Seventh Annual
Spring Research Symposium

March 28, 2009
St. Croix Campus
Division of Science & Mathematics
University of the Virgin Islands

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The Effects of Oxotremorine on the Pyloric Central Pattern Generator of the Caribbean Spiny Lobster, *Panulirus argus*

Rifa Abdullah
Richard Hall, PhD

In spiny lobsters, motor commands to muscles for eating are produced by small neural circuits known as the central pattern generators (CPG) that are located in four ganglia of the Stomatogastric Nervous System (STNS). The paired commissural ganglia (CoG) are part of the central nervous system (CNS) and send axonal projections to two peripheral ganglia: the esophageal ganglion (EoG) and ultimately through a solitary nerve to the distal stomatogastric ganglion (STG). We are investigating the ability of CNS neurons of the CoG to influence the activity of a peripheral CPG.

The pyloric CPG located in the STG produces rhythmic bursts of action potentials that power food sorting. When connectives from the CoG to the STG are cut, the pyloric CPG disappears; thus input from higher centers are required to produce a pyloric rhythm. Previous work demonstrated that superfusion of the STG with muscarinic agonists such as pilocarpine and oxotremorine transiently increase burst frequency and duration of bursts of the pyloric dilator (PD) of the pyloric CPG while inhibiting activity of the ventricular dilator (VD) and lateral pyloric (LP) neurons. We hypothesize that the CoG's utilize the same set muscarinic controls on the pyloric CPG as observed by direct superfusion of the STG. We predict that superfusion of the paired CoGs with oxotremorine will increase duty cycles of PD bursts while decreasing duty cycles of LP bursts. To test this prediction, we superfused both CoGs with oxotremorine saline ranging from 10^{-5} to 10^{-4}M for five minutes and followed each treatment with a twenty-minute wash with lobster saline.

Oxotremorine superfusion of the CoG increases PD duty cycle up to concentrations of 2×10^{-5}M oxotremorine but absolute changes depend on control burst frequency. At a pyloric rhythm of 1.4 Hz, the duty cycle of PD increased from 0.325 ± 0.007 to 0.569 ± 0.149. While preparations with rhythm frequencies of 0.4 Hz, PD duty cycles increased slightly from 0.153 ± 0.043 to 0.224 ± 0.007. The relationships between LP and PD duty cycles are complex and complicated by variations in LP bursting. In general, as PD duty cycles increase, LP duty cycles decrease. While oxotremorine superfusion of the CoG clearly increases PD duty cycle, it also increases variability in LP bursting characteristics.

Does the Heart's Elastic Visceral Pericardium Act as a "Spring" in the Normal Cardiac Cycle?

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This cardiac physiology research aims to explore the mechanical properties of the visceral pericardium (VP) to gain a greater understanding toward how the VP supplements the energy used during the heart's cardiac cycle to perform work and required to regain the heart initial state, after contraction. The visceral pericardium (VP) is the outermost layer of the heart and consists of collagen and elastin fibers oriented nearly perpendicular to the outermost myocytes of the left ventricle (LV) myocardium. The orientation of the fibril structures and the known effect the VP has on the passive mechanical properties of the LV has led us to believe that the VP mechanically contributes to the normal cardiac cycle of the heart where its purposes are symbolic to that of a mechanical spring in which would affect the end systolic and initial diastolic periods of the cardiac cycle. Specifically, we hypothesized that the twisting of the ventricles at end-systole would result in the loading of the VP elastin "spring" and that the unloading of energy will increase the rate of untwisting which is thought to affect the filling of the ventricle in early diastole. In order to test this, we mechanically disrupted the VP layer of pig hearts (n=6) and analyzed the motion of the heart before and after the disruption (NIH, National Heart, Lung, Blood & Institute protocol H-0213). The motion of the heart was captured using high-speed imaging (200 fps) and video analysis to determine any effects on the local twist angle on the surface of the heart. We also analyzed changes in the gap size in the disrupted VP, comparing systolic and diastolic levels. We predicted that during the loading of the VP the gap size would increase. Our preliminary analysis shows disrupting the VP did affect the rate of change in the in the twist angle during contraction ($.62 \pm .09$ vs $.45 \pm .12$ rad/sec), however, no significant change was found during the relaxation phase of the cardiac cycle. The analysis of the gap size showed a consistent and significant increase in the gap size at end-diastole (11.0 ± 0.7 vs. 9.2 ± 0.7 pixels). These results do not support the VP acting as a spring to increase the filling of the heart in early diastole, but do point to it playing a role in the contraction phase of the cardiac cycle.

