out whether the naturally available EGCG (green tea extract) could kill breast cancer cells. I compared it to the known treatment, a chemotherapy agent, Faslodex(ICI 182780) anti-estrogen receptor blocking agent.

I treated breast cancer cells with various amounts of EGCG (10 μ mol, 50 μ mol, 100 μ mol, 200 μ mol) and Faslodex (1nmol, 10nmol, 100nmol) using fetal bovine serum as a control medium. I incubated the cancer cells for 96 hours. I added Cell Counting Kit-8 (CCK-8) solution to determine the number of cells killed. The CCK-8 solution contains a WST-8 tetrazolium salt which is converted by dehydrogenase enzyme in living cells and forms formazan, a yellow colored dye. I used a spectrophotometer to detect the amount of light passing through the solutions at 450nm. The optical density obtained was varied by the amount of formazan produced. Optical density is directly proportional to the number of viable cells which was then calculated with a standard calibration curve.

According to my research, 10 μ mol EGCG killed 15.28% cells, 50 μ mol EGCG killed 40.46% cells, 100 μ mol EGCG killed 45.78% cells, and 200 μ mol EGCG killed 79.33% cells. Further, 1nmol ICI killed 6.75% cells, 10nmol ICI killed 44.91% cells, and 100nmol ICI killed 58.57% cells.

This concludes that green tea extract (EGCG) has a lethal effect on breast cancer cells compared to currently available Faslodex.

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Category MI L19 Identification of Genes in C. Albicans that Contribute to Antifungal Resistance

Abstract AIDS patients struggle when confronted with Candidiasis. Candidiasis is caused by Candida Albicans. The purpose of the investigation is to determine genes in C. Albicans that confer resistance to three antifungal agents: Aureobasidin, Rapamycin, and Fluvastatin. The expected outcome would facilitate smarter synthesis of new drugs and open up possibility of combination therapy of drug composites. The hypothesis that the same genes would not confer resistance to multiple drugs was tested. Among alternative research techniques available, overexpression was chosen due to its ability to investigate on a global scale. An established plasmid library for C. Albicans was plated. After incubation, colonies were isolated. These colonies were replica plated to check for resistance at different drug concentrations. Subsequently, resistant colonies on the plates were selected and their DNA was extracted and amplified through transformation in E. coli. The DNA was then cut with EcoRI and run on an agarose gel to see if plasmids were present and differed from the control MAL vector. The DNA with clear bands were transformed back into C. Albicans and replica plated to check for a definite resistance phenotype. Finally, the plasmids were sent to a specialized laboratory to be sequenced. Analysis of available data was conducted through the online Basic Local Alignment Search Tool (BLAST). The preliminary observation suggests that the IPT-1 gene increases resistance in C. Albicans to both Aureobasidin and Rapamycin. This disproves the hypothesis that genes can only confer resistance to one drug. Further analysis will include other plasmids conferring resistance and observations. The vision is to generate information about the three drugs and Candida Albicans that will allow smarter synthesis of new drugs and combination therapies to help immunocompromised patients in their battle against Candidiasis.

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Category MI L20 Diatoms: Nature's Nano Architects

Abstract

Diatoms are unicellular organisms, and are considered to be some of nature's finest architects. Diatoms engineer intricate shells of amorphous silica on the nanometer scale. However, little is known about how such detailed construction is carried out at such a small scale. Due to their photosynthetic capabilities and abundance, diatoms have a profound impact on the delicate equilibrium of the environment. They account for approximately 45% of the Earth's oceanic energy production, and are responsible for nearly 20% of global carbon fixing capacity. Therefore, understanding the unique cellular processes of diatoms will provide us with new insights into mineral deposition in larger animals, such as the deposition of bone in humans. Since different species of diatoms construct markedly different exoskeletons, I hypothesized that species-specific soft proteinaceous structures may exist in diatoms, controlling and regulating the precise deposition of silica. In the current study, I provide evidence for the first time of a pore like protein complex in the *Thalassiosira pseudonana* diatom cell membrane, explored using atomic force microscopy. The primary objective of this study was to understand the precise mechanism of the deposition of the silica exoskeleton, or frustule, in diatoms. Preceding the formation of the silica structure, silica in the form of silicic acid is taken in by the diatom from its environment and collected in a large vesicle. The vesicle docks at the cell membrane and releases its contents to form the shell of the diatom. The molecular mechanism of release and arrangement of the frustule was the focus of the study. Using high-resolution electron and atomic force microscopy, both the frustules and the cell membranes of diatoms were examined. Examination using AFM yielded a circular protein complex on the diatom cell membrane. T-SNARE s or target proteins are proteins that are required for the secretory vesicle docking and fusing process in cells. Western blots were used to validate the presence of T-SNARE proteins in diatoms, and T-SNAREs were consistently found in analyses of centrifuged diatom pellets. The "pore" structure was positively identified as the silica secretory machinery in this unicellular organism. Further analysis of this complex could yield the answers to many questions, including the details of the deposition of mineralized osseous tissue in vertebrate bone structure. New frontiers in the rapidly expanding field of biological mimicry or biomimetics would be established, especially in nano-scale processes such as drug delivery, the development of catalysts for use in industry, and even nano electronics and robotics. Furthermore, the large role that diatoms play in our environment will allow us to use the knowledge gained from such studies to reverse many of the negative impacts of environmental pollution to our planet, and the use of diatoms as an energy source and for global carbon fixation.

