Twelfth Annual

Fall Research Symposium

September 26, 2010
St. Thomas Campus
College of Science & Mathematics
University of the Virgin Islands

Twelfth Annual
Summer Research Symposium

September 26, 2010
St. Thomas, U.S. Virgin Islands

Sponsors:

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- National Institutes of Health, Minority Biomedical Research Support Research Initiative for Scientific Enhancement (MBRS RISE) Program
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  - HBCU-UP Research Scholars
  - Summer Undergraduate Research Experiences (SURE)
  - Summer Sophomore Research Institute (SSRI)
- The Virgin Islands Experimental Program to Stimulate Competitive Research (VI-EPSCoR)

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A cell culture approach to studying fatty acid modulation of porcine lung macrophage-like cell function

Frazly Alexander

Dr. Kevin Fritsche (mentor)
University of Missouri, Columbia

Omega-3 (n-3) fatty acids improve cardiovascular health and may have beneficial effects on the immune system. In these experiments we sought to investigate the anti-inflammatory actions of these fatty acids using a porcine lung macrophages cell line, 3D4/31. First, we characterized how we could modify the fatty acid profile of these cells by adding different combinations and concentrations of different fatty acids to the cell culture medium. Following this we determined how such changes in cellular fatty acid composition affected the production of the pro-inflammatory cytokine, tumor necrosis factor-alpha (TNF-a). Our results show that under normal culture conditions this cell line displayed a fatty acid profile unlike that of lung macrophages isolated directly from pig lungs. We were able to normalize the fatty acid profiles by co-culturing the 3D4/31 cells with linoleic acid (LA) and arachidonic acids (AA) for 24 hr. When a mixture of n-3 fatty acids, EPA and DHA (3:2 @ 50 uM), were added to the culture medium along with LA and AA, the overall fatty acid profile in the 3D4/31 cells was similar to lung macrophages isolated from pigs fed a diet containing fish oil. Culturing the 3D4/31 cells with LA and AA reduced their ability to produce TNF-a. Enriching these cells with EPA and DHA diminished TNF-a production even further. We also investigated the impact of EPA and DHA treatments separately. Our data suggest that both of these n-3 fatty acids reduced porcine macrophage TNF-a production to a similar extent and in a dose-dependent manner. Additional studies are needed to determine the specificity of this effect as well as the underlying mechanism(s) for n-3 fatty acids on immune cell function. In conclusion, the porcine macrophage cell line 3D4/31 appears to be a useful in vitro system to study the immune modulating effects of omega-3 fatty acids.

This project was sponsored by NIH MARC Grant # 5T34GM008422 and by the Miller summer program in animal sciences, University of Missouri, Columbia.

Developing Unique ISSR Fingerprints for Banana Varieties

Hema Balkaran

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In the Caribbean, *Musa acuminata*, also commonly known as banana, is a widely grown crop. It is one of the most exported crops that bring in foreign exchange into Caribbean islands. There is just one species of banana, but approximately 500 varieties some of which are difficult to identify. The fruit has lots of health benefits. Bananas reduce depression and high blood pressure, and help to maintain a healthy kidney and healthy bones. It also provides a lot of iron and helps to maintain healthy eyesight. To identify unknown varieties, it can be helpful to develop a DNA fingerprint by studying the genetic diversity of banana through developing a molecular analysis technique. The purpose of this experiment was to create a unique DNA fingerprint to identify unknown banana varieties. Banana samples were collected from different trees and their DNA was extracted and amplified through polymerase chain reactions (PCRs) using 18 primers. I found out that the different varieties of banana, despite being cloned from one another, have different DNA fingerprints. So far, six primers worked really well with *Musa acuminata*. Some varieties have the same alleles, but some differ. Future research would include getting these same primers to work with different individuals in the same varieties already tested. It would be interesting to compare those genotypes with the ones already obtained. Another step would be to test different varieties and compare their genotypes.

This research was funded by NIH MBRS-RISE grant number GM061325

Fireworm Size and Copepod Parasitic Load are Positively Correlated in Brewer's Bay

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University of the Virgin Islands, St Thomas Campus

The fireworm (*Hermodice carunculata*) is a polychaete well known for its fuzzy, stinging chaeta located along either side of their long slender lengths. Fireworms are scavengers and predators of cnidarians such as corals and sea anemones. Fireworm gills may be parasitized by copepods, *Pseudoanthessius tortuosus*, that belong to the family *Pseudoanthessiidae*, a family that mainly parasitizes echinoderms. This species of copepod was only recently described as parasitizing fireworms in the Caribbean. We investigated the correlation between the size of fireworms and the copepod parasitic load, as well as if there were differences in parasitic load at different sites. Eleven fireworms were captured in baited traps constructed from PVC fittings in the intertidal zone near the UVI dock. Another 11 fireworms were caught by hand in rocky habitat near the airport runway. The fireworms were then placed in anaesthetic solution (Magnesium Chloride) and left for one to two hours. Under a dissecting microscope, copepods were removed, counted and preserved in separate vials for future reference. We found a significant, positive correlation between the parasitic load and the sizes of fireworms found under the dock ($p < 0.001$, $R^2 = 0.8$). The fireworms collected at the airport runway averaged approximately half the size of the fireworms found under the UVI dock. Despite the size differences, the fireworms at the airport runway still fall within the general trend with the parasitic load with the fireworms found under the UVI dock. It remains to be seen whether the parasitic load affects predatory and scavenging ability of the fireworms.

This research was funded by NIH MBRS-RISE grant number GM061325.

Triunitary Perfect Numbers

Leonardo Bardomero

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Given positive integers n and d, we write $d \,||\, n$ if d divides n but the greatest common divisor of d and n/d is 1. We may write instead $d \mid_1 n$. In this case we call d a **unitary divisor** of n. Then we write $d \mid_2 n$ if $d \mid n$ and the greatest common unitary divisor of d and n/d is 1. In this case we say d is a **biunitary divisor** of n, and we write $d \mid_2 n$ in this case. We may extend this inductively: we say d is a **k-ary divisor of** n, and we write $d \mid_k n$, if d divides n, and the greatest common (k-1)-ary divisor of d and n/d is 1. We refer to 3-ary divisors as **triunitary divisors,** and to 4-ary divisors as **tetraunitary divisors,** and so on.

Now let $\sigma^{*k)}(n)$ denote the sum of k-ary divisor of n. We say that n is **k-ary perfect** if $\sigma^{k)}(n) = 2n$. In this talk we will give all our results to date regarding the existence of triunitary perfect numbers.

This research was funded by the University of the Virgin Islands Math Skills Fund and supported by NSF HBCU-UP grant number HRD – 0506096.

Parasitic burden of the American eel, *Anguilla rostrata* by *Anguillicoloides crassus* in two estuaries of South Carolina

Jan-Alexis Barry

Steve Arnott & Bill Roumillat (mentors)

Anguillicoloides crassus is a parasitic nematode that naturally infects the swim bladders of eels in Asia. In recent years, it was unintentionally introduced to Europe and America, where it now infects non-Asian eel species. Infections in the American eel *Anguilla rostrata* are of great concern because the parasite may have severe effects on eel health. Furthermore, eel population numbers have undergone severe declines.
In this study, we examined infections of *A. crassus* in *A. rostrata* at two locations in South Carolina (Cooper River and Winyah Bay) during June and July 2010. Eels were collected by electrofishing and were counted and measured on site before returning them to the laboratory at South Carolina's Department of Natural Resources (SCDNR). There, they were weighed, aged (using otolith ear bones) and examined internally for parasites. Spleen and liver weight were also determined and used as indices of health. In June, parasite prevalence was slightly higher in Cooper River (79.2%) than Winyah Bay (51.2%), but in July the prevalence declined (20% Winyah Bay, 16.9% Cooper River) and did not differ between systems, but indicated it was an effect attributed to the month. Winyah Bay had larger eels, and in June, small/young eels were more likely to be infected than large/old eels in both systems. Infected eels had enlarged spleens. Liver weight was not affected by infection, but declined from June to July.