Initiation of a whale sighting registry for St Thomas, US Virgin Islands

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University of the Virgin Islands, St Thomas

North Atlantic Humpback whales (*Megaptera novaeangliae*) migrate to warm seas of the West Indies during the winter months to calve and breed. A record of sightings by recreational boaters and land-based observers was kept from 1986 until 2001 by Rafe Boulon who was then at the USVI Fish and Wildlife office. Peak whale sightings occurred in February and March with Humpback Whales being the most abundant species identified. This spring season we have distributed questionnaires to various marinas, dive shops, and harbormasters with information pertaining to descriptions of whale or dolphin sightings. We will then tally our findings and perform a statistical test to compare it with findings from the earlier observation. The re-establishment of this whale-sighting registry may help to determine the location and frequency of whale sightings in the territory and if any changes have occurred since the earlier records were kept

Comparison of Soil Characteristics in Waterways Based on Various Land Cover

Classifications in St. Croix, USVI
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Brian Daley (Mentor)

Loss of forest cover is frequently associated with a decrease in water quantities and qualities leading to unhealthy waterways, characterized by degraded soil and water. This study was conducted to determine if there are differences in soil characteristics in waterways based on land cover or land use. We expected to find that the forested waterways (commonly known as guts) will exhibit relatively healthy soil conditions while guts that have recently experienced land cover change will show signs of soil deterioration.

We used the results of the recent land cover change analysis by UVI-AES (Agricultural Experimental Station) in which the result determined the type and extent of land cover. Using a Geographic Information System (GIS) and Global Positioning System (GPS) technology we selected 30 sample sites from waterways in three categories, forested, deforested and recently forested. We collected soil samples at each site and tested their physical and chemical properties.

We conducted an ANOVA with the seven tested variables (temperature, pH, nitrate content, bulk density, infiltration rate and electro-conductivity); it indicated that the forested waterways have displayed soil with the most favorable properties. Data from recently forested and deforested waterways were variable, but had a similar trend of soil degradation. We interpreted from the results that there was a similarity of soil properties between the deforested and reforested waterways. Recently forested sites were formally deforested sites where as the deforested sites were formally recently forested sites.

Relative abundance of sea turtles in the bays of St Thomas

Tiffany Bernier, Agene Rogers
Mentor: Dr. Paul Jobsis

Over the past ten years there has been a modest increase in the number of recorded turtles nesting on the protected beaches of St Croix and Puerto Rico's Mona Island. It is unclear if the turtles are staying in these waters during their inter-nesting period. Most of these adult turtles have foraging grounds well offshore of St Thomas; however juvenile sea turtles are relatively abundant in some of our bays. There are many anecdotal stories of turtles seen in St Thomas, USVI, being more abundant in some bays than others, but there is no scientific evidence that differences occur. We test the null hypothesis that there are no differences in the number of turtles observed during swimming surveys of the bays. The five bays that were chosen to be observed were John Brewers Bay, Lindbergh Bay, Sprat Bay, Turtle Bay and Magen's Bay. The species of turtle was recorded as was the dominant forage in the bay. Correlations of the forage type and the observed species of sea turtle were preformed as were line transect estimates of their relative abundance. Our study continues, but early results suggest that Brewers Bay has the highest number of green sea turtles with the predominant forage being sryngodium sea grass. Completion of this study will help determine which bays are the most important as a sea turtle habitat in St Thomas. Obtaining and documenting such information will be fundamental in the planning and creation of appropriate conservation plans for maintaining Green Sea Turtle population numbers in and around St Thomas, United States Virgin Islands.

Wet Chemical Synthesis of Monodisperse Silver Particles

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Paul Carpinone
Dr. Kevin Powers

Silver particles have various uses due to their unique properties which range from use as antimicrobial agents to use in catalysis, biological labeling, surface enhanced Raman spectroscopy (SERS), and conductive inks for printed circuit boards. The goal for the summer was to research methods of producing silver nanoparticles (NPs), in order to gain a fundamental understanding of how these particles are formed and how the size and morphology can be manipulated. The ideal method would allow me to produce particles with a controllable dimension (ex. Length of a rod or diameter of a flake). Ideally the diameter of a rod or thickness of a flake would be kept below 100nm (for particles with a dimension in the micron range). This required an in depth look at various reducing agents, surfactants, and synthesis methods and their effect on the morphology of the nanoparticles, to obtain the best combination for a formula. Silver particle synthesis is more challenging than that of other noble metals due to the tendency of silver to aggregate. It was found that the type and amount of surfactant used greatly affected the silver particles, from how well the particles stayed separated to the type of particles in the colloid. Polyvinylpyrrolidone used in conjunction with ascorbic acid and a mild heat yielded the largest amount of HAR (high aspect ratio) particles. Testing still needs to be done to optimize the synthesis of silver particles.

Adenovirus Regulates the Cell Cycle

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In the United States cancer is the second leading cause of death. Additionally, the therapies used to treat cancer are either highly invasive or toxic to the body. This is because they do not differentiate between normal and cancerous cells. Adenoviruses, however, have been shown in clinical trials to specifically kill cancer cells and are significantly less toxic, making them of interest as cancer treatments. In a recent publication, Cherubini, et.al reported that mutant adenovirus onyx-015 induced endoreduplication in normal cells. However, whether adenovirus induces endoreduplication in cancer cells remains to be determined. In aim 1 of this study, experiments were done to determine if adenovirus induces endoreduplication in cancer cells. Here we report that mutant as well as wild type adenovirus induced endoreduplication in cancer cells.