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Category MI L21 A Bacterial Procedure: A Census of Gram-Positive and Gram-Negative Bacteria Fo

Abstract Purpose: To compare the bacteria from human feet and the shoes of human feet before and after deodorizing; if the deodorizer actually affects the human feet itself or the shoe.

Hypothesis: The process of deodorizing will affect the human feet more than the human shoe.

Introduction: Bacteria are found everywhere and could be pathogenic or beneficial. A gram-stain test is performed to identify the bacteria and the bacteria are visible and usually have two outcomes; gram-positive and gram-negative.

Procedure: Make nutrient agar plates. Swab human feet and inoculate swab onto the agar plate. Swab the human shoe and inoculate onto the agar plate. Spray the human foot with the deodorizer and the human shoe, swab both with different swabs and inoculate onto the agar plate. Let the bacteria grow over five days and record the growth of each day. Perform a gram-stain test to determine if the bacteria are gram-positive or gram-negative.

Conclusion: The hypothesis for the experiment was correct; the human feet is affected more compared to the human shoe. The results show a larger difference between the deodorized human foot and the deodorized human shoe; there were a lot more gram-positive bacteria on the deodorized human foot compared to deodorized human shoe.

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Category ZO L22 Macro-invertebrates of the Rose Garden Pond: Part 2

Abstract This is a continuation of my project from last year.

My project's purpose was to create a two-year-long phenological timeline of the aquatic macro-invertebrate life in the four corners of the Henry Ford Rose Garden Pond. The application of my body of data was to help the University of Michigan-Dearborn naturalists conduct pond stewardship operations in such a way as to minimize detriment to the ecosystem. My hypothesis is that with 104 weeks of consecutive data I will be able to draw some conclusions about the macro-invertebrates that I studied.

I acquired my data every Wednesday at approximately 3 p.m. In each corner of the pond, I netted plant matter and placed it into a water-filled pan. I swished the vegetation and removed it. I captured the macro-invertebrates, identified, counted and recorded them, and then released them, with their vegetation, back into their corner. In addition, each week I recorded water and air temperature, ice thickness, cloud cover and any other observations that may or may not affect my study.

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Category ZO L23 What Flowers Do Bees Frequent?

Abstract

The purpose of this study was to identify the flowers that honeybees visited throughout a growing season, based on the pollen present in their hives. It was hypothesized that the bees would collect more pollen from those flowers blooming profusely during any point in the growing season, and this type of pollen would be the most abundant found in the hives.

To conduct this study, pollen was collected from two sources; flowers and beehives, on the University of Michigan-Dearborn Campus from April through September 2008. Flowers were selected by identifying those that were blooming most abundantly in the area. Flowers were picked every two weeks from April through August. The pollen was removed, dried, and frozen. Pollen from three honeybee hives, located next to each other, was collected every two to four weeks (dependent on availability of beekeeper) from May through September. This pollen was also dried and frozen.

The flower and the hive pollen were then prepared on slides, which were examined and photographed with a microscope. The flower pollen was compared to the pollen found in the hives using the parameters of shape, size, and date of bloom for identification.

Results of the comparison between the individual flower pollen and the hive pollen showed that eight-three percent of the pollen found in the three hives throughout the summer, was from the flowers that bloomed most abundantly in the area surveyed. This finding supports my hypothesis that honeybees collect pollen from the most abundantly blooming flowers in the area.

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Category *CH P01* Sludge

Abstract Can you use characteristic properties to separate a mixture of solids and liquids? I did this because to see if separate the pollutions from our water.

Bibliography IPS book

Category CH P02 Fuel For Thought... Recycling Organic Waste Into Energy

Abstract The purpose of this project is to determine if it is possible for a household to construct a simple still that would be capable of recycling its fermented organic garbage into a grade of ethyl alcohol that would meet some of the household's energy needs. The secondary objective of this project is to test other fuel sources to see how efficient they are as an energy source compared to ethyl alcohol. Research indicates that petroleum based products such as gasoline and kerosine are in demand today. Unfortunately, petroleum based products come from crude oil, which is a nonrenewable resource. Ethanol is a clear, colorless alcohol fuel made from the sugars found in grains such as corn, wheat, rice, and other sources such as yard clippings and organic kitchen waste. Ethanol is a renewable fuel source.

