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Student Presenter: Maria A. Bell-Stuart
W.F. West High School
Chehalis, WA

Extracting *Neospora caninum* and *Toxoplasma gondii* from Beef

Abstract

Parasites are highly feared and too commonly found in our foods. *Neospora caninum* and *Toxoplasma gondii* are the hardest parasites to kill and are often found in beef, pork, and lamb. *Toxoplasma gondii* is extremely infectious to most mammals and although *Neospora caninum* is considerably harmless to humans, it is extremely infectious to livestock. The purpose of this experiment was to test local meats and see if livestock is infected with *Neospora caninum* or *Toxoplasma gondii* through extracting parasite cysts and eggs, and running them on PCR. Visually it was confirmed that there were parasite cysts and eggs in the extracted meat. But none of the parasites I extracted were *Neospora caninum* or *Toxoplasma Gondii*.

Student Presenter: Matthew J. Bremgartner
W.F. West High School
Chehalis, WA

Determining the Necessity of RNA Polymerase Pausing After the Region 1-2 Hairpin Structure in the Tryptophan Operon of *E. coli*

Abstract

The tryptophan operon in *E. coli* is responsible for regulating the production of tryptophan in the cells. There are two regulatory functions, primary and secondary, that later of which was the focus of this lab. The purpose of this experiment was to determine the necessity of the region 1-2 hairpin structure that forms in the secondary regulatory function, also known as the trpL gene. It was hypothesized that the 1-2 hairpin structure was very necessary because it would not be advantageous for the cell to waste energy on an unnecessary process. In order to perform this experiment, the trpL gene was modified so that region 1 could no longer bind to region 2. Then, the GFP gene was attached to the modified trpL gene and cloned into *E. coli*. Finally a fluorometer was used to measure the amount of GFP in the cells and consequently the amount of gene expression allowed by the trpL gene.

Student Presenter: Ashiyah M. Cays-Vesterby
Sequim High School
Sequim, WA

The Use of Antenna Pigments from Marine Algae for Sensitization of Photovoltaic Cells

Abstract

Solar energy is inexhaustible, available worldwide and generates no harmful pollutants. Solar cells are devices that convert light energy into electricity through the photovoltaic effect. Most PV cells are made of silicon. Other cells include thin film semiconductors and dye-sensitized Grätzel cells. Grätzel cells produce energy by a method similar to photosynthesis. Goals of this research included: analysis of marine algae antenna pigments for light absorption capacity, evaluation of pigments and semiconductors for voltage production (open circuit conductions), determination of maximum power generated by optimum combinations of pigments and semiconductors (closed circuit conditions). Antenna pigments representing three algal divisions were extracted and evaluated for absorbance maxima. Grätzel cells were constructed using these pigments. Tests were run on pigment and semiconductor combinations under open circuit conditions. Closed circuit tests were run using the semiconductor titanium dioxide and pigment extracts. Power curves were plotted and evaluated. Green algae chlorophylls showed a 17% higher output than red algae phycobilins. Grätzel cells sensitized with algae pigments exhibit 10% of the power output of silicon cells, but construction is 10% the cost of silicon cells. Unlike silicon cells, Grätzel cells exhibit power output under very low light conditions and retain a charge after the light source is removed.

Student Presenter: Anne C. Ellis
Columbia River High School
Vancouver, WA

The Effect of the Georgia Pacific Paper Mill on Pollution Levels in the Washougal River

Abstract

Water pollution can come from agricultural sources, industrial sources, such as paper mill, and urban run-off. The Georgia Pacific Paper Mill is located on the Washougal River in Camas, Washington. In this experiment the Washougal River was tested for the harmful pollutants, ammonia and chlorine, in order to determine if the paper mill has an effect on the cleanliness of the river. A test for nitrate, a common agricultural pollutant, was also performed to help determine the general health of the river and test for the presence of agricultural pollutants as well as those that could possibly come from the paper mill. Dissolved oxygen levels were also tested to determine the general health of the Washougal River. The part of the hypothesis that stated that the chloride and ammonia levels would be higher at site 3 was supported by the data. The dissolved oxygen levels also supported the hypothesis and supported that the river was less healthy at site 3. The other parts of the hypothesis concerning ammonia and nitrate were not supported.