The adenovirus E4orf1 protein activates the PI3-kinase pathway and members of this pathway have been reported to enhance endoreduplication. Therefore in aim 2 we seek to determine if the PI3-kinase pathways is involved in adenovirus-induced endoreduplication. To test this, various inhibitors of the PI3-kinase pathway were used. In all the samples excluding mock, the drug Rapamycin caused a decrease in endoreduplication with a significant decrease in dl309. The drug LY294002 also caused a decrease in endoreduplication in the samples, though to a lesser degree. This suggests that the P13-kinase pathway is involved in adenovirus induced-endoreduplication.

Mutant Adenovirus 3112 Reduces U87 (brain cancer) Tumors in Nude Mice

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Despite the oncolytic efficacy of chemotherapy, radiation therapy, and surgery, these forms of treatment not only kill cancer cells but also destroy living tissues as well. Additionally, chemotherapy and radiation result in lymphedema (fluid retention in arms and legs), memory loss, infertility and secondary cancer in many patients. An ideal cancer therapy therefore should be noninvasive and exhibit minimal toxicity and side effects. Adenovirus (ONYX-015) has been in phase III clinical trials in the United States and is used to treat cancers in China. Although ONYX-015 has been successful in killing cancer cells in tissue cultures, as an individual therapy it is less successful in reducing tumor size. Therefore a virus with the advantages of ONYX-015 with improve killing effects would be beneficial.

Research has shown that the viral early region 4 contains proteins that protect the virus - infected cells from dying. Removal of these proteins (E4orf1 and E4orf3) in the context of ONYX-015 may increase virus induced cell death. In this experiment, we compare mutant forms of adenovirus which lack either E4orf1 or E4orf3 to determine if these mutations may contribute to reducing the volume of the malignant glioblastoma cell line U-87 (aggressive type of primary brain tumor) in a nude mice model. We hypothesized that treatments with MAT2 (mutant E4orf1) and virus 3112 (mutant E4orf3) would decrease the tumor volume more effectively than ONYX-015. To test these hypotheses, U-87 (brain tumor) cells were implanted in 20 nude mice. The mice were marked for identity purposes and 20% of the tumor volume (width^2 x ½ length) was the volume of virus administered to each mouse. As a control, U87 cell line was implanted in five mice without any viral treatment. Virus 3112 had more oncolytic potency than ONYX -015 and MAT2. Although MAT2 was less effective at reducing the tumor size than virus 3112, MAT2 is shown to be more oncolytic than ONYX-015. These data suggest that the mutation of E4orf3 in virus 3112 has increased its oncolytic potency. Because of small sample size and death of mice, results are preliminary.

Determination of Nanomolar Concentrations of Acetaminophen (Paracetamol) in Aqueous Media by a Simple Colorimetric Method using a Liquid Waveguide Capillary Cell coupled to a UV/Vis Spectrophotometer

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Pharmaceuticals and personal care products are being increasingly found in urban watersheds with unknown consequences for aquatic life. Few means of measuring these chemicals have been developed; thus those that are presently in use are often expensive and time-consuming. We modified a simple, rapid colorimetric method for measuring acetaminophen by coupling a liquid waveguide capillary cell to an Ultraviolent/Visible Spectrophotometer[©] to improve the sensitivity required for the examination of environmental samples. Various colorimetric methods were analyzed and manipulated to create a technique which measured low quantities. Success was achieved by using 2-nitroso-1-naphtol-4-sulfonic acid and trichloroacetic acid as the color reagent to induce a color change along with sodium nitrite. In freshwater standards, we were able to detect the concentration limits of acetaminophen as low as 11.9 nM and quantify concentrations as low as 37.3 nM. We also tested on 3% salt solution to observe that salinity did not significantly affect the concentration. We determined that freezing at -20^oC was an appropriate method for sample storage prior to performing measurements. We also tested solid phase extraction C-18 cartridges to condense the concentration of acetaminophen in a large sample of water to a small manageable amount. This method was used to show that nanomolar concentrations of acetaminophen are present in the Willamette River, Oregon (0.67 nM). Future studies entail researching the effects of acetaminophen on aquatic organisms.

Developing an AdHu5 vector for a HIV-1 Vaccine

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HIV has developed into a pandemic and the number of infected individuals continues to grow at an alarming rate. Thus the need for a vaccine is desperate. Despite recent antiviral strategies, Human serotype 5 adenovirus has achieved the most success as a potential HIV vaccine candidate. Adenovirus is known for causing illnesses such as diarrhea, pink eye and the common cold. Nevertheless, the benefits of using adenovirus to construct an AdHu5 HIV-1 vaccine vector include the fact that the virus has been proven safe; the virus's ability to naturally induce long lived mucosal and systemic immunity, and ease of manipulation.