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Category CH P03 Wettability Reversion in Plastics Treated with Glow Discharge Plasmas

Abstract Corona discharge treatments are widely used to promote wettability and adhesion in industrial processes for lamination of composite materials, as well as application of paints, adhesives, and inks. However, the effects of the treatment are not permanent. General industrial practice dictates that treated plastic materials be subsequently processed within 4 hours of treatment. In this project, I investigated the effect of corona discharge treatment on various plastics at increasing post-treatment durations to quantify the change in wettability over post-treatment time. To determine how the effectiveness changes with time, I conducted several experiments involving the measurement of contact angles of water droplets on the surfaces of six plastic materials treated by corona discharge plasma. These contact angles reflect the surface energies—a measure of wettability—of the plastics, which are changed during corona discharge treatment. Samples of widely used plastics, such as polyethylene, polypropylene, polystyrene, polyvinylchloride, polyethylene terephthalate, and polymethyl methacrylate, were selected. These plastic samples were mounted on microscope slides and treated with a corona discharge plasma for one minute. At various times after treatment, water droplets were placed on the plastic surfaces. Image analysis of pictures taken with a digital camera was used to determine the contact angles of the water droplets. My study showed that the effect of increased wettability of plastic surfaces by corona discharge treatment was not completely irreversible. This reflects the partial reversion of the plastic surface back to the untreated state. The measured contact angles of all plastics slowly increased as a function of elapsed time from two minutes to five days. This experiment showed that, for most plastics tested, the contact angle recovered to around 50% of the value for the untreated contact angle within 15 minutes. After four hours, the contact angle recovered to around 65% of the value for the untreated contact angle. After 5 days, the contact angle recovered to around 75% of the value for the untreated contact angle. Thus, processes which require high wettability after treatment of the materials should take place within 15 minutes after corona discharge treatment. However, if processes do not require such high wettability, several days can elapse before the subsequent processes must take place. These results have useful applications in reducing process costs and maximizing process output in fields such the automotive, aerospace, and medical industries.

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Category CH P04 Grow Your Own Gas: Making Cellulosic Ethanol From Common Biomass

Abstract The purpose of this experiment, "Grow Your Own Gas," was to demonstrate that ethanol could be produced through the breakdown and fermentation of cellulosic biomass or any material containing rigid plant matter. The project consisted of three major steps: hydrolysis or breakdown of the cellulose in the biomass; fermentation of glucose; and separation. Five cellulosic materials were selected: grass, sawdust, banana peels, leaves, and newspaper. Then, three sets of these five materials were prepared for the experiment; groups were labeled A, B, and C to correspond to the method of hydrolysis used to break the material down. Group A was exposed to acid, B to cellulase (a cellulose-consuming enzyme), and C to both acid and enzyme, all for seven days. After hydrolysis, the decomposing biomasses were neutralized in pH with lye and fermented with yeast for six days. The resulting product, a mixture of a solid mash, liquid ethanol, and impurities, was separated; the mixture was strained through a wire mesh screen to remove the solids, and a freeze distillation process was used to remove water. Finally, after two rounds of separation, the resulting liquid was tested with coolant and alcohol breath strips which confirmed the presence of ethanol in all 15 samples. Group C, broken down by the combination of enzyme and acid hydrolysis, produced the strongest presence of ethanol. Overall, "Growing Your Own Gas" proved that renewable fuels, like bioethanol, can be produced from commonly-found cellulosic materials through hydrolysis, fermentation, and separation.

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Category CH P05 Biodegradable Nanoparticles: Drug Delivery System for Cancer

Abstract

The aim of my project is to develop biodegradable nanoparticles, an anticancer drug delivery system so when the anticancer drug is delivered to the target the system will be completely metabolized without any toxic metabolites. This will reduce the burden of toxic waste accumulating inside the human body.

The effect of polymer ratio, pH, and agitation speed on the formation of nanoparticles was studied. Nanoparticles were created by mixing weight to weight ratios of protamine and dextran sulfate (1:1, 1:2, 1:3) using zinc sulfate as a cross linking agent. pH buffer solutions were added to each weight ratio samples to create pH 5, 7 and 8 mediums. Each sample was loaded with doxorubicin. Samples were agitated for 5 minutes with the magnetic stirrer at 600rpm, 1000rpm, and 1400rpm values at room temperature.

My project confirmed that with the 1:1 weight ratio of Protamine sulfate and Dextran sulfate at a neutral pH of 7 and agitation speed of 1400 rpm at room temperature produced nanoparticles with an ideal size of 205nm that is within the recommended range of 100-250nm. Nanoparticles were further characterized by dynamic light scattering zeta plus analyzer and obtained Polydispersity Index (0.7080) and Zeta Potential (-34.44mV) values at the size of 205nm. A higher value in polydispersity index and zeta potential confirms the stability of the nanoparticles in the colloidal system. I analyzed my data with Analyse-it® Statistical Model and obtained p value of 0.0001 which is statistically significant.

This concludes it is possible to create stable biodegradable nanoparticles.

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Category CS **P06** Software, is it really helpful

Abstract

This experiment tests the effects of problem-solving software on learning. The hypothesis for this experiment was that the students that did not use the software will have overall higher scores. Half of the test subjects used software while learning the distance formula. The other half of the students did not use the software. After the lesson, the software was taken away and all test subjects were issued a test. The results showed that the students that used software while learning had overall lower scores and the students that did not use the software had overall higher scores. These results supported the hypothesis. Therefore the experiment indicated using problem-solving software while learning a subject will inhibit learning and would encourage dependence on software.