Student Presenter: Eric A. Foss
Kentwood High School
Covington, WA

A Radiological Survey of Washington State

Abstract

Nuclear Background Radiation occurs everywhere in the environment at low levels, coming from two main sources: radioactive elements in the earth's crust, and cosmic rays. Using a homemade portable radiation survey system, I mapped the levels of background radiation across the State of Washington with 1022 measurements made while driving 3700 miles of highway. I used surface mapping and geographic information software to display the results and find the local geology for each measurement. In general, I found the lowest levels of radiation in the lowlands of Western Washington, and the highest levels in the northeast corner of the state. Using multivariate linear regression, I calculated the background radiation sensitivity to elevation and rock type, and proved the significance of local rock type with ANOVA tests. Using a variance reduction technique, I removed the influence of elevation and geology from my data set. Applying t-tests to the remainder, I found that the Eastern Washington scablands affected by the Great Missoula Floods were higher in background radiation level than the rest of the state. I also found that the loop of highway around the Hanford Site was not statistically different from the rest of the Columbia Basin.

Student Presenter: Hanna Giuntini
Columbia River High School
Vancouver, WA

The Effect of Car Emissions (Heat, CO, and Particulate Matter) on the Health of the Perennial Pansy

Abstract

The purpose of this experiment was to determine the effects of car emissions on the health of the perennial pansy. The hypothesis for the experiment was: If plants are exposed to ten minutes of car exhaust fumes daily, then their growth will be stunted as compared with the control because the harmful CO, particulate matter, heat, etc. will cause the plant cells to become more flaccid and less efficient at creating glucose for energy through photosynthesis. Therefore, the plants exposed to the most emissions will die. The results for this experiment were attained by exposing plants to car exhaust weekly, daily, or not at all (control group). The results of this experiment showed that car emissions have a negative effect on a plant's ability to photosynthesize, thus supporting the hypothesis. The average height and number of leaves, buds, and flowers was much lower in the daily and weekly exposure plant groups as compared with the control. This indicates that the emissions caused the leaves to become flaccid and unable to create adequate amounts of glucose for photosynthesis.

Student Presenter: Melissa R. Greenwalt
Odessa High School
Odessa, WA

Comparison of Crested-Wheatgrass *(Agropyron cristatum)* and Soft White Winter Wheat (*Triticum aestivum)* in Annually Cultivated Soil

Abstract

This research project was designed to determine if a perennial wheat hybrid, using crested-wheatgrass, would result in an increase in the important soil nutrients NPK. Cultivated soil was tested for the NPK levels prior to seeding. Wheat (n=8) and crested-wheatgrass (n=7) were grown in cultivated soil. There was no statistical difference, with the wheat or the crested-wheatgrass, when compared with the soil after analysis with a two-tailed t-test. With more time, and the opportunity for the plants to fully mature, a more effective set of data could be obtained. The data collected at this time, however, would suggest that the cost would not be reduced by a nutrient gain because the nitrogen levels did not rise, therefore fertilizer would have to be used, equaling the money that was not spent reseeding.

Student Presenter: Tiffany A. Hylkema
W.F. West High School
Chehalis, WA

The Development of an Assay Used to Determine the Presence of the Factor V Leiden Mutation in Samples of Human DNA

Abstract

Factor V Leiden is a point mutation that changes the cleavage site of the Coagulation Factor V. The purpose of this research was to develop an assay which will effectively identify the genotype of three known samples of human DNA by amplifying an 810 bp fragment using PCR and restricting the fragment to determine banding patterns. The targeted fragment was successfully amplified in each of the three samples however in two of the samples, an extra fragment was also amplified. The restriction of the product containing only the targeted fragment showed the proper banding pattern associated with the heterozygous form of the mutation (which was appropriate for the sample). Concluding, the assay is effective, however, more research will be performed in order to discover the cause of the extraneous fragment in the 2 samples and eliminate the unnecessary fragment. Once this is completed, restriction results should show proper banding patterns for these genotypes also.