The purpose of this research is to determine which AdHu5 mutant virus would be the best candidate for designing a vector to develop an effective HIV-1 vaccine. Cell lines H-1299, U-87, and Hela cells were infected with nine mutant adenoviruses. The nine adenoviruses were analyzed for their ability to produce late viral proteins. The virus that produces the least amount of late viral proteins is expected to elicit the least adverse immune response and hence be the safer candidate. Our results show that in both H1299 and U-87, virus dl223 exhibited the least amount of late viral protein production. In Hela cells, dl1520 produced the least amount of viral proteins. Future research would involve placing the HIV *gag* or *env* gene into one of these vectors and assessing the immune response. Additionally, chimeric viruses made from other Ad subgroups with similar mutation to dl223 or dl1520 may be used in creating an AdHu5 HIV-1 vaccine vector.

Virgin Islanders Can Identify Corals: Divers More So Than Non-Divers

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Coral reefs are a vital part of the marine ecosystem and are home to the most biodiversity in the world. However, the number of healthy reefs on the planet is sharply declining due to natural and human activity. As the need to conserve our reefs increases, so too does the need for the public to become better aware of the threats posed to the reefs and the marine ecosystem. Before management measures can be implemented, the knowledge of the public must first be assessed. To do this, a survey was conducted in the summer of 2008 in St. Thomas, United States Virgin Islands. Participants were asked to identify pictures of ocean organisms and answer question regarding their perception and knowledge of coral and how they relate to the ocean. The survey found that the average of correctly identified pictures for scuba divers was highly significantly greater than the average of participants that stated they did not dive ($p < 0.001$, t-test). The same was true for snorkelers whose total average of correct answers was significantly greater than those who did not snorkel ($p < 0.001$, t-test). Virgin Islanders were better able to identify coral than participants of a similar study done in Brazil were. For example, 90% of the Virgin Islanders surveyed could identify the Elkhorn coral (*Acropora palmata*) in contrast to less than 50% of the Brazilians surveyed.

Synaptic Interactions between Neural Cells in the Pyloric STNS Circuit

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Dr. Richard Hall[1]
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The pyloric Central Pattern Generator (CPG) is a small neural circuit that controls food sorting and mechanical behavior in the foregut of decapod crustaceans. It is a model circuit for studying control of rhythmic motor behaviors such as walking, breathing and chewing. Communications between individual neurons in the pyloric CPG are capable of modifying performance of the entire circuit. Graded synaptic transmission (GSP) plays a key role in controlling the pyloric rhythm. In GSPs, small depolarizations, ranging between 1 and 5 mV, in presynaptic neurons trigger release of neurotransmitter which inhibits the postsynaptic neuron resulting in a slight delay in bursting. Decreasing temperatures weaken GSP and should alter activity in the pyloric CPG. I observed the affect of different temperature assays on the CPG of the Caribbean Spiny Lobster, *Panulirus argus.* The aim of my research was to locate and measure the synaptic interactions between the pacemaker neuron (AB), the pyloric dilator (PD), and the three other neurons that control pyloric constrictor muscles in *P. argus*. I will be comparing the effects of assay temperature on rhythmic bursting behaviors with effects on GSP strengths in warm-acclimated animals. Nerve activity is recorded both intracellularly and extracellularly to identify the 5 cells to be studied. I am currently optimizing the parameters to gather the necessary data to observe assay temperature and synaptic strength. These studies will establish the range of temperatures where GSPs become temperature sensitive. This knowledge will help to identify the location of the other three neurons in the circuit to begin recording and observing bursting behaviors. The neural circuits of temperature modified behavior are poorly understood. Studying the pyloric CPG could help to study the effect of temperature on cellular, synaptic, and circuit levels of the nervous system.

Investigation into the Function of the Heart's Visceral Pericardium

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The visceral pericardium (VP) is the outermost layer of the heart and is rich in elastin and collagen that give this layer considerable strength and elasticity. Presently the function of the VP is not fully understood. Aside from the importance of better understanding the normal function of the heart during diastole, the VP is affected by various cardiac diseases including myocarditis, pericarditis, and recovery from cardiac arrest to name just a few. The VP is known to affect the opening angle and the pressure volume relationship in the relaxed heart, but it is unclear if the VP effects the contraction or relaxation of the beating heart. The orientation of the elastin fibers of the VP on the heart surface suggest that it may affect the twisting and untwisting of the ventricles during late systole and early diastole. During early diastole the pressure within the ventricle drops below zero as the heart springs open. The mechanism of this opening of the heart is unclear. Could the VP be responsible for the rapid opening of the ventricles in early diastole? To investigate this we disrupted the VP layer in pig hearts, (n=6, National Heart, Lung and Blood Institute protocol H-0213), imaged the heat with a high speed camera, and measured the affect on the local twist angle of the surface of the left ventricle (LV) and effects on LV pressure. Our preliminary findings indicate that there is a difference in the rate of change in the local twist angle in the area of the disrupted VP layer (0.62 ± .09 vs 0.45 ± .12 Rad/sec) during contraction, but no significant affect on the LV pressure or maximum and minimum dp/dt before and after disruption. The results do not support the VP functioning as spring to open the ventricles during early diastole. Funding from this project was received from the NIH's National Heart, Lung and Blood Institute's Laboratory of Cardiac Energetics and NIH MARC (GM008422) and RISE (GM61325) grants to the University of the Virgin Islands.