Funding for this research was by South Carolina Department of Natural Resources Minorities in Marine and Environmental Science Program (MIMES) and the National Science Foundation. This work was also supported by NSF HBCU-UP grant number HRD – 0506096

Happiness and Life Satisfaction in Stateside and Caribbean People

Vanessa Battiste

Dr. Aletha Baumann (mentor)
University of the Virgin Islands, St. Croix Campus

The purpose of this study was to compare the measurements of happiness and well being between stateside and Caribbean people. Arrindell, Heesink, and Feij (1999) reported that Deiner felt that subjective well-being is another term used to describe life satisfaction. In contrast, researchers have described life satisfaction as a “global cognitive judgment of one's life” (Suh, Diener, Oishi, & Triandis, 1998, p. 484). The Satisfaction with Life Scale (SWLS) was created by Arrindell et al. in 1999. The scale measures satisfaction with life, general health, self-esteem, neuroticism, sociability, impulsitivity, disinhibition, boredom susceptibility, dysphoria, and euphoria. The Orientations to Happiness scale created by Petersen, Park, and Seligman in 2005 consists of 18 questions ranging from participants feelings toward pleasure, meaning, and engagement. Results showed interesting variations in relationships between age, gender, and marital status and the pleasurable life, the meaningful life, the engaged life, and the satisfied life. The sample mean score for the pleasure subscale in the Orientation to Happiness Scale was used as the sample statistic in the z-test, $M = 3.82$. The z-test did not reveal a difference in level of pleasure between Caribbean people in this study and the norm group from the United States, $z = .74$, $p > .05$.

Presentation of this work was supported by VI EPSCoR grant #0814417.

An Association Study of Candidate Genes and Preterm Infants with Patent Ductus Arteriosus (PDA)

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OBJECTIVE. Patent ductus arteriosus is a congenital heart defect that leads to abnormal blood flow between the aorta and the pulmonary artery. The incidence of patent ductus arteriosus increases with decreasing gestational age where up to 76.9% of preterm infants are born at 24 weeks gestation have PDA. Our goal was to investigate possible genetic risk factors that may be involved in the etiology of patent ductus arteriosus. **METHODOLOGY**. We conducted an association study to investigate whether single nucleotide polymorphisms (SNPs) in the voltage dependent calcium channel (*CACNA1* and *CACNB2*)genes, potassium voltage gated channel (*KCNA2*) gene and solute carrier family 2 (*SLCO2A1*) genes were markers associated with the smooth muscle contraction of the ductus arteriosus. In our study, 16 single nucleotide polymorphisms were evaluated in DNA samples collected from a cohort of babies <37 weeks gestation. DNA from their parents was also extracted and a family based association test (FBAT) was used to analyze the genotyped data in order to evaluate association of alleles with PDA. **RESULTS**. Of our 16 single nucleotide polymorphisms, a p-value of <.01 was observed in the *CACNB2* gene of the voltage dependent calcium channel. **CONCLUSION**. Studies have shown that both environmental and genetic risk factors play a role in patent ductus arteriosus. Further analysis is yet to be done in our study to analyze whether genetic variation in the genes analyzed is associated with the persistent patency of the ductus arteriosus in preterm infants.

This research was funded by NIH MBRS-RISE grant number GM061325.

Do Black Long-spined Sea Urchins have substrate preferences?

Eugene Brooks Jr.

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The Black Long-spined Sea Urchin, *Diadema antillarum* is a herbivorous marine invertebrate which resides on coral reefs throughout the Caribbean Sea and Atlantic Ocean. This keystone herbivore holds a vital role in preserving a coral dominated reef. This was demonstrated when a massive die-off of this species, in the early 1980's, resulted in a phase shift to algal dominated reefs. *Diadema* densities remain low and algal domination persists. Understanding what factors prevent flourishing numbers of *Diadema* requires knowledge of habitat preferences. The question was asked: Do adult *Diadema antillarum* prefer substrate covered with the brown alga, *Dictyota* versus being bare versus crustose coralline red algae? A two part study was, developed. First, urchin transects were sampled at two areas of Brewers Bay, St. Thomas, US Virgin Islands. Four 30 m transects were used, with 10 randomly chosen quadrats for each transect. Areas with high densities of urchins had little or no brown algae. And conversely, areas with high biomass of *Dictyota* had few or no urchins. In the lab, preference experiments were performed in sea water tables. Bare rocks, rocks with crustose coralline algae, and rocks with *Dictyota*, were used to test urchin preference.

This research was funded by NSF HBCU-UP grant # HRD–0506096 awarded to the University of the Virgin Islands.

The Speed of Sound Through PZT

Nagid Brown

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Today's military uses all kinds of vehicles as a source of transportation. The vehicles and aircrafts used usually do not always meet their life expectancy. This is mostly due to operators being unaware of severely damaging stresses or strains acting on the vehicle or aircraft. The concept behind a Structural Health Monitoring system is the installation of several non-invasive transmitters/receivers along the hull of a vehicle or aircraft that will emit sound waves throughout the vessel and be reflected back to the transmitter or picked up by another transmitter or receiver. The time it takes for the sound wave to be picked up by the receiver, and the frequency and wavelength it's picked up at will determine if there is any damage to the vehicle/aircraft. Experiments conducted included finding the best way to test Lead Zirconium Titrate (PZT) substrate with pulse echoes to determine the speed of sound through PZT.

Funded by EPSCoR and supported by NSF HBCU-UP grant number HRD – 0506096.

Determining Odd Triperfect Numbers

Cherise Burton

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Imagine coming so close to stumbling upon something that scientists deemed non-existent for years. Number theory is so mind boggling. Think back to the first mathematicians who discovered aspects as basic as perfect numbers, the core of my topic. This research project is specifically designed to get a closer look into the world of odd triperfect numbers. In particular, this project aims to find necessary conditions under which these numbers can exist if there are any at all. My hypothesis states that if there exists an odd triperfect number, then its largest prime divisor must exceed one billion. We are calculating the numbers using a program that my mentor has created. It uses simple commands which I have to input to calculate numbers and which allows me to formulate a number tree. We will be able to show that if an odd triperfect number exists, all of whose prime divisors are less than a billion, then 3 cannot be a divisor. This would be a major step toward proving that the largest prime divisor of an odd triperfect number must exceed a billion.

This research was funded by NSF HBCU-UP grant # HRD–0506096 awarded to the University of the Virgin Islands.

Overgrowth Interaction of *Dictyota pinnatifida* with Live and Dead *Porites asteroides*

Charnele Burton[1] & **Kianna Phillips**[1]

Mentors: Angela Dikou[1,2], Tyler Smith[1,2] ([1] College of Science and Mathematics, University of the Virgin Islands ,[2] McLean Center for Marine and Environmental Studies, University of the Virgin Islands)

Presently in the Caribbean, corals have succumbed to the over abundance and replacement of corals by algae on reefs. Scientists are baffled as to why this change or 'replacement' is taking place. In the past, coral reef systems have flourished in low nutrient levels. Over time, this characteristic has changed and nutrient levels have increased highly due to human-induced pollution. With the increase in nutrient levels and other human-induced stressors, such as increase in seawater temperature and overfishing, algal species have become dominant on reef systems and coral reefs seem to have lost their resilience. In nature, algae thrive upon high nutrient content. With this, one can inquisitively state: Do algae possess mechanisms that cause coral mortality in order to take over or does algae take advantage of other factors, which may cause coral mortality for its own blooming to occur? We analyzed data from the 2008-2010 Territorial Coral Reef Monitoring Program of the US Virgin Islands to identify algal "winners" and coral "losers" on USVI coral reefs. *Dictyota spp.* was the most abundant algae on these reefs (15.1% of benthic cover) while *Porites asteroides* (74% of corals) were among the corals exhibiting the highest frequency of interaction with *Dictyota spp.* A controlled field experiment was conducted at the University of the Virgin Islands MacLean Marine Science Center, focusing on the coral species *Porites astreoides* and the algal species *Dictyota pinnatifida*, in an effort to determine whether algae overgrow corals when corals are dead or alive. Expectations were geared towards *D. pinnatifida* not overgrowing the live *P. astreoides*, which would imply that *D. pinnatifida* is dependent on other prominent factors of coral mortality for its overgrowth. If there is no difference however, in the ability of *D. pinnatifida* to overgrow live or dead *P. astreoides*, it can be deduced that algae use mechanisms which cause coral mortality in order to out compete coral and take over. This experimental research will be a stepping stone in addressing the adverse decline of coral reef systems, our barrier reef protectors, throughout the world. Particularly in the Virgin Islands, the results of this research will be useful to environmentalists, the Department of the Natural Resources (DPNR) and the Waste Management Authority (WMA) as it will be insightful in addressing the issue of algal-coral interactions in our ecosystems.