Student Presenter: Colin S. Ip
Bellarmine Preparatory School
Tacoma, WA

Solar Powered Self-Sustainable Waterfall

Abstract

The objective of the project is to design and build a self-sustaining waterfall that runs on solar power and replenishes its water through rainwater. Three rain barrels that are linked in series collect precipitation. They are placed underneath a downspout of a neighboring roof and connected to the waterfall with a float valve. The solar system consists of four solar panels on a single axis tracker. The panels are connected to the pump via a charge controller, two twelve-volt batteries, and an inverter. Electrical and water data are collected for a 124 day period. The water level in the rain barrels and the voltage of the batteries are recorded to measure the waterfall system's ability to be self-sustaining. Therefore the solar panels capability to be a reliable source of power can be analyzed. During the experiment, the rain barrels only had to be refilled once. The voltage of the battery remained relatively constant and above 23 volts, which means that the solar panels proved to be a reliable source of power.

Student Presenter: Marley E. Iredale
Sequim High School
Sequim, WA

Variations in Disjunct Populations of Alaska Yellow Cedar

Abstract

Alaska yellow cedar is a member of the Cedar Family found in the Pacific Northwest. Stands range from Alaska south to the Olympic Mountains. Disjunct inland populations and two isolated populations occur in Washington and Oregon. This research compared morphology, calcium levels and genetic variability in Alaska yellow cedars from geographically distinct populations. Alaska yellow cedar branches were collected from Olympic and North Cascade Mountains (WA), and Aldrich and Siskiyou Mountains (OR). Morphological studies included number of axillary branchlets and length and scale ratio and shape. DNA was isolated from conifer tissues. RAPD analysis was used to detect genomic polymorphisms using two primers in a polymerase chain reaction. Gel electrophoresis was run on PRC products and DNA bands analyzed. Conifer tissues differ in calcium levels. Tissue Ca/Mg levels were measured using the Schwarzenbach EDTA Method. Morphologically, scales from Aldrich Mountain trees differed from other sites. ANOVA's showed no significant differences in branch morphology between sites but cluster analysis showed some relationships. Ca/Mg ratios were highest in trees from the Olympic Mountains. RAPD analysis showed Aldrich cedar DNA is distinctly different and genetic diversity minimal. This study demonstrates genetic changes in isolated plant populations and has implications for genetic conservation during climate changes.

Student Presenter: Alex R. Null
Odessa High School
Odessa, WA

Engineering a Catalytic Converter for a 200 cc Four-Stroke Engine

Abstract

An automobile catalytic converter was used to build the system. The ceramic core of a catalytic converter was cut to a smaller diameter (18mm) because the smaller displacement engine would not produce enough exhaust flow to heat the entire core to operating temperature. Behind the catalytic converter was the converter/muffler system that was a system of baffles and packed with fiberglass silencing material. The stock exhaust system on the small engine was completely replaced with the new system that is being engineered. The new system was slightly larger then the stock system. The exhaust system for the small engine was modeled after a system used on full sized cars, working on the same principals yet it is just on a smaller scale. The data for this study was based on the amounts of CO2 produced from a stock system then the modified system was measured to see if the CO2 levels have been decreased by the catalytic system. The system was able to reduce the amount of hydrocarbons by 25% of the stock level. If all lawn mowers were equipped with catalytic converters there would be at least 5% drop of green house gas emissions in the United States.

Student Presenter: Rylee J. Paris
Odessa High School
Odessa, WA

The Effect of Homeopathic Insect Repellant Using Sagebrush *(Artemisia tridentate)* on Mosquitoes *(Culex sp.)*

Abstract

Mosquitoes are a vector agent carrying disease-causing viruses and parasites from person to person without catching the disease themselves. Malaria, which is transmitted by mosquitoes, remains one of the greatest threats to global health. Sage brush was widely in use by many native North American Indian tribes who used it to treat a wide range of disorders: to heal problems of the stomach, colon, kidneys and liver. The purpose of this research was to test a homeopathic repellant, sagebrush, that naturally repelled mosquitoes. By doing this, a repellent that was just as effective as the commercial repellant DEET, but less harmful would hopefully be found. 20 Culex sp. mosquito were released into a “T” shape tube and had 10 minutes to acclimate to the three different variables (control, commercial repellent and the experimental repellent). Statistically the sage performed similar to DEET at the 90% confidence level ($t \pm 1.70$, $p < .1$, $df = 60$). The hypothesis was accepted because the DEET and the sage were statistically different then the control (water) revealing that the method was viable. This is probable cause to create a method to plant sagebrush in third world countries that are plagued with malaria to decrease the number of mosquitoes.