Pattern Recognition using Parsers: Applications in computer science and beyond

Sara Rebeca Danaher
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Marc Boumedine (mentor)

Parsing or syntax analysis is an essential part of computer science and linguistics. Parsing techniques provide theoretical foundations for compiler construction and are the pillars of most existing software. For instance, Web browsers uses parsers to analyze the structure of HTML documents before rendering the information. Postscript printers programs analyze Postscript languages before printing documents. In addition, parsing techniques are also applied in a wide range of disciplines such as pattern recognition, bioinformatics, requirements specification stage of software life cycle development. Parsers rely on a set of rules or grammars which provides a high structured level of expressiveness to describe what is permitted and what is not. One particular type of grammar of interest is context-free grammars (CFGs). This work illustrates how CFGs can be utilized to perform pattern recognition tasks. CFGs are used to define both the semantic of a pattern in the context of the structure of its language. This research focuses on how parsers as used in compiler construction applications. First, the practical implementation of parsers is illustrated by introducing the concept of context-free grammar. Then top-own techniques called recursive-descent follow by LL(1) parsing and Recursive-Descent Parser are illustrated using a small language called the TINY language. Finally, this research shows how the concept of parser can be extended to solve elegantly more general pattern recognition tasks such as computational linguistics and bioinformatics.

Confidence Levels of Undergarduates Enrolled in Skills Mathematics Courses

Andre Douglas
Dr. Rosalie Dance (Mentor)

I have been studying the mind frame of the students enrolled in the math skills program. Through this research, I am observing how the students of two MAT 023 courses respond to challenges. Questionnaires were used to determine where the students stood on issues such as self confidence and like/dislike for math. As the course went along, I gave the students a choice of "easy" or "challenging" problems that were relevant to whatever mathematical content the class was studying. I observed the level at which the questions were chosen. I will use this data to see if the rate of students who want to challenge themselves will increase over time. Then I will give another questionnaire to determine whether or not this causes students to be more confident in their work overall, and whether their like/dislike for math changes.

The Influence of Red Mud and Stabilized Red Mud on Seed Germination and Plant Growth

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Red mud is an end-waste product from the process of isolating alumina from bauxite. It has a red-clay color and a mud-like appearance when wet, a pH ranging from 12-14 and poor drainage which severely inhibits plant growth. These factors make growing plants in red mud nearly impossible. However, work was recently completed on St. Croix, USVI, to develop a protocol to stabilize the red mud and reduce the pH. The objective of this research was to compare seed germination and plant growth in red mud and stabilized red mud to determine if the stabilized red mud will sustain and promote plant development. This was done by growing a variety of plants from diverse plant families, Solanaceae, Cucurbitaceae, Caricaceae and Poaceae (tomato, cucumber, papaya and corn, respectively). Seeds were planted in ProMix with 0%, 10%, 25% and 50% red mud and 25%, 50% and 100% stabilized red mud. Seed germination was recorded for 18 days. Plant height, number of leaves and general appearance were also recorded over time. Water samples were collected from leachate from the pots and pH was determined weekly. Deceased plants were also collected and dried in preparation for a leaf analysis. Plants in the red mud treatments were adversely affected, exhibiting delayed germination, reduced growth and a variation in leaf color. In contrast, the plants in the stabilized red mud mixtures grew normally. However, the 100% treatment had poor germination which was probably due to poor aeration in the soil. In red mud treatments, total plant height and number of leaves gradually decreased as the concentration of red mud increased, whereas in stabilized red mud plants did well at 25% and 50%. These results indicate that the use of stabilized red mud promotes seed germination and normal plant growth over a wide range of concentrations as compared to red mud which caused nutrient deficiency symptoms and early plant death.

Levels and Demographic Correlates of Life Satisfaction among African American Undergraduates

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Life Satisfaction accounts for the global evaluation of an individual's quality of life according to their own criteria. This has received little research attention in the past but has in recent years become a topic of great interest. The majority of research on Life Satisfaction has used majority older populations and predominantly white samples. Research that has looked at African American populations finds that determinants of life satisfaction in whites tend to be different in African Americans. It is important to understand what demographics correlate with different levels of life satisfaction among African American undergraduates so that we may understand how to enhance their productivity as active members of society. This research used a questionnaire to collect demographic data, and the Satisfaction With Life Scale to assess the individuals' level of life satisfaction. Data was collected and linear regressions and correlation tests were run. Findings show that there was a difference between the correlates of life satisfaction in females and males. Correlates of high life satisfaction in females were age and major. In males they were family status and study habits. Overall, African American undergraduates expressed having medium levels of life satisfaction with differences among the sexes.