This research was funded by a 2010 VI-EPSCoR Incubator Grant # 203053, NSF HBCU-UP grant # HRD–0506096, and VI-EPSCoR grant # 0814417.

DNA Damage Levels in Skin Tumors from Mice with a Partial Defect in the Hus1 DNA Damage Checkpoint Protein

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Effective genome maintenance is essential in all organisms and acts to prevent diseases such as cancer. Natural sources of DNA damage occur continuously, from endogenous factors, such as oxidative free radicals and replication errors, as well as from exogenous factors, such as UV light and environmental carcinogens. To maintain the integrity of the genome, there exist two main highly conserved DNA damage checkpoint pathways, the Atr and Atm pathways, which serve to protect against accumulation of mutations. In the presence of DNA damage, these pathways are activated and halt the cell cycle, initiate DNA repair, and induce senescence or apoptosis. However, if these checkpoints become altered and are unable to repair damaged DNA, cells acquire mutations that may lead to tumorigenesis. Additionally, if cells acquire excessive mutations, the resulting genomic instability may lead to cell death. This information is especially pertinent to the field of tumorigenesis, as the hyper-replication and increased genomic stress observed in cancer cells may make them more dependent on genomic maintenance mechanisms to prevent cell death. In a previously conducted experiment, a two-step skin carcinogenesis model was created using mice with impaired Atr pathway function. It was observed that mice with decreased Atr pathway function developed significantly smaller and fewer tumors. We hypothesized that the decreased tumor size and incidence observed is due to DNA damage induced cell death as a result of the cells' inability to repair damage caused by replicative stress. To test this hypothesis, I utilized immunohistochemical techniques, using □-H2AX staining as a marker for DNA damage, on tumor sections to determine if mice with an impaired Atr pathway showed significantly more DNA damage than wt mice. The results show that the decreased tumor size and incidence observed in mice with impaired Atr pathway function does not correlate with increased DNA damage, suggesting other factors may be involved. An alternative hypothesis for differences in tumor size and incidence is that cells of mice with an impaired Atr pathway may have senesced in response to oncogenic stress and therefore do not acquire significant DNA damage. To test this hypothesis, p19 immunohistochemical staining, as a marker for cell senescence, will be used. Together these experiments will provide valuable information on the mechanics of the Atr pathway and its role in tumorigenesis.

This research is supported by MARC GM008422

Chemical Resolution of 1,10-Phenanthroline Derivatives with (*R*)-Mandelic Acid

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The resolution of 5,6-dihydro-6-((R)-α-methylbenzylamino)-1,10-phenanthroline-5-ol with (R)-mandelic acid was studied using various solvents to get the best separation of stereoisomers. Mandelic acid protonated the amino group attached to the B-ring to form two salts with different properties. The properties of the two diasteromers were observed and the results compared to those obtained previously with (S)-mandelic acid. The best result was obtained when the salts were crystallized from a chloroform/ethyl acetate mixture (1:1) to give a 30.9% diastereomeric excess. Lastly, the dehydration reaction of the aminoalcohol led to an advanced intermediate

This project was sponsored by NIH MARC Grant # 5T34GM008422

Genetic Analysis of Endangered Species, *Erythrina eggersii*

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Erythrina eggersii is an endangered endemic plant species found in the USVI (St. Thomas, St. John), the BVI, and Puerto Rico. The populations protected on St. John are still threatened and suffer damage due to feral herbivorous animals. Continuous construction and development on both St. Thomas and Puerto Rico threaten populations there as well. We will analyze the genetics of available populations to help develop a conservation plan. Genetic diversity aids in the individual's ability to adapt and increases biodiversity. In this summer's research, I analyzed samples from two populations on St. John (Caneel Bay, Fish Bay) to determine polymorphism and heterozygosity. My data has revealed that the first population (Caneel Bay) 84 % polymorphic alleles and 0.27 heterozygosity for the 25 loci analyzed. The second population (Fish Bay) has 48 % polymorphic alleles and 0.21 heterozygosity for the same 25 loci as the first population. The lower numbers in the second population may be due to the small population size (only 4 individuals). Analysis performed by AMOVA concludes there is no significant difference between these two populations. These average heterozygous and polymorphic results, give hope and starting material for the conservation and recovery of *E. eggersii* populations. Because there is no significant difference between these two populations, seedlings from individuals with higher polymorphism and heterozygosity can replenish those individuals in the second population. Despite average heterozygosity and polymorphism, the populations are very small, which is why damage from independent factors like hurricanes, disease, and invasive species may impact more severely than would a larger population. If any individuals of *E. eggersii* can be found on St. Thomas and Puerto Rico, further analysis can determine if these St. John populations can help to restore populations in these areas or vice versus.

This research was funded by NSF HBCU-UP grant # HRD–0506096 awarded to the University of the Virgin Islands.

Understanding the Function of HIV-1 REV through N- and C -Terminal Truncations

Adrianne Crooke

Jason Frenandes, Alan Frankel, Ph.D (mentors)
University of the Virgin Islands and University of California San Francisco
2010 University of California San Francisco Summer Research Training Program

Regulator of Expression of Virion Protein or REV is an RNA-binding protein that plays a major role in the export of the HIV-1 virus from the nucleus of the cell to the cytoplasm. The main function of REV is to move HIV-1 RNA strands into the cytoplasm before they can be properly spliced. This occurs because REV essentially “pulls out” 9 kb and 4 kb RNA strands before they can be properly spliced to 2 kb strands. The goal of this research is to understand how the different regions of REV affect the export of HIV-1 RNA from the nucleus to the cytoplasm. To determine how this occurs, truncations of REV were constructed using Phusion PCR. A Western Blot was then performed to test whether the constructs expressed any proteins. Those constructs that expressed protein well were used to perform a GAG/POL reporter assay to determine export activity. The results from the GAG/POL reporter assay were inconclusive due to high levels of unspecific binding on the gel. A repeat of the reporter assay must be repeated at a later time in order to determine if the binding is indeed unspecific or if there is export activity.

This research is supported by MARC Grant # GM008422.

Studying the Historical Ethnoecology of the USVI-St. Thomas Fishing Community

Jeremiah Duffy, Benise Tavernier, & Keturah McCrae

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Fishing in the US Virgin Islands has been a part of island survival and culture since before Europeans and slave trade found its way into the Caribbean. However, any potential decreases in Virgin Island fisheries, is likely to directly impact the viability of the local fishing industry, and have negative consequences to the fishing communities and their fisheries-dependent livelihoods. The aim of our research is to collect, study, and analyze local ecological knowledge of fishermen and the St. Thomas fishing community and how such knowledge of the past and the present can be best used to inform future sustainable and resilient decisions in regards to USVI fisheries and its management. Our research methodologies includes community-based participatory methods, observational studies, historical archival research, and literature review to gather subjective information to be evidence-based evaluated using qualitative models and methods of analysis. Such methods include content analysis, qualitative classification, photographic interpretation, longitudinal or panel analysis, classification matrixes, and mapping of social networks. We also seek to understand the conditions and thresholds that are likely to produce a sort of “domino effect” and negative feedback mechanisms, ensuing fishery decline resulting in species extinction, coral decay, loss of jobs and food, and increased fish prices in a recession weakened tourism-based economy. We will contribute to the construction of a web-based archive, which will include our findings and digitally cataloged photos and data. This archive will provide the fishing community and future generations with easily accessible public knowledge about themselves, their history, and their environment.

This research was funded by VI-EPSCoR grant # 0814417 and NSF HBCU-UP grant # HRD–0506096.