Student Presenter: Kyle J. Saari
W.F. West High School
Chehalis, WA

Laminar Qualities and Aerodynamic Drag Coefficient with Solar Vehicle Criterion

Abstract

Fuel efficiency has played a very important part in our world today. The better a vehicle's aerodynamics, the better fuel efficiency. An even better efficiency and "green factor" can be achieved with a solar powered vehicle. Two solar vehicle models have been tested thus far to find the most wind efficient design for a vehicle. According to this research, it is not possible to achieve a drag coefficient for a solar car of 0.23 or better, compared to an average vehicle drag coefficient of 0.30 to 0.35 and sport vehicles only being 0.25. For the most part, the shape with the best efficiency is one without seams or abrupt edges. It must let air gradually go over the surface without sudden starts or ends to the surface. The design also must have a very small frontal area. This research was conducted in the best manner in the amount of time given. Stronger and faster equipment along with more accurate force meters are needed to create more valid results.

Student Presenter: Chelsea E. Smith
Columbia River High School
Vancouver, WA

The Presence of Alcohol in Teen Lives: Positive and Negative Effect

Abstract

In this study, an extensive survey is released to 50 students between the grades of 9 through 12 to evaluate the emotional status of each student and the teen's relationship to alcohol, to address the correlation between the two. Mentored by Dr. Brian Goff (PhD, Psychology), the purpose of this experiment is to research the positive and negative effect of the presence of alcohol in teen lives by having them evaluate their personal emotional status/relationship to alcohol in a way that the results could be calculated quantitatively.

Student Presenter: Ceri J. Weber
Columbia River High School
Vancouver, WA

What is the Effect of Repeated Hot Plate Testing on the Baseline and Cumulative Subcutaneous Morphine Dose Response Hot Plate Latencies in the Rat?

Abstract

This study examines the relationship between repeated hot plate testing and hot plate latencies in a dose response curve and morphine dose response scores in male Sprague-Dawley rats. If rats learn to associate a testing environment with pain, and foot-licking with removal from this environment, then learning explains the reduction in hot plate latencies over time. Three pre-testing groups were exposed to a hot plate, a cold plate, and no plate, then tested on the hot plate meter with cumulative subcutaneous morphine injections. Baseline scores showed a significant difference between the pre-testing groups with an ANOVA p value of 0.0019. Differences between the cold plate and hot plate pre-testing groups were insignificant. A dose response curve and an ED50 line were used to display the increase in hot plate latencies with cumulative doses of morphine. The results were insignificant despite differences in the baseline data. Groups familiar with the testing environment did not respond to the stimuli like those in the novel environment. The hypothesis was not entirely supported. The pre-testing treatment was judged to affect the dose response but this was not necessarily due to learning but more likely due to stress.

Student Presenter: Inar P. Zhang
Mercer Island High School
Mercer Island, WA

Novel Roles of Dyx1c1 in Neuronal Migration and Dendritic Arborization: Implications in Human Dyslexia

Abstract

Developmental dyslexia is a prevalent learning disability that afflicts millions of Americans and manifests itself primarily as a difficulty with written language, phonological processing deficiencies, poor executive function, and protracted lexical retrieval. Currently, two major observations have been made in developmental dyslexia: 1) the presence of neocortical malformations in the perisylvian region of dyslexic individuals and 2) the identification of several candidate susceptibility genes (CDSGs) potentially linked to neural development and axon pathfinding. In this investigation we analyzed the postnatal brain anatomy of rats after embryonic disruption of one of the new CDSGs, Dyx1c1, via RNAi-induced knockdown. We utilized in utero electroporation, perfusion, histology, and a customized computer analysis program to determine postnatal effects of Dyx1c1 knockdown. We demonstrate that suppression of Dyx1c1 expression results in neocortical malformations remarkably similar to those seen postmortem in human dyslexics. Moreover, we document significant elaboration of dendritic processes in knockdown subjects relative to controls. This study identifies novel roles for Dyx1c1 in neuronal development, and discusses their implications for understanding the biological substrates as well as therapeutic targets of human developmental dyslexia.