Rapamycin has an Inhibitory Effect on Primary Effusion Lymphoma (PEL) Cells' Growth

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Human herpesvirus-8 also known as Kaposi's sarcoma-associated herpes virus (KSHV) is a gamma herpes virus that causes Kaposi's sarcoma (KS), multicentric Castleman's disease (MCD) and primary effusion lymphoma (PEL). PEL is a non-Hodgkin's type of B-cell lymphoma, initially identified as an AIDS associated malignancy. KS is characterized by cutaneous skin lesions, and came into prominence as an AIDS defining disease. Rapamycin is an immunosuppressant drug commonly used in transplant patients and additionally shown to have antitumor activity. Rapamycin targets the pro-growth mTOR signaling pathway; it inhibits phosphorylation events downstream of mTOR. This study looked at the effects of rapamycin on the growth of PEL cells. The effect of rapamycin on PEL cell growth was monitored by treating two different PEL cell lines with an ethanol control and seven different concentrations of rapamycin. The number of live cells was counted every 24 hours for 4 days. Proteins were extracted from two PEL cell lines both treated with ethanol and rapamycin; the proteins were blotted with anti phosphorylated S6 ribosomal protein. Also, proteins were extracted from three representative PEL cell lines and they were plotted for Akt, mTOR, TSC1, TSC2, Raptor, and Rictor. There were fewer live cells in rapamycin-treated PEL cells compared to the ethanol treatment. Also, rapamycin-treated PEL cells had a reduced presence or complete absence of phosphorylated S6 ribosomal protein. However, all three PEL cell lines showed the presence of Akt, mTOR, TSC1, TSC2, Raptor, and Rictor. Therefore, I can conclude from this study:

1. PEL cells are susceptive to growth inhibition by Rapamycin.

2. Rapamycin specifically inhibits phosphorylation of S6 ribosomal protein.

3. MTOR signaling pathway is conserved in PEL.

The Relationship between Anemia and Depressive Symptoms in Police Officers

Jacinthia Greaux
Luenda Charles, PhD.

Depression is a psychological disorder that affects mood and behavior and is characterized by sadness, insomnia and loss of appetite. Anemia is a physiological disorder identified by a decrease in red blood cells and is characterized by dizziness, weakness and paleness of skin. Our objective was to investigate the relationship between anemia and depression in police officers. We conducted a cross-sectional study of 105 randomly selected officers, 63 men and 42 women, from the Buffalo, NY. Police Department. Anemia was assessed by Complete Blood Count on fasting blood samples, and depression by the Center for Epidemiological Studies Depression (CES-D) Scale. Pearson's correlation, Student's t-test, ANOVA and ANCOVA were used to assess associations in SAS. Officers were predominantly white and ranged from 27 to 61 years of age. Nine percent of officers were depressed and anemia was prevalent in 24% of women and 2% of men. Among women, hemoglobin was positively correlated with age (p=0.044) and years of service (p=0.012). Among men, hemoglobin was positively correlated with alcohol intake (p=0.004) and depression score with Body Mass Index (p=0.005). No associations were observed between mean CES-D score by gender-specific tertiles of hemoglobin in multivariate models adjusted for age, education and Body Mass Index. Anemia was not significantly associated with depression in this cohort. Further investigation is recommended on larger samples of workgroups at risk for depression.

A Real-Time Collaborative Mobile Sketching Software

Kelvin Harry, Ezequiel Lares

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Sketching is a valuable tool commonly performed in the early stages of design. For example, it is important in the development of software, because a simple drawing is sufficient to represent complex ideas. A large percentage of sketches in software design are done using traditional methods (e.g. pencil and paper). This method is usually effective for small teams working on a project. However, in today's society it is common for people in different locations across the world to collaborate projects. To support mobile collaborative sketching, software must make sketches available, portable, easily reproduced, shared and editable. Our Real-Time Collaborative Sketching (RTCS) software will accomplish this by providing a sketching environment made for real-time remote collaborative editing. The RTCS software will also function on desktop computers but offers the portability of mobile devices such as PDAs and Smartphones.

Do Exotic species have a higher incidence of pests and diseases than native species on the urban, St. Thomas, University of the Virgin Islands campus?

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The University of the Virgin Island campus contains various introduced, native, and naturalized trees. As exotic richness increases, their effects on the community become more pronounced. Mechanisms by which exotics alter community dynamics are modification, competition and predatory release. Each tree censused was identified to species level, DBH (diameter at breast height) and height measurements were taken. Health assessment was graded on fair, poor, excellent or good. A total of 821 trees were censused on the St. Thomas Campus. The exotic/ introduced species accounted for 21% of the population, while native and naturalized species accounted for 39%. Endemic trees accounted for the remaining 0.5% of the trees. The condition of the trees based on a 54% majority was fair, only 1% of the trees were listed in excellent condition, 18% were in good condition and 28% were in poor condition. Naturalized trees had a higher incidence of disease and accounted for 48% of the data, followed by native species with 34%, and then by exotics with a 19% incidence of disease. Not all trees on the UVI St. Thomas campus were censused. Further studies are needed to identify the cause of the incidence of disease. The results of this study have important implications in management, eradication of hazardous trees and restoration of the urban community of the University of the Virgin Islands.