Investigation of the Synergistic effects of phytochemical components in select ethno medical preparations on the island of St. Thomas, USVI

Emilio Edwards

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In today's society many diseases have been cured by synthetic medicines made in the laboratories. Efficacy claims from most synthetic pharmaceutical treatments are based on the properties of a single active ingredient. In the Virgin Islands, many locals use ethno medical preparations containing a mixture of several "active" ingredients to relieve themselves of their sickness; this is also called folk medicine. This research investigates the potential synergistic benefits of multi-component ethno medical preparations used in the USVI over single drug therapies. Fractionation/liquid liquid extraction, Brine Shrimp Toxicity assays, LCMS, evaporation and Disc Diffusion assays are some of the methods that were used in our investigation. Of the 28 different ethno medical preparations that were investigated, only three displayed optimum antimicrobial efficacy against S. marcescens bacteria and low cytotoxicity. Kenip leaves (decoction), Red Hibiscus (tonic) and soursop (decoction) will be further investigated to elucidate the bacteriostatic, bacteriocidal, and synergistic vs. additive properties.

This research was funded by VI-EPSCoR grant # 0814417 and NSF HBCU-UP grant # HRD–0506096.

Fungipod Formation in Immature Dendritic Cells Depends on Particle Ligand Size

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Fungal infections are prominent in immunocompromised individuals; however these infectious diseases can also attack the innate immune system of healthy humans. Dendritic cells (DC) are critical antigen-presenting cells responsible for capturing microbial antigens. Assisting DC's regulatory efforts are C-type lectins (CLR), pattern recognition receptors expressed in human immature dendritic cells. Dendritic cells use these CLRs to recognize fungal pathogens invading the body and present them to T cells for initiation of immune responses. Expressed on immature dendritic cells is CD206 (Mannose Receptor), a CLR that is activated by a specific carbohydrate, mannan, found in the yeast cell wall, thereby forming a novel CLR-driven cellular protrusive structure termed the fungipod. We are interested in investigating how physical properties of a fungipod stimulating particle influence the DC's fungipod response. We used beads, varying in size and coated with mannoprotein, to understand the possible contact areas required between DC and yeast for fungipod response. We hypothesized that larger contact areas would have a significantly greater fungipod response. **Differential interference contrast** (DIC) analysis revealed a gradual decrease in fungipod formation as the bead sizes decreased. Interestingly, the 0.5 µm beads were unable to induce fungipod formation in comparison to the larger 4.5 µm beads, which stimulated funigod response. Thus, fungipod formation depends on bead size. Confocal microscopy suggested that the size of the CD206 contact site is correlated to the size of the stimulating particle/bead. The bigger size beads were able to monopolize enough CD206, which resulted in a greater number of fungipods formed. Ongoing experiments using cubes varying in stiffness are examining if DC can utilize the stiffness of the yeast cell wall for recognition of fungal pathogens. Future work entails further use of live imaging of contact site fungipod formation to investigate efficiency of CD206 recruitment in contact site for different bead size and whether a particular threshold is required for fungipod stimulation.

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Volume Rendering: Creating 2D Images From 3D Datasets

Sean A. D. Francis

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Have you ever imagined being able to see a person's skull simply by examining a photograph of the head? Volume rendering has become an increasingly popular field for its usefulness in medicine, engineering, and even astrophysics; it is a technique used to project 2D images from 3D datasets. A 3D dataset is a set of cross sectional scans of a certain object scanned in an MRI or other acquisition devices. Usually, an MRI scan is taken for every millimeter of the object to complete a dataset. When the dataset is rendered, we have the ability to visualize the internal structures along with the external structures in a single projection. During the process of volume rendering, an initial image of a dataset is projected on a grid though the use of voxels. These 3D pixels are each assigned a value from 0 to 255 based on their intensity level. Now a person would manipulate a transfer function, a "linear piece-wise function", to determine which voxels are to be rendered transparent and which are to be rendered opaque and to determine the color of these voxels. This is what creates the 2D image from the 3D dataset. The current volume rendering programs are slow, inefficient, and subject to research. Using the program "vuVolume", we created transfer functions to generate 2D images from 3D datasets that will be used for benchmarks for examination of algorithms that promise to be a faster, more reliable program. The transfer functions, develoed over the summer, have yielded lovely results and for future research, more transfer functions will be needed to test the upcoming program which, after completion will be distributed for academic purposes.

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The human Neuroblastoma cell line SH-SY5Y as a model system to study Pregnenolone Sulfate action in the nervous system

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Pregnenolone Sulfate (PS) is a neurosteroid derived from cholesterol by the process of a cholesterol side chain cleavage followed by addition of a sulfate group by a Sulfotransferase enzyme. Previous studies have shown that PS is beneficial for cognitive and memory function, and that it modulates a number of ion channels, including the N-methyl-D-aspartate (NMDA) receptor. Recently, it was demonstrated that PS induces increases in intracellular calcium in rat cortical primary cells. Due to methodological disadvantages of using primary cell lines, we tested alternate cell lines, such as SH-SY5Y cells, to use as models of mammalian neurons for further study of PS-induced calcium release. SH-SY5Y is a human neuroblastoma cell line cloned from SK-N-SH which was first established in 1970 from a metastatic bone tumour. It has been revealed in prior studies that treatment of the SH-SY5Y cells with retinoic acid (RA) induces the morphology of a neuronal cell. SH-SY5Y cells express NMDA receptors in both the undifferentiated as well as differentiated state, and we hypothesized that the PS would induce a calcium response in these cells.

The first goal of our experiment was to monitor the progress of differentiation with RA visually using phase microscopy and biochemically using immunohistochemistry. A preliminary visual inspection of the cells differentiated in 9-cis retinoic acid suggests that after a 10 day differentiation period the cells do not retain their neuronal morphology. We performed initial optimization of the immunostaining conditions in primary culture neurons, which were labelled with Microtubule Associated Protein 2 (MAP2)-Fluorescein isothiocyanate (FITC) Green, a marker for neuronal cells; Glial Fibrillary Acidic Protein (GFAP)-Texas Red, a marker for glial cells, 4-6-Diamidino-2-phenylindole (DAPI) – Blue, a nuclear stain. The initial primary culture staining results are consistent with the presence of both neurons and glia in culture.

It was vital to determine whether or not the SH-SY5Y cells demonstrated increases in calcium in response to PS. We loaded the cells with Fluo-4 calcium-sensitive dye and the confocal microscope to image the fluorescence intensity of calcium in the cell. In initial experiments, the SH-SY5Y cells responded to PS at 50 pM, however additional experiments are required to confirm this result. The Calcium imaging proved to be challenging due to the fact that the cells had a tendency not to adhere to the dishes. Use of gelatine or methyl cellulose in the perfusion solution may be considered in future studies to correct this problem, and Brain Derived Neurotrophic Factor (BDNF) may be used in addition to RA to prevent the cells from reverting back to their original morphology. The human neuronal cell line SH-SY5Y is a promising model system for testing PS calcium responses, and should prove useful for further studies in the development of novel human therapeutics.

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CariPac Internship with UPR in Puerto Rico

Akima George

Prof. Sally Gonzalez, Dr. Angel Gonzalez, Dr. Gladys Gonzalez,
Dr. Robert Godfrey (mentor) of CariPac

Caripac is an agricultural program for Caribbean and Pacific students. Although it focuses on agriculture in the islands, non agricultural majors are accepted as well. As the first Caribbean student to partake in the Caripac program and the only non agriculture major in the group, I learned a lot about the agricultural techniques in Puerto Rico and in the other Pacific islands. The purpose is to inform students of the existence of this program and to encourage students to take advantage of this opportunity. The internship exposed the students to agriculture in organic farming, organic pest control, and organic fertilizing. We visited orchids, coffee, bananas, and mango plantations. We helped with sorghum seed packaging, herding and milking cows, and taking care of piglets by tagging and giving them iron injections. We also visited a rabbit farm and made ice cream, cheese, and sausage.