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Category CS P07 Catch it Early: Web-Based Screening for Melanoma

Abstract

Artificial intelligence has the potential to improve early detection rates for melanoma. If caught early melanoma, the most dangerous form of malignant skin cancer, can be surgically removed with a near 100 percent survival rate. Despite this, melanoma kills more than 60,000 people every year. Identifying early-stage melanoma with the naked eye is exceptionally hard, meaning that the average person is unaware of their melanoma until later stages. An automated diagnosis system was created using artificial neural networks and principal components analysis. The system screens images for signs of melanoma and produces a positive or negative result. The computer-aided melanoma diagnosis system achieved an overall accuracy of 75%. A freely available website was created using the system. The website will allow more accurate self-examinations, second-opinions for dermatologists, or clinical use in rural areas or third-world countries. Hopefully, this will increase early detection of melanoma and reduce mortality rates.

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Category CS **P08** HotHouse: A Computer Program to Simulate the Thermal Characteristics of a Home

Abstract HotHouse is a program that simulates the thermal characteristics of a home. It takes as input various parameters of a house that effects how heat flows out of the building, information about the home's furnace and thermostat, and actual out door temperature data from 2007 measured at Detroit Metropolitan Airport. It then does a complete thermal simulation of the home over a period of time, computing the internal temperature and one minute intervals, determining in the process when and for how long the furnace runs. At the end of the simulation, it reports the furnace run time and furnace energy consumption on a daily and monthly basis.

The home data is maintained in a file that can easily be changed to simulate different types of houses or to study the effects of making changes to an existing house. This can be useful to study how the change of a parameter, such as increasing the amount of insulation in the ceiling, effects the energy consumption of the home.

The program was used to compare a house built with building from the late 1970s with the same house built using current technologies. Six different items were changed and the effects of each change on the energy consumption was determined by running a simulation with only one change made. The simulation were run over the period of October 1, 2007 through April 30, 2008 which covered the time when the furnace was needed the most.

The last simulation compared the home with all old items versus the same home with all new items. Since the program calculates the total energy used over a complete winter it is possible to use it to determine the cost savings or pay-back period of investing in energy saving items like new windows.

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Category CS **P09** Central Authentication

Abstract

The Dearborn Christian School has a computer lab filled with a number of unsecured computers. The administrators of that school would like them to be secured using a centralized authentication system, in each computer shares the same user accounts data. However, there are two main obstacles: all of the computers have Microsoft Windows XP installed and there is no Microsoft Windows "Server Edition" license. To complicate matters, some of the copies of Windows XP are of the "Home Edition" for which Microsoft disabled joining "Domains" which allow a form of centralized authentication.

The school has had a GNU/Linux based server running an old version of Redhat to provide shared file storage with minimal security to secure the few files important to the school. This project is the upgrading and administering of this server while preparing and building a centralized authentication system that does not require using either the "Professional Edition" or "Server Edition" of Windows. The result should give the school a security and networking setup similar to many universities: each client will run Windows which accesses a GNU/Linux ("Unix")-based back-end.

To reach this goal, the following existing technology/software will be leveraged and, as they are designed to be, interconnected: Samba, Windows XP, pGINA, MIT-Kerberos5, OpenLDAP, and GNU/Linux (Gentoo). Though each of these technologies is simple to use independently, work has to be done to glue them together.

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Category CS P10 Effect of Predominant Pixel Color Variation on Computer Monitor Power Consumpt

Abstract Effect of Predominant Pixel Color Variation on Computer Monitor Power Consumption

With numerous uses of energy in today's society, over usage of energy is highly abundant. Because the excessive usage of energy may result in environmental and sociopolitical impacts, methods of reducing Power consumption are always desirable. Through experimentation, this work may offer a promising new method to reduce the amount of Power consumption of a computer monitor through use of different screen pixel color predominance.

Data required for this experiment includes Voltage levels of the computer monitor during the display of each individual color template on the computer monitor. Additionally, current flow of the computer will be measured for Power consumption calculation.

Different computer templates of visible spectrum colors will be prepared, in addition to the standard black and white color. A standard computer monitor is prepared, with exposed sensing circuitry so as to readily measure power consumption through the Central Processing unit.

Voltage levels will be measured through use of a voltmeter. Probes of the voltmeter will be attached to different areas of sensing circuitry on the computer monitor to measure the current voltage of the monitor when different color templates are displayed. An ammeter is used to measure electrical current flow for the computer monitor.

Each color template is displayed on the screen, and Voltage levels are measured for three trials for each separate color template. Collaterally, this results in a total of 36 trials, with three trials for nine color templates.

Once Voltage levels are recorded, they are multiplied by the Current Flow of the Computer monitor to yield levels of Power Consumption for each individual color. All results are compared.

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Category EA P11 The Science of Dominos

Abstract Earthquakes are very destructive and affect people's lives greatly. I did this project so that people can prepare for earthquakes and be safe when an earthquake hits. I wanted to know if earthquakes have more of an effect on houses with denser bases. My hypothesis was that earthquakes are more destructive on houses with less dense bases. I investigated this problem by putting bricks (dense) and wood (not dense) on a treadmill with dominos on top of them. As I ran, dominos fell and I recorded how many dominos fell each trial. This is a simulation of an earthquake because I am causing vibrations as I run and the dominos represent houses. My results show that when comparing the number of dominos that fell on wood to the number of dominos that fell on bricks, the p-value was 98.9%. The density of a base is not significant in making a house safer in an earthquake. This project doesn't contribute to the area I live in, but it could contribute to areas where earthquakes happen very often. They should build houses that are safer in the presence of an earthquake in these areas.