Generative models using object distances in protein microscope images

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In the constant investigation to understand the human system, the subcellular location of proteins is being investigated. Location Proteomics attempts to accurately define and model the location of proteins within a cell. Protein location in a cell gives information that helps to determine protein functionality in the cell. Microscope images of a live protein were obtained from the Murphy Lab at Carnegie Mellon. The protein image, which had been isolated into fifteen 2D slices, was computationally manipulated using the MATLAB program to identify the images as a compilation of individual objects. For each image slice, the number of objects varies and so does the distance between each object and every other object. Thus, a slice can be identified with a number of objects and a distance matrix which contains the distances from the center of each object to the center of every other object in the slice. Using the MATLAB program, we identified the number of objects as well distance matrices for each slice.

The probability density function for the number of objects and the distance between objects was modeled. From this probability density function, one is able to simulate a distance matrix for the objects. Using a simulated distance matrix and multidimensional scaling techniques one is able to lay out the relative position and number of objects in a protein image. Future work would test these generated images to see how closely they replicated actual images. Once the protein itself is regenerated, it should be possible to then use existing computational methods to determine the subcellular location of the protein.

Will Analyses of Complete Sequences from the Large Ribosomal Subunit (28S) Produce a Well-supported Phylogenetic Hypothesis for Relationships Among Scleractinian Coral Families?

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Scleractinian corals are the foundation of coral reefs, intricate ecosystems that serve as habitats for a diverse array of organisms and provide many benefits. Conservation of coral reefs depends on a clear understanding of evolutionary relationships among corals. Taxonomic classifications based on morphological traits divide the order Scleractinia into seven suborders, but molecular phylogenetic analyses divide the order into only two clades that do not correspond to any of the seven suborders hypothesized based on morphological data. However, relationships between groups within each clade are not well resolved. Scleractinian molecular phylogenetic analyses have included sequences from the nuclear 28S ribosomal gene, yet these analyses included representatives of only up to 14 of the 25 scleractinian families and did not include all of the variable regions of the gene. Although the 28S gene is approximately 3500 base pairs long, previous analyses have included only 200-700bp of the gene. We hypothesize that analyses of the complete 28S gene region from a greater number of taxa will result in a highly robust hypothesis for relationships among sub-groups within each of the two clades supported by all molecular analyses. We analyzed samples representative of 9 scleractinian families. We extracted coral DNA using a CTAB protocol, and amplified the 28S gene region using the polymerase chain reaction (PCR). DNA sequences of PCR products were determined by automatic sequencing. A BLAST search aligned our sequences to other scleractinian 28S sequences in GenBank. These sequences will be aligned and used to construct a phylogenetic tree based on maximum parsimony and maximum likelihood criteria. Initial analyses are expected to generate a phylogenetic hypothesis that is concordant with other molecular phylogenetic analyses, but further analyses will be necessary to determine whether complete 28S sequences provide a more robust hypothesis than analyses from shorter regions of the 28S gene and other gene regions. Samples representative of all 25 scleractinian families will be analyzed. Complete sequences from the 18S, 16S, and COI gene regions will also be included in future phylogenetic analyses.

Induction and Recursion: Combining Mathematical Induction for Enhancing Programming Techniques using Recursion

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This research explores the concepts of recursion and induction in the context of computer programming and problem solving. Many problems can be solved using recursions. Solving recursive problems requires breaking the problem into sub-problems of the same type until the sub-problem is becoming trivial. This is done by defining rules (base and general cases) or procedure or the pseudo-code to break down complex cases or problems into simpler cases. This procedure represents the solution of the problem. Classical examples are Fibonacci and factorial functions, sorting elements, the tower of Hanoi, searching elements in a tree etc.
Once the procedure has been defined, the question is how to show that this solution that has been proposed is correct? One approach is to use a powerful method called mathematical induction in order to proof that the proposed pseudo-code is working as it should be.

These two fascinating concepts of recursion and mathematical induction are introduced and explained step by step, using case studies. The advantages and deficiencies of recursive programming techniques will be highlighted and contrasted with other computational techniques.

The Pyloric CPG Responds to Cholinergic Treatment of Higher Neural Centers in the Stomatogastric Nervous System (STNS) of *Panulirus argus*, the Caribbean Spiny Lobster

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The stomatogastric nervous system (STNS) controls all motor activity of the lobster foregut and is comprised of four ganglia. The paired commissural ganglia (CoG) are located within connectives of the central nervous system and send axonal projections to two peripheral ganglia: the esophageal ganglion (EoG), and through a single nerve to the most distal stomatogastric ganglion (STG). The pyloric central pattern generator (CPG) in the STG produces rhythmic bursts of action potentials even in isolated STNS preparations. Central nervous system input is necessary for the pyloric CPG and cutting all connections from the CoG to the STG stopped bursting activity. While two neurons in the CoG are known to influence the pyloric rhythm, the pharmacology of these interactions is not clear.