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Effect of Sarcotesta on Carica Papaya Seed Germination

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Carica papaya L. is a fruit bearing tree whose seeds are surrounded by a thin sheet of a juice-filled membrane called the sarcotesta. The objectives of this project were to determine the influence of the sarcotesta on the germination of papaya and if the affects were different based on variety. Ten varieties of papaya were used for seed extracted from mature fruit that had varying seed size and smoothness. Approximately half were clean of the sarcotesta and the other half were left with sarcotesta intact. Two trials were done, in situ and in vitro. The results revealed that the sarcotesta accounted for ten to twenty-seven percent of seed dry weight. Both trials indicated earlier germination for seed without the sarcotesta. For all ten papaya varieties, seeds with the sarcotesta intact experienced delayed germination, lower germination percentage and seedling failure after germination. Removing the sarcotesta from papaya seeds can improve the rate and survivability of germinating seeds.

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Nuclear Transformation of *Valeriana* Using Biolistic Gun for Transient Expression

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Plants have been the pioneers of many biotechnological efforts for quite some time now, because of their importance to the drug, food, and cosmetic industries, as well as many others. Though, biotechnologists have succeeded in the genetic engineering of a number of plants, there is still room for even greater strides in this specific discipline. *Valeriana officinalis*, a perennial herb with uses as a sedation and anti anxiety agent is one of such plants that merit biotechnological undertakings. Thus, the question was asked, “Is the nuclear transformation of *Valeriana officinalis* possible using the biolistic delivery system method of gene transfer?” In carrying out our experiments, we utilized juvenile and mature leaves and petioles. After biolistic delivery procedures were carried out on these plant tissues, we employed the results of a kill curve that we had established prior to gene delivery in order to isolate transformed and non-transformed cells. Transformed plant cells would survive, as they had been bombarded with a plasmid that encoded for resistance to Kanamycin, an antibiotic that proved most deadly to non-transformed cells. In addition to the use of a selectable marker system, we also incorporated two visible marker genes, being the Green Fluorescent Protein (GFP) or Beta-Glucoronidase (GUS) into specific plasmids. Though precise quantification was not done, positive results were obtained. Therefore, we can conclude that the biolistic approach is one that may be employed in the nuclear transformation of *Valeriana officinalis* with regard to transient expression.

This research was funded by the National Science Foundation.

The Genetic Structure of Two Mangrove Species found in the Virgin Islands

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Although mangroves have significant ecological importance to our marine ecosystems, they have been diminishing rapidly over the last 30 years. Alarmingly, 20% of mangroves found around the world have been depleted and 67% of the mangroves found in the Virgin Islands have been destroyed. Therefore, in an effort to find appropriate ways to conserve these mangrove we seek to find out more about the population genetics of *Rhizophora mangle* (red mangrove) and *Laguncularia racemosa* (white mangrove). This information will allow us to distinguish which populations merit special protection due to the genetic variation of each mangrove community. In this project, we sought to find the best DNA extraction/isolation kit that will have yielded the most DNA with the least contaminants. We used a UV Spectrophotometer to determine the DNA quantification concentrations of our samples. The kits used were the Ultra Clean Plant DNA Isolation Kit (MO BIO Laboratories, Inc) and MasterPure Plant Leaf DNA Purification Kit (EPICCENTRE Biotechnologies). After visualizing the DNA on a 0.7% high melting Agarose gel, our results indicated that there were no visible differences between the two kits. However, we amplified our extracts using a thermo cycler with primers that have been tested and proven to amplify different loci on each species and found that there was a difference between the two kits. We will also be testing different PCR protocols for DNA amplification. All of our samples will be amplified and dehydrated before being sent to the Genetic Ecology Laboratory at Harbor Branch (Florida Atlantic University) to be separated using an automated sequencer. This crucial information will give us insight about the diversity of these plants, enable us to preserve and protect these mangroves from further damage, and monitor the loss of genetic variation in the future.

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Detecting Viruses Using ELISA for Sweet Potatoes in St Croix, VI

Chinaemere Igwebuike

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Sweet potato is an important staple food to the Virgin Islands and many other parts of the world. Viruses of the sweet potato plants can tremendously decrease the yield farmers receive from cultivating the tuberous roots of this plant. The objective of this research is to determine if viruses are present in local sweet potato crops and, if so, which viruses are present. ELISA kits were used to determine if viruses are present throughout the local sweet potato crop of St Croix. An ELISA kit uses antibodies to detect the presence of a specific protein produced by a virus; in this case sweet potato leaf samples. Leaf samples were collected from 6 locations around the island of St. Croix and tested for three different viruses. The data was then plotted and graphed onto a map. Forty-two (42) samples of sweet potato leaves were collected from around the island of St. Croix and the University of the Virgin Islands. An in vitro virus-free variety, obtained from the USDA Germplasm Repository, was used as a negative control. Most of the sweet potato plants on the island of St. Croix were positive for at least one virus. ELISA tests indicated that 15 samples were positive for Potyvirus, 12 samples were positive for Cucumber Mosaic Virus and 22 samples were positive for Zucchini Yellow Mosaic Virus. Of these results, 16 sweet potato samples were infected with multiple viruses. Eight (19%) of sweet potato samples tested negative for all three of the virus tests performed. The ELISA test was an effective way to detect the presence of Potyvirus, Cucumber Mosaic Virus and Zucchini Yellow Mosaic Virus in sweet potatoes grown on the island of St. Croix.

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Determination of the Equilibrium Constant of CMPO-HDEHP Systems

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Nuclear processes as a basis for the production of energy has been used for decades and is receiving increased interest in recent years. The renewed interest in nuclear power is mainly because of its fuel availability for decades to come, and the fact that it produces very little greenhouse gas emissions. One obstacle to the expansion of nuclear power is the long term management and disposition of the nuclear waste arising from this technology. If fission-based nuclear power is to be produced as a widespread form of energy in the coming decades, isolation of the waste from the environment and reduction of the long-term risk will be essential. The transuranic elements found in nuclear waste can be extracted and reused, thus limiting the amount of high risk radioisotopes requiring disposal. Towards this end, the scientists in Radiochemical Processing Laboratory (RPL) at the Pacific Northwest National Laboratory (PNNL) have been investigating new ways to reprocess and reuse nuclear fuels as a means to turn nuclear energy into a renewable energy source. One system being investigated uses a combination of bis-(2-ethylhexyl)phosphoric acid (HDEHP) and octyl(phenyl)-N,N-diisobutyl carbamoylmethyl-phosphine oxide (CMPO) to extract and separate the transuranic elements from other components of irradiated fuel. In this work, various samples were prepared for Nuclear Magnetic Resonance (NMR) Spectroscopy to determine the equilibrium constant of the adduct(s) that form between HDEHP and CMPO. Understanding this equilibrium is necessary to the understanding and development of the process for separating the transuranic elements. Numerous experiments were carried out in order to measure the adduct formation constant and the HDEHP dimerization under a variety of conditions. Measurements were done using varying concentrations of HDEHP with 0.1 M of CMPO in dodecane contacted with deionized water. An attempt to measure the dimerization constant for HDEHP by NMR spectroscopy led to results inconsistent with literature. This suggested that the NMR technique is perhaps not suitable for determining the HDEHP dimerization constant, conceivably because a suitable concentration range could not be accessed with the instrument used. The equilibrium constant for the formation of the CMPO-HDEHP adduct was calculated using the chemical shifts recorded by the NMR data generated and HypNMR modeling.

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Ligand penetration pathways in hemoglobin: a molecular dynamics study

Blanche Letang

Mentors: Ana Damjanovic, PhD; Bertrand Garcia-Moreno, PhD; Juliette Lecomte, PhD
Research Conducted at: Johns Hopkins University in Baltimore, MD

Hemoglobin is the protein responsible for transporting oxygen from the lungs to the rest of the body. Vertebrate hemoglobin is a tetramer composed of two α and two β subunits, each containing a single heme group. The protein, or globin, protects the iron from oxidation to the ferric state. For its simplicity, we used monomeric hemoglobin from the cyanobacterium *Synechococcus* sp. PCC 7002 which contains a single heme group. At the center of the heme is a ferrous iron ion that allows for reversible binding of molecular oxygen. From previous studies, it is known that in order for oxygen to bind to this type of hemoglobin, one of two histidines bound to the iron, namely His46, must first be displaced; however, very little is known about the actual pathway oxygen takes to get to the heme. We attempted to find ligand penetration pathways, i.e., cavities, in hemoglobin using computer simulations. We used VMD, molecular modeling software, to embed a hemoglobin molecule into a box of water. Then NAMD, molecular dynamics software, was used for the minimization, equilibration, and simulation of the molecule at 1 ns intervals. Using VMD to analyze the resulting trajectories, we found a cavity in the protein that appears to be leading toward His46. Some residues in its general vicinity included residues Phe50, Tyr53, Ala88, Ile111, Val112, and His117. Additionally, we found that the rotameric state of residue His117 shifted from *trans,* when it was covalently bonded to the heme 2-vinyl, to *gauche (-)* when it was not, which matches NMR data. Now that we have identified this potential cavity, in future studies, we intend to verify its exact position and location through experimentation and NMR. In addition, we intend to investigate the possibility of more cavities and to investigate the effects, if any, of amino acid replacements.