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Category EN P12 Electromagnetic Mass Driver

Abstract As the human race continues to explore the vastness of space, the need for a more cost-effective means of reaching orbit grows. The purpose of the project is to research and develop a viable solution to this problem. The main focus is the use of electromagnetic accelerators as a viable means to reach orbit. By demonstrating tuned and efficient RLC circuits as well as effective stage timing and power management, this project will present an alternative to conventional rocket propulsion.

The results collected from the project suggest electromagnetic accelerators, when tuned properly and carefully, can achieve efficiencies suitable for the proposed application. With further refinement and development this concept could easily become a large scale replacement for chemical fuel rockets. A smaller scale application that could readily be implemented is the use of electromagnetic accelerators to launch numerous micro-satellites into orbit instead of single, large satellites. The project's results support the concept and the possibility of reaching escape velocities.

The specific approaches used in the project set it apart from other common designs. The implementation of a single, universal power source for all of the stages of the accelerator allow for far greater control of power levels throughout the firing sequence. Optical triggering of each stage provides better timing for the solenoids opposed to manual timing of each stage. Tuned RLC circuits provide balanced inductance, resistance, and magnetic field strength to achieve lower switching times and more powerful solenoids. With all of these ideas and concepts applied to the project, it is able to produce results that are significant and substantial.

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Category EN P13 Improving Heat Transfer in a Passive Liquid Cooling System

Abstract Computer processors are continually getting faster, and putting out more heat. The increased heat has the potential to damage the processor and other components, which can be extremely costly. The traditional way to combat overheating is a heatsink and fan. Heatsinks are designed to be contiguous with the surface of processors, increasing the surface area, which increases heat transfer.

In phase 1 of this project, it was found that a brass, water filled heatsink that utilized natural convection cooled a CPU better than a standard heatsink and fan. The goal of this project was to increase the efficacy of the phase 1 heatsink. A new design was made for the phase 2 heatsink that consisted of a water filled brass box with 2 concentric coils of copper tubing that are open to the air.

Both the phase 1 and 2 heatsinks were tested by running a CPU stress tester, and a temperature monitoring software that recorded the processor's temperature every 5 seconds simultaneously. A third program, made specifically for this project, was used to average the temperatures recorded, and find the difference between the initial temperature and the average temperature.

In a facility with 100 computers, 3000 KWH of electricity consumed solely by CPU fans. If that facility adopted the phase 2 heatsink, the 3000 KWH would be cut from the electricity bill, and decrease the drain on the natural resources used to produce the energy.

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Category EN P14 The Effects of Concrete Composition on Bridge Flexibility

Abstract

The purpose of the experiment was to evaluate the effects of different compositions of the bridge deck on the resulting structure's flexibility. The experiment was conducted using six unique combinations of cement, sand, water, lightweight aggregate, metakaolin, and two types of fibers called polyvinyl alcohol, PVA-1 and PVA-2. Each of the model decks was created using a mold in which the mixture was then allowed to set for one week to let the cement harden and achieve maximum strength. After each of the models was created, they were placed on supports to simulate the pillars of an actual bridge. Then, the amount of weight on each deck was progressively increased by pouring sand into a container placed in the center of the model. The total weight of the container of sand was then recorded when the model deck broke, which is the load capacity of the deck. The break in the model with a standard cement mix was clean and sudden because the material was very brittle, which is detrimental to bridge safety. The incorporation of lightweight aggregate and metakaolin improved the model deck's flexibility. But the greatest flexibilities achieved were from the models with PVA fibers. Furthermore, the model containing PVA-1 performed better than the one containing PVA-2. Thus, not all fibers are equally effective in increasing a bridge's flexibility.

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Category EN P15 Using PSpice Simulations to Predict the Performance of a Cuk Converter

Abstract My project was to see how different IGBT (Insulated Gate Bipolar Transistor) models affected the performance of a Cuk converter as simulated by PSpice. I expected the simulations with the simple model to run faster than the simulations with the Infineon model. I simulated 3 IGBT models: a mathematical model available from Infineon and 2 behavioral models. The first behavioral model was as simple as possible, a switch and voltage source. I added a resistor and capacitor in parallel to the device to create the second model (to simulate switching losses). To measure the usefulness of the simplified models, I ran simulations of the converter with each IGBT model but with one parameter changed to see how the converter responded to this change. I calculated high-level waveforms (such as efficiency, input power, and charging current) by integrating the functions over a 8.333ms period with PSpice and converting the integrals to normal averages and RMS averages with established formulae. I simulated the circuit over 108.333ms to generate steady state conditions rather than startup conditions. The high-level waveforms produced by the models were all within a few percent, proving that simpler models could simulate as well as a complicated one. In addition, the simplified models ran about 50 times faster than the Infineon model. The contributions made by this project are applicable in any IGBT use, especially the field of hybrid vehicles.

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Category EN P16 The Little Engine That Could... Power Itself Using Alternative Fuels

Abstract

This experiment tested which alternative fuel would most effectively power a steam engine. The purpose of this experiment is to find an alternative energy source that is effective. Water covers nearly 70% of the Earth's surface and this project may find an effective way to use water as a power source. The steam engine was first patented by Thomas Savery. A steam engine works by using a heat source to boil water forming steam. This steam is forced into the motor unit and moves the piston.