This research was supported by the Genentech Foundation Grant 3415342 and the NIH MARC Grant GM008422-15.

Investigating the Synergistic effects of phytochemical components in select ethno medical preparations on the island of St. Thomas with respect to anti-proliferative effects

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In today's society many diseases have been cured by synthetic medicines made in laboratories. Efficacy claims from most synthetic pharmaceutical treatments are based on the properties of a single active ingredient. In the Virgin Islands many locals use ethno medical preparations containing a mixture of several "active" ingredients to relieve themselves of their sickness; this is also called folk medicine. This research investigates the potential synergistic benefits of multi-component ethno medical preparations used in the USVI over single drug therapies. Fractionation, Brine Shrimp Toxicity assays, liquid-liquid extraction, LCMS, and Disc Diffusion assays will be utilized in our investigation. The main purpose of anti-proliferative drugs is to kill cells or slow down the cell growth process and will be tested using the Brine Shrimp Cytotoxicity assays. From our experimental design we discovered that out of the 28 different concoctions prepared there are four botanicals that are suitable for the anti-proliferative study. Kenip Seeds, Crown of Thorn, Aralias, and Sweet Scent are the plants that will be used for anti proliferative study. Decoctions were prepared for Crown of Thorn, Aralias, Kenip seeds and an infusion for the sweet scent botanical. These plants depicted high cytotoxicity at low concentrations. At the lowest concentrations, Aralia showed a 94% death ratio, 90% for Kenip seeds, 60% for Sweet Scent, and 100% death ratio for Crown of Thorn. These botanical preparations will be further investigated to assess the synergistic vs. additive effects.

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Seed Germination in Nine Varieties of Sorrel

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Sorrel (*Hibiscus sabdariffa*), also known as the rosella, is an annual plant that is in the Malvaceae family and grown for its red calyx. Juices made from sorrel are popular during the winter holiday season in the Caribbean. The objective was to evaluate seed germination in nine varieties of sorrel collected locally or from the USDA Germplasm Repository. Fifty seed were placed on wetted filter paper and placed in an incubator at 29 °C. Data was recorded daily over a week. All treatments were replicated four times and germination was recorded when the radicle emerged from the seedcoat. Within twenty-four hours, seed germination was observed in some varieties while other varieties took up to four days to start germination. A variety from Bangladesh averaged 80% germination in 24 hours. Some seed variety stocks became moldy and didn't germinate. Sorrel is a unique plant with very rapid seed germination occurring in some varieties. Future research will investigate if a fungicide could control molds and enhance those varieties to germinate. This research was funded in part by the USDA and VIDA-SCBG.

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Overgrowth Interaction of *Dictyota pinnatifida* with Live and Dead *Porites porites*

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Corals face problems, which vary from overfishing to coral diseases and global warming, which have all led to their decline. This decline has become an issue of concern to many scientists. Throughout the Virgin Islands, as well as other regions of the world, coral reefs are seemingly being replaced by “algal reefs”, prompting the question: Does algae overgrow live or dead corals? This study examines the overgrowth effects of the allelopathic algae *Dictyota pinnatifida* on live and dead samples of the reef-building coral *Porites porites*. Nubbins of live and dead *P. porites* were placed next to *D. pinnatifida* on a wire frame and monitored for overgrowth. We expect that the defense mechanism of *P. porites*, i.e. the production of a thick film of mucus, will be effective at preventing algal overgrowth of *Dictyota pinnatifida.* We also expect that *D. pinnatifida* will overgrow dead corals due to the absence of this defense mechanism. If we find that *D. pinnatifida* does not overgrow the nubbins of live *P. porites,* but overgrows the nubbins of dea*d P. porites*, it can be safely concluded that *D. pinnatifida* is unable to overgrow *P. porites* without the help of external disturbances. Also, we can further conclude that “algal reefs” only occur in areas were the corals had since been dead, and, therefore, are not a contributing factor in the recent decline of coral reefs. From this, scientist can go on to further narrow down exactly what is causing the wide spread death of corals.

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Data mining of socio-economic factors to predict Violent Crime in Communities

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One of the key concerns the law enforcement agencies is how to enhance investigative effectiveness by analyzing large data sets that are collected from different sources. The main goal of this research is to predict crime patterns by using data mining tools. The data sets that were used primarily focus on social and economic factors that contribute to obtaining information on the crime per capita ratio. The data were obtained from the machine learning repository at the University of California Irvine (http://archive.ics.uci.edu/ml/machine-learning-databases/communities/communities.names). Data sets were compiled from the 1990 US Census, the law enforcement data from the 1990 US LEMAS survey, and crime data from the 1995 FBI UCR. The data sets includes variables such as the percent of the characteristics of the population, family income, education level, number of police officers, and percent of officers assigned to drug units. The per capita violent crime variable was calculated using population and the crime variables considered violent crimes in the United States such as murder, rape, robbery, and assault. In order to analyze these large data sets, a regression model has been designed and tested using an artificial neural network (ANN) tool available in the data mining package Weka. Given the values of the independent variables (socio-economic factors), the ANN predicts the unknown dependent variable, which is the crime per capita ratio. In order to build an effective predictive model, a series of random testing was done using different parameters for training purposes. These parameters included running tests with different amount of folds, ranging from 2 to 18. Beginning with 128 different socio-economic variables, multiple tests with different amounts of folds have been run. Our experiments show that using 21 attributes at 10 folds give the most accurate prediction. We obtain a high correlation coefficient value of 0.7126 and a mean absolute error being 0.1179 which signified how close our predicted results were to real outcomes. Additional indicators such as the root mean squared error at 0.1795, the root absolute error at a 66 %, and the root relative squared error being at a 77% confirm our results. Based on our current experiments, we are able to conclude that data mining techniques can be used to predict the crime per capita ratio with an accuracy rate of at least 66%. These preliminary results are encouraging and crime data mining has a promising future for increasing the effectiveness and efficiency of criminal and intelligence analysis. Many future directions can be explored in this young field. For example, more visual and intuitive criminal and intelligence investigation techniques can be developed for crime pattern and network visualization. In relation to the Virgin Islands we hope that, based on these current results, data mining could be introduced to assist Virgin Islands' police and enforcement agencies.

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A Parish Nurse Intervention Model: The Wilkinsburg Community Health Initiative to Reduce a Behavioral Health Disparity in Wilkinsburg

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Within the context of healthcare disparities, the African American community appears to be among the highest minority group to suffer from behavioral health risks (BHR). In a small urban northeastern city in Pennsylvania the mental health risk of depression, anxiety and stress has become a prominent concern for African American (AA) women who head single family households, especially those of lower incomes. It this community it is very common to notice AA women between the ages of 21-70 in low paying job struggling with three or more young children to provide adequate food, clothing, shelter and utility payments for their families. Additionally, many are stressed from being overweight, behind in bill payments, absent fathers or conflictual relationships with their significant other, and juggling the entire burden of raising a family. Growing evidence over the past 20 years indicates that there is a positive relationship between spirituality and health. The church is noted as the most trusted institutions in black communities to provide refuge from stressful circumstances, especially for black women. However, the church is not being utilized as major component to deliver health care. Parish Nursing has recently developed to enhance the physical and spiritual health of parishioners. The purpose of the Parish Nurse Intervention Model (PNIM) is to test a new model to decrease depressive symptoms, anxiety and stress in at-risk African American women who are single mothers. This pilot study is to test the feasibility of a Parish Nurse Intervention (PNI) to reduce the following Health Disparities in (anxiety, stress, and depressive symptoms) by providing initial and follow-up PN assessments and referral services to specific Health Services among African American single mothers of 8-12 year old children. This study will examine the three identified behavioral risk using intervention model components (traditional, non-traditional, faith-based) in a protestant denominational church site in a targeted neighborhood. The preliminary analysis would consist of detailed descriptive analysis (e.g., means, standard deviation, percentiles, and ranges) and graphical techniques (e.g., histograms, scatter plots). A non-parametric comparison would be conducted to address the specific aims. A pre and post repeated measures design and linear contrasts are planned. The ultimate goal of this study is to provide specific strategies to promote the collaboration between research scientists and community residents to improve the African American health.