This experiment was conducted by using 6.0g of Esbit solid fuel, wood fire starters, wood, corn, peanuts, pistachios and soy beans to power a steam engine. The steam engine was connected to a wheel that could accurately calculate the number of revolutions the engine made. Each fuel had a total of three trials in which the amount of time for the water to boil, the amount of revolutions made by the engine, the time the engine was revolving, the RPM's of the engine and the mass remaining after the trial was measured. Each fuel burned for 1 minute 15 seconds after the water had began to boil and then the steam engine was activated by $\frac{1}{4}$ turn of the flywheel. The hypothesis was if 6.0 grams of Esbit solid fuel, peanuts, soy beans, corn kernels, pistachios, wood, and wood fire starters are burned to power a steam engine, then the Esbit solid fuel will be the most effective fuel based on the amount of time to bring the water to a boil, the amount of revolutions made, the time revolving and the amount of mass remaining after the trial.

After this experiment was completed, it is safe to conclude that the wood fire starters were the most effective fuel based on all categories tested. The wood fire starters were the quickest to bring the water to a boil, had the most revolutions of the steam engine made, the longest time of the engine revolving, the most RPM's, and the most mass remaining after the trial of any fuel. The corn kernels were the only fuel that did not bring the water to a boil. Based on these results, it is safe to conclude that the hypothesis that the Esbit solid fuel is the most effective fuel is incorrect. These results also show that the wood fire starters are an effective fuel to power a steam engine and that corn kernels are not an effective fuel.

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Category EN P17 Catching SunBEAMS

Abstract

Solar panels play a large role in lessening the world's dependence on non-renewable fossil fuels. In order to obtain the greatest efficiency from a solar array, the panels in the array must be placed at the correct angle in relation to the sun's position above the horizon at noon. This poses the question: If a stationary array positioned at the correct angle is more efficient than one that is not at this angle, will not an array designed to automatically follow the sun be even more efficient? Having considered this and researched the existing body of knowledge, the following hypothesis was formulated: A solar panel which automatically follows the sun will generate more voltage than a stationary panel. A robotic device to keep the panel properly aimed was designed and constructed using BEAM technology. It was then subjected to eleven test periods, each lasting one day. During these periods the voltage produced by the moving panel was gathered, along with that produced by a stationary control panel of the same model. The data was gathered using a Lego Mindstorms NXT microprocessor and was wirelessly transferred to a laptop computer. The data was analyzed using computer-generated graphs and it was decided that the sun-tracking solar panel did indeed produce more voltage than the stationary one. The difference in voltage produced was found to be 0.1-0.5 percent.

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Category EN **P18** Which Structural Design Best Resists Earthquakes?

Abstract

This project was designed to test the ability of different structural designs to resist lateral loads. The application of this is to earthquake engineering, due to the fact that earthquakes apply lateral loads to structures. The experimentation was done by constructing model buildings out of popsicle sticks. Two types of building designs were used in the experiment: an x-braced structure and a cube structure as a control. Each building was tested five times on a homemade shake table that was designed to simulate earthquake forces.

To determine which structure best resisted lateral loads, each was shaken at the same level of intensity until failure of the structure. Failure was constituted primarily by the detachment of any of the four walls from the rest of the building. This was not always a clear cut definition, but there was little ambiguity on whether a structure had failed or not.

After the failure of a structure, the building would be reassembled and put back onto the shake table. This was repeated five times for each structural design, giving a total of ten trials.

When experimentation was completed it was very clear that the x-braced structures had best resisted lateral loads due to the fact that each trial of the x-braced structures exceeded those of the cube design. Not only did the times for the x-braced structure exceed those of the cube structures every time, but also exceeded by a large increment. Approximately one minute longer for each trial.

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Category EN P19 Linear Analysis of Times Series to Identify Optimal Time Parameters for Lane De

Abstract The goal of this project is to determine the time parameters for the two-second rule first developed by Delphi and implemented by Ford Motor Company to control the trigger of the adaptive Lane Departure Warning System (LDW). The two-second rule states that the hypothetical driver must be in the 'pose not forward' position for two minutes and in a state of distraction for one minute inside the lane. 'Pose not forward' means that the driver is not facing forward; this is detected by a camera focusing on specific facial features, such as a nose or ears. If the time limits are met by the driver then the LDW system assumes that the driver is exiting the lane unintentionally and is triggered. However, in Ford VIRTTEX lab's study of the LDW several of the subjects were not warned about the time or were warned at the wrong time. Six of the total subjects received a delayed warning because of the two-second rule. In order to identify the optimal time parameters for the LDW system several MATLAB scripts will be coded and utilized. The first script will analyze the variables of each of the forty subjects to identify the amount of time that the subject was 'pose not forward', the amount of time that the subject was in a state of distraction and the time difference between when the LDW was triggered and when the subject actually exited the lane. The second MATLAB script will identify the 'noise' of the LDW system. 'Noise' is similar to percent error of fractional error; it represents the technological faults. While identifying the optimal time range for the LDW to be triggered might be finding a specific number, it might not be the perfect trigger rule. Therefore, this project will also entail a third script that identifies the cumulative sliding time window. The cumulative rule will combine all of the driver's 'pose not forward' time to account for technical or behavioral mistakes. While the goal of this research project is to utilize MATLAB to identify the optimal time parameters for the LDW trigger, the purpose of this project is to determine the safest and most accurate method of applying the LDW technology to everyday life.

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Category EN P20 Power Tower: Designing Green Buildings with Integrated Wind Turbines

Abstract This project's purpose was to determine what kind of wind turbine works best, a regular wind turbine or an integrated wind turbine. Integrated wind turbines are wind turbines that can be used for multiple purposes, including commercial residences. Wind turbines are integrated in the design of the building and using the building's shape as an airfoil, wind energy can be maximized. Two integrated wind turbines were constructed and compared to a free stream wind turbine. The integrated wind turbine buildings consisted of two towers each. The two wind turbines were a rectangular base building design and an airfoil base building design. Testing for power produced, the airfoil based integrated wind turbine produced the most wind energy, the rectangular base building design coming in second, and lastly the free stream wind turbine. Therefore in conclusion, an integrated wind turbine design harnesses more wind energy than a conventional free stream wind turbine. This is due to the fact that wind is accelerated in between the two towers which allows for greater RPMs of the propeller.

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Category MA P21 Harmony and Discord

Abstract Harmony and Discord
Pelham C. Barron
Huron High School, Ann Arbor, Michigan

This project compared irrational ratios of sound wave frequencies with rational ratios of sound wave frequencies. These were generated by plucking taut strings of specific lengths and subjectively rating them as harmonious or discordant. Drawings of the frequency ratios were produced by a harmonograph and a computer model. The closer the irrational ratio was to a rational ratio, the more organized and less chaotic the drawing was. Ratios very close to rational ratios almost sounded pretty good while those that were way off sounded very dissonant or out of tune. Frequencies in rational number ratios align themselves periodically causing the rational sounds and drawings to look neat. The irrational ratio drawing and sounds never completely aligned making the drawing and sound very chaotic.

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Category MA P22 Patterns in Transitive Relations

Abstract

The question of how many transitive relations there are on a set with n elements is currently an open question in the field of mathematics. A transitive relation is a relation on a set such that, if (a, b) and (b, c) are in the relation, then (a, c) is also in the relation. The number of transitive relations on a set grows extremely rapidly as the number of elements increases. The number of transitive relations has only been counted for sets with sixteen or fewer elements. No formula for the number of transitive relations on a set is known, so it is as yet impossible to predict the number of transitive relations on a set. Answering this question is beyond the scope of the present project. However, this project does make some headway in identifying some specific types of transitive relations in an attempt to count some of the transitive relations on a set. In this study, patterns in transitive relations on sets with a small number of elements were analyzed and attempts were made to find generalizations from these patterns. These small sets were chosen because they are large enough to insights into the problem, yet small enough to be manageable. In examining transitive relations on these sets, several patterns emerged. Some theorems and conjectures were formulated that provide a starting point for answering the larger question about the number of transitive relations on a set with n elements. It is conjectured that any transitive relation with sufficiently many elements is almost reflexive (has not more than one non-reflexive relationship), where "sufficiently many" is a function of the cardinality of the set the relation is on. If true, this conjecture reduces the number of relations that must be considered when counting the transitive relations on a set.

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Category MA P23 Market Behavior as a Function of Macroeconomic Factors

Abstract Recent financial news and in particular the stock market performance in the U.S. has been gloomy. The primary United States stock market index, Dow Jones Industrial Average (DJIA), lost approximately 40% of its value in the period from December 2007 to November 2008. With this situation at hand investments are put at a greater risk. For this project, a stepwise regression method was used to find an equation to predict the performance of the DJIA. A literature review was done to identify macroeconomic factors that influence the stock market performance. The factors that significantly influenced the DJIA were the unemployment rate, bank prime rate, and the exchange rate. The multiple regression analysis consisted of an equation taking into consideration quadratic terms and interaction between factors. A spreadsheet tool was developed to present the analysis and to conduct scenario analysis. In addition, predicted DJIA values were compared with the actual data, which showed an accuracy of 66.8%. This tool can be used to forecast the behavior of the Dow Jones Industrial Average based on estimates of the main factors.

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Category PH P24 Sensible Sandbags

Abstract

Through my project, I wanted to find which material, inside a sandbag, would soak up the most water. In my experiment I placed bags inside of halved PVC pipe and poured two cups of water down it. The excess water not soaked up went into a tub at the bottom. During the first trial, gravel did not soak up 1.75 cups of water of 2 poured down the tube. In the second trial it didn't soak up 1.75, and the same results came from the third trial. The average of all three trials was 1.75 cups. The next was sand. The first trial left .75 cups, the second left 1.75 cups, and the third left 1.5 cups. Its average is 1.33 cups. The third was dirt. The first trial left 1.5 cups, the second left 1.25 cups, and the third left 1 cup. Its average was 1.33 cups. The fourth was moss. The first trial left 2 cups, the second left 1.75 cups and the third left 1.75 cups. Its average was 1.83 cups. The last material that I tested was mulch. The first trial left 1.5 cups, the second left 1.5 cups and the third left 1.25 cups. Its average was 1.416 cups. From best to worst, the materials went from, dirt, sand, mulch, gravel, moss. My most important conclusions are that mulch and moss let water pass right through, gravel dams the water, and dirt and sand were the only materials to soak water up.