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Kingella kingae PilC2 May Contain Two Functionally Relevant Calcium-Binding Sites

Sanlin Robinson

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Kingella kingae is a bacterial, pediatric pathogen responsible for diseases such as septic arthritis, osteomyelitis, and bacteraemia. *K. kingae* expresses surface type IV pili, which it uses for adherence mediated pathogenesis. The adhesins in *K. kingae,* PilC1 and PilC2, also control type IV pilus extension and retraction. Recently, the crystal structure of a homologous *Pseudomonas aeruginosa* protein, PilY1, was found to contain a calcium-binding site vital for pilus biogenesis. We therefore hypothesized that the *K. kingae* PilC proteins also contained functionally essential calcium-binding site(s). We sought to test PilC1's and PilC2's ability to bind calcium followed by using site directed mutagenesis to confirm the location of the putative binding site(s). We began by over-expressing and purifying PilC2 using nickel affinity chromatography and gel filtration. We then used chelex-100 resin columns to chelate divalent metals from the protein. To test PilC2's calcium affinity, we set up competition assays between our protein and Oregon Green 488, which fluoresces when bound to calcium. By limiting the amount of available calcium, we are able to compare protein concentration to level of fluorescence. Through this assay, we found that PilC2 contained two putative calcium-binding sites. We began confirming the location of the calcium binding sites and measuring affinities by making a point mutation in one of the two sites. Future goals include, measuring calcium-binding affinity of double mutants, crystallizing and solving the structure of PilC2, as well as determining its functional relevance by inserting mutations into the organism. Finally, we would also want to characterize PilC1.

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You think it's cool being a pig in heat?

Agene' Rogers

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Heat stress (HS) can negatively affect a sow's fertility and reproductive performance. The purpose of this study was to see if sows experience heat stress more readily in a certain environment, and how it impacts both reproductive and piglet performance. Traditional production entails keeping sows in rooms with forced air ventilation during their farrowing stage, since cool rooms are expensive to build. However, we wanted to see if being in a cool room would decrease sow heat stress and improve reproductive and piglet performance. The sows' rectal and body temperatures, as well as respiration rates [breaths per minute (BPM)], were recorded twice a day while in a common breeding/gestation room. Approximately one week before farrowing, the sows were separated into two groups, those going into the hot room (forced air) and those going into the evaporatively cooled room. Once inside the rooms, measurement recordings continued. After the piglets arrived, their rectal temperatures were also taken. There was an effect of treatment, day, and time for rectal temperature ($P < 0.0025$) and ear skin temperature ($P < 0.001$). The piglets' rectal temperatures also increased as they got older (day, $P < 0.001$). The cooled room exposed sows to lesser environmental temperatures, easily seen on the hotter days. On cooler days, the thermal balance of the sows in both rooms appeared similar. The ear skin temperature was also more variable for sows in the hot room. Results also suggest that piglets may be less sensitive to heat stress.

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Optimization of Agrobacterium-mediated Genetic Transformation in Valeria (*Valeriana officinalis* L)

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Valeria (*Valeriana officinalis* L.) is a hardy, perennial, flowering plant used as an herbal medicine. The roots contain a compound, Valerian, which is used as an excellent remedy for anxiety, nervous tension and insomnia. Tissue culture and genetic engineering methods have enabled us to develop desirable varieties of many cultivated plant species. Transient gene expression has a wide range of applications in molecular biology. The goal of this work was to establish an optimal transient expression system using *Agrobacterium* for T-DNA gene delivery into different explants of *Valeriana* from which the whole plantlets can be regenerated. Leaf explants derived from one-month-old seedlings of in-vitro-grown plants of *V. officinalis* were infected by *A. tumefaciens* carrying a binary vector that harbors a *gusA* gene and an *nptII* gene. The infected leaf explants were incubated for three days before they were subjected to *gusA* histochemical assay. The transformability was determined as the percentage of leaf explants expressing the *gusA* gene and as the intensity of *gusA* expression per responsive leaf explant. A variety of parameters such as different acetosyringone concentrations during co-cultivation with *Agrobacterium* suspension, the length of pre-culture period of explants prior to infection, co-cultivation period, different bacterial density (OD) and duration of immersion periods were tested. The results based from transient *gusA* gene expression of explants suggested that one week old leaf explants inoculated for 60 minutes with 0.4 OD, 150 µm acetosyringone and co-cultivated for 3-4 days in MS medium with 2, 4-D (1.0 mg/l)showed 80-90% transformation efficiency. Therefore, the investigation of factors that influence T-DNA delivery is an important step in genetic transformation of Valeria via *Agrobacterium* method.

This work was supported by NSF HBCU-UP grant number HRD – 0506096

Effects of Surface Treatments on Sapphire for Pt Bottom Electrodes

Kara Spencer

Dr. Wayne Archibald (UVI Mentor)
Dr. Matthew Ivill & Dr. Melanie Cole (ARL Mentors)

Electronic devices utilizing parallel-plate capacitor designs require robust bottom electrode structures for optimal performance. Pt thin films are a common choice for bottom electrode material due to its chemical inertness and high thermal stability. In this work we evaluated the effect of thermal and plasma treatments on sapphire (Al2O3) substrates and the subsequent properties of sputter deposited Pt thin-film electrodes. The surface morphology of sapphire and Pt films was analyzed with atomic force microscopy (AFM) and film stress was evaluated using laser reflectivity with Tencor FLX-2320. Four surface treatments were utilized on the sapphire substrates used in this work. One sample was kept in its as-received, polished state, from the vendor; sample two was annealed in oxygen at 950^{o}C for 60 min.; sample three was annealed in air at 1400^{o}C for 60 min.; and sample four was cleaned in an Ar plasma for 6 min. at 50 Watts in 3mTorr Ar. 200 nm Pt electrode layer was sputtered on each sample. The surface roughness, stress measurement and sheet resistance (using a four-point probe) used to analyze the surface of each electrode.

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Cytoplasmic Domain and Tyrosine Residues of Tim-3 protein Involvement in Regulation of TCR signaling

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T-cell immunoglobulin and mucin domain 3 protein (Tim-3) is a type I transmembrane protein that regulates T-helper type I cell responses and is expressed on a variety of cells such as, CD 8^+ Tc1 (cytotoxic) and dendritic cells. Expression of Tim-3 on T-cells is known to regulate autoimmune diseases and is involved in chronic viral infections like HIV, HCV, and HSV. We have observed that transfection of Jurkat T-cells with wild type Tim-3 enhanced NFAT-AP1-luciferase activity induced by TCR signaling. The cytosolic domain of Tim-3 has two conserved tyrosine residues (Y256 and Y263), which are predicted to be phosphorylated by Src family kinases, and three distal tyrosine residues (Y271, Y272 and Y274). We hypothesized that the cytosolic region of Tim-3 containing the conserved two tyrosine residues (Y256 and Y263) are responsible for Tim-3 functioning. We generated a series of three Tim-3 deletion constructs that consist of the deletion of the cytoplasmic region that included three distal tyrosine residues from the C-terminus (269-282), deletion of the cytoplasmic region that included the distal and conserved tyrosine residues (256-282) and deletion of the entire cytoplasmic region (223-282). We confirmed the expression of the Tim-3 constructs in Jurkat T cells, and performed NFAT-AP1-luciferase reporter assay. Results from this experiment showed that the two conserved tyrosine residues (Y256 and Y263) are involved in the regulation of signal transduction initiated by TCR activation and the three distal tyrosine residues (Y271, Y272 and Y274) maybe involved in some inhibitory function of Tim-3.