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Category PH P25 Light Modulation for Optical Communications

Abstract

This project is a study of the interaction between visible light and ultrasonic waves in a dense flint glass via the acousto-optic effect. The practical goal of the project was to assemble a system that uses this interaction to achieve amplitude modulation of a red Helium-Neon laser beam and transmit a song from a CD player to a speaker through free space. This, in turn, has required a detailed study and characterization of the acousto-optic modulator employed.

A parallel-plate dense flint glass acousto-optic modulator driven by an RF signal with a central frequency of 80 MHz was employed. The first order of diffraction produced by the sound-induced grating could be observed experimentally at an angle of 0.73 degrees. This is within 11% of the theoretically calculated value of 0.80 degrees, based on a known value of the speed of ultrasound in dense flint glass of 3630 m/s. Furthermore, a linear dependence was found between the diffraction angle (in radians) and the frequency of the RF signal, as predicted by diffraction theory. An experimental value of 2.0×10^{-10} radians/Hz is found for the slope, in reasonable agreement with the theoretically calculated value of 1.74×10^{-10} radians/Hz.

The intensity of the first order diffracted beam varied linearly with the amplitude of the driving RF signal, allowing undistorted modulation of the laser beam. The modulated beam was then detected by a photodiode set to receive the diffracted beam, and the recovered modulated signal was amplified and played back in a set of speakers, demonstrating the transmission of sound over a laser beam through free space.

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Category PH P26 Insulators: Is Wood an Insulator or Conductor?

Abstract Inquiry into the Conductivity of Wood When Wet

The purpose of this experiment was to determine if wood, when saturated with water transitions from an insulator into a conductor, and if it does, will the density and species of wood affect its ability to become a conductor when wet.

To conduct this experiment, multiple samples of various wood species were submerged in water for specified times after which measurements of mass, volume, density, and conductivity were taken and compared to prior values. The data from the determinations of mass, volume, density, and conductivity for each wood species were then averaged and graphed according to their resistance and absorption.

The wood species used in the experiment were cherry, hickory, maple, African mahogany, pine, poplar, and Red oak. Six samples of each of the seven species were tested using a multimeter and the resistance was recorded; for each piece, mass and volume were recorded, and density was calculated. Then after submersion in 300mL of room temperature tap water for 20-minute increments, for a total of 60minutes, resistance and mass were again measured and recorded, along with calculating the amount of water absorbed by each piece of wood after each submersion. For the most part, the data indicated that as absorption of water increased, resistance decreased.

Observed were the changes in the amount of water absorbed for each time increment, as well as the resistance of each piece of wood. There was a strong correlation between absorption and resistance.

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Category PH P27 Stability of Gold-Thiolate Nanoparticle Vapor Sensors at Elevated Temperatures

Abstract The ability to detect explosives is essential to protecting our country from terrorists. Currently, researchers are developing a micro gas chromatography system that separates and electronically identifies chemical components of a sample. Gold-thiolate nanoparticle vapor sensors, which are being tested as explosive detectors, may be used in the system. However, explosive particles are heavy and nonvolatile, so they have difficulty moving through the column. Operating the system at elevated temperatures overcomes this problem, but it may also damage the heat-sensitive sensors. The purpose of my experiment was to determine the maximum temperature that the gold-thiolate nanoparticle vapor sensors can operate at. Also, I hypothesized that crosslinking the nanoparticles reduces the sensors' sensitivity to heat.

Six gold-thiolate nanoparticles vapor sensors were constructed. They were grouped based on nanoparticle type: 4-mercapto-diphenyl-acetylene (DPA), 1-octanethiol (C8), and 1-mercapto-6-phenoxyhexane (OPH). Each type had one crosslinked and one un-crosslinked sensor. A device was engineered to measure the sensors' resistances. Resistance measurements were taken every 60 seconds for three days at 22°C, 50°C, 75°C, 90°C, 105°C, and 125°C. Labview and Origin software were used to calculate each sensor's normalized change in resistance, a standard measure of stability.

The results indicate that the maximum temperature gold-thiolate nanoparticle vapor sensors can operate effectively at is 105°C. Over 105°C, all sensors malfunctioned (the normalized change in resistance >20%). Overall, crosslinking significantly decreased the impact of elevated temperatures on the sensors ($p=0.0059$). These findings are critical to the development of a micro gas chromatography system that can successfully detect explosives.

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Category PH P28 Musical Decibels

Abstract In the high school setting, musical directors are often in front of groups of ranging ability, for multiple hours a day. It is a major concern that directors may experience hearing loss induced by the loud volume levels of the musical groups. This project focuses on the affects of the musical groups on the director. It was hypothesized that the sound produced by the musical groups would be sufficient enough to cause damage to the director's hearing. Volume in decibels was recorded from the various groups, and ability levels that might be encountered in a high school musical setting. The data contradicted the hypothesis; the decibel levels produced by the groups were not over the dangerous levels, for a significant level of time to cause any permanent, significant damage

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