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Fireworms *Hermodice carunculata* are not chemically attracted to food smell but may be attracted to smells of conspecific feeding

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The fireworm *Hermodice carunculata* is a scavenger and a predator of coral and anemones. Some studies have concluded that *H. carunculata* does not use olfactory senses to find food, but rather only senses food via direct contact. However, we have personally observed that when a dead prey item is introduced, searching behavior begins and leads *H. carunculata* to the food source. We conducted y-maze experiments to determine if *H. carunculata* could chemically detect the presence of dead prey. One side of the maze contained the smell from a large chunk of dead fish while the other contained no prey smell. Fireworms were placed in the end of the maze and observed for up to 24 hours, and in some cases videotaped. A binomial test indicated that *H. carunculata* were not significantly attracted to the odors of dead fish (7 of 15 trials, p=0.69). Video replay showed that the worms explored both sides of the maze extensively. In a second set of experiments the y-maze was used to test whether the scents emitted by conspecifics during feeding, perhaps along with the food scent, attracts *H. carunculata*. One side of the maze contained dead fish and several conspecifics, while the other side did not. During theses trials a second y-maze was constructed. A binomial test suggested that there was no attraction to the conspecifics feeding (10 of 15 trials, p = 0.15). However we noted that results were dramatically different in the second maze versus in the original maze. All 8 replicates conducted in the original maze resulted in fireworms choosing the side with the food and conspecifics (p=0.003). Worms in the second maze tended to go to the left side of the maze whether prey/conspecifics were present or not, implying we had some sort of structural problem in the second maze.

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Microbial enumeration of Leatherback sea turtle (Dermochelys coriacea) nest sand

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Leatherback sea turtles are globally recognized as an endangered species by the USFWS. It is estimated that since 1980, there has been a dramatic decline in the global population of nesting females. Finding ways to maximize hatchling success is one approach for increasing the population of Leatherback and understanding factors affecting hatch success is essential for designing conservation plans. While bacterial contamination is suspected to contribute to egg and hatchling mortality, the presence of bacteria in nest sand samples has yet to be thoroughly studied. The purpose of this research is to identify bacteria and bacterial loads present in nest sand that potentially affect the Leatherback sea turtle eggs and hatchling success. In the initial stages of the research, we collected sand samples from 28 Leatherback sea turtle nests in Sandy Point National Wildlife Refuge, St. Croix, within 7 days after hatchling emergence and stored in the refrigerator before processing. Nesting site and adjacent sand was collected for comparison. Plans to analyze the samples include nutrient agar plating, florescence microscopy and digital image analysis, and We plan on enumerating planktonic bacteria and surface bound bacteria (biofilms) along with bacterial counts in sand in effort to observe the microbial complexity of the nest environment.

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Matching 3-D models to fluoroscopic images to assess *Knee Implant* performance

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Suppose you suffer a severe accident that renders your knee immobile or damage to the cartilage on either one of the bones that make up the knee causes you to suffer from severe arthritis. Normally these incidents would be conditions that could only be treated and never fully “cured” in the sense that all the functions of the knee are restored. Fortunately, advances in technology specifically in the field of biomechanics and implant design has led to the widespread use of total knee arthroplasties (TKA’s) to treat these conditions. However, before the development of fluoroscopic imaging techniques surgeons had no way of measuring which implants restored the motion of the knee best. In our research, we have been performing 3-D to 2-D model-image registration using the JointTrack software in an attempt to measure the performance of knee implants in-vivo. Our hypothesis was that these models would accurately be able to match these models to the replicate the motion of the knee implant at the moment when the image was taken so that we would ultimately be able to determine the maximum range of freedom the patient experiences with the implant. We successfully fit the models of the implants to the fluoroscopic images and we were able to acquire data on the performance of the implants and compare that data to data acquired from patients with normal knees.

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Physical Activity and Cognitive Function in Multiple Sclerosis Patients

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Multiple Sclerosis (MS) is an inflammatory, demyelinating disease of the central nervous system (CNS). Previous research has shown that 45-65% of MS patients experience some form and degree of cognitive dysfunction. Working memory and retrieval memory functions in short-term and long-term memory appear to be the most common cognitive deficits in MS. Based on prior research, physical activity increases hippocampal activity, which is an area often affected in MS patients. Despite this, cognitive functioning in MS patients has received little to no attention from health care professionals. Therefore, the purpose of this research is to develop awareness and to help maximize the quality of life of MS patients through non-pharmacological methods. This study investigated how physical activity impacts brain plasticity and cognitive functioning in MS patients. We hypothesized that individuals who have a higher score for physical activity will have greater brain plasticity, which will result in better cognitive functioning. Participants wore an accelerometer for 7 days, which measured their physical activity before the resting MRI session of the study. The MRI lasted approximately 30 minutes. The relationship of physical activity and brain plasticity was examined through the MRI. High-resolution T1 images measured hippocampal volume in MS patients. Sub-cortical segmentation is performed using FMRIB Software Library (FSL). Regression and correlation analyses determined the relationship among physical activity, hippocampal volume, and performance on an item-relation memory task (face-scene recognition). The multiple linear regression that predicted relational accuracy based on average hippocampal volume was even significant (F (1,28) = 7.30, p = .012, with an R^2 of .207. A non-significant regression was found (F (2,27) = 2.69, p = .166, with an R^2 of .166. Thus 16.6% of the variation in left hippocampal volume can be explained by differences in activity and relational activity scores. Taken together, these results suggest that hippocampal volume exerts a prophylactic control of MS patients' cognitive functioning performance on tasks such as relational accuracy.

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An Arts Intervention for Drug-Using Homeless Youth

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Adolescents living on the streets in the United States, now approximately 1.5 to 2 million, increases yearly, and many use drugs. A two-phase Community Based Participatory Research (CBPR) study was conducted in Los Angeles County, California. The purpose of the study was to assess the acceptability of an intervention program, ART MESSAGING, meant to increase drug and health promotion and the completion of the hepatitis A and B vaccine series among the homeless drug-using youth. The impact of the intervention was measured by the completion of the intervention program, reduction of drug and alcohol use, and completion of the hepatitis A and B vaccine. The sample included 256 homeless youth, defined as an adolescent 15-24 years-old who resides on the street, and is also a drug-user. Participants were recruited through a homeless drop-in cite in Santa Monica and were randomized into the ART MESSAGING (AM) intervention or the usual care (UC) condition. The researcher administered a screener for eligibility and a Baseline Questionnaire on socio-demographic information, mediating variables, cognitive factors, health seeking and coping behaviors, and psychological distress. AM participants received equivalent health advice about drug and alcohol use and health promotion strategies as the UC group, but also translated that information into art-form messages. A six month follow-up is currently in process in which an instrument similar to the Baseline Questionnaire is administered. While six month results are not yet complete, this study should lead to a larger clinical trial with strategies tailor-made for homeless drug-using adolescents with health disparities.

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Using Model Railroading to Teach Real-time Control Systems

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When teaching computer programming and computer architecture, most universities' curriculum focus on preparing students for careers in developing desktop and web-based business applications. With nearly 99.5% of all processors installed in embedded systems, there is a great need for additional curriculum related to the development of embedded systems (McCormick, 2007). At the University of Northern Iowa, students learn the details of embedded systems development by programming real-time control systems for a model railroad. This research investigates the viability of adapting the laboratory and instructional techniques used at the University of Northern Iowa in order to enhance the computer science and engineering curriculum at the University of the Virgin Islands. The software tools will be migrated from Ada to Java, the hardware will be migrated from HO-scale to N-scale, and the control systems will be migrated from analog-based to digital-based. These modifications are necessary in order to address the constraints and requirements that are unique to the University of the Virgin Islands. This migration of tools and techniques will enable development of a class at the University of the Virgin Islands that will better prepare students with an interest in Computer Science and Engineering for future work in real-time control systems.

McCormick, John W. (2007) ‘Model Railroading and Computer Fundamentals”, Computer Science Education, 17:2, 129-139.

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