Lobsters, like most animals, employ relatively few types of neural transmitters in motor circuits. We hypothesized that control of higher motor centers will involve neurotransmitters also used in peripheral centers. Acetylcholine is an important inhibitory neurotransmitter in the pyloric CPG and acts through muscarinic receptors. To test this hypothesis we superfused the CoGs with a muscarinic mimic, oxotremorine, at concentrations ranging from 1×10^{-5}M to 7×10^{-5}M, for five minutes followed by twenty minute washes with lobster saline. Pretreatment Pyloric burst frequencies ranged from 0.45 to 1.24 Hz, and doubled following superfusion of the CoG with 2×10^{-5}M oxotremorine. Saline washes and higher concentrations of oxotremorine did not significantly increase bursting activity. The response of the Pyloric rhythm following treatment of the CoG with oxotremorine differs from responses following direct application of oxotremorine to the STG (Bal et al., 1994). First, a 4-fold higher concentration of oxotremorine was required to obtain maximal effects when acting through the CoG (2×10^{-5}M versus 5×10^{-6}M). Second, the maximal increase in burst frequency following superfusion of the CoG with oxotremorine was proportional to pretreatment activity. Third, indirect stimulation of the pyloric CPG via the CoG had long acting effects that are not diminished significantly during 20-minute washes. Thus, we confirm our original hypothesis that muscarinic neurotransmitters are involved in higher center control of the pyloric CPG; however, central effects are distinctly different from peripherial effects on the pyloric rhythm.

Diethylstilbestrol (DES), a model synthetic estrogen, displays carcinogenic effects that are dose-dependent and transgenerational

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DES is a synthetic estrogen that was popularly used for prevention of miscarriages and other complications associated with high risk pregnancies from the 1940s through the 1960s. Approximately 4 million women worldwide have been exposed to DES during pregnancy. There has been much controversy concerning the role of DES as a carcinogen. Many studies to this date have been focused on assessing the adverse effects of DES as a cancer causing agent as well as its transgenerational effects. In order to obtain answers to the questions of whether DES is a carcinogen and the mechanism by which DES causes endocrine disruption, animal models have been used including the human and the mouse. DES could be a carcinogenic agent with dose-dependent effects that can be transmitted among following generations. If this is the case, then there should be an increased cancer risk observed in the exposed compared to the unexposed at higher doses seen among generations. Dose-dependency, cancer statistics of DES-exposed women and their grandchildren, as well as potential mechanisms for DES endocrine disruption were assessed. Doses were given to rats ranging from 0.0002-2μg/kg of mouse body weight in five treatments, and data were analyzed using the ANOVA to determine dose-dependency. Cancer incidence was determined according to relative risk values for the DES-exposed and an ANOVA, as well as Fisher's Exact test were performed to show statistical significance in results. Some of the effects observed included an increased breast cancer and vaginal adenocarcinoma incidence in DES exposed women and in F1 and F2 generations. Transgenerational repercussions of testicular tumors were also observed in male offspring. Greater cancer risks were observed at higher doses. Results from the literature review suggest the hormonally active chemical DES, to display carcinogenic activity and the adverse effects observed are dose-dependent. However, the mechanism by which DES causes endocrine disruption is still not completely understood and thus this leaves much room for further research of this topic.

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Feeding behavior of juvenile *Diadema antillarum*, the long-spined black sea urchin

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Diadema antillarum play an important role in the coral reef community as a keystone grazer. As such they eat algae which compete with coral for space on the reef. Their grazing maintains algal density to a low level allowing corals to flourish and facilitating the recruitment of new corals. However, in the early 1980's there was a Caribbean wide die-off of *Diadema* caused by a still unknown pathogen removing 99% of the population. This created the opportunity for macroalgal cover on reefs to increase. Thus, the return of *Diadema* to reefs is important, but the feeding preference of the juvenile urchin (< 2 cm) is uncertain. Recent availability of the juvenile urchin in Brewers Bay, St. Thomas, US Virgin Islands allowed for an assay to assess feeding preferences. Five trials were conducted, each with 30 juvenile urchins, and each urchin was fed a single algal thallus for five days. Trials tested: the red alga *Acanthophora spicifera*, the brown algae *Dictyota menstrualis* and *Lobophora variegata*, the calcified green alga *Halimeda opuntia,* and the uncalcified green alga *Caulerpa macrophysa*. Juvenile urchins had distinct significantly different preferences (Kruskal-Wallis, $p < 0.001$): they ate large amounts of *Acanthophora* and *Caulerpa* but much less of the other species. This information may help managers wishing to return urchins to reefs.

Using Distance Matrices to analyze and generate object shapes for cell images

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To understand sophisticated systems it is important to fully comprehend the basic components that make up the system. A cell is the smallest unit of living organisms. Hence, to understand the complex systems in the human body, it is essential to know the functions and make up of cells. One method of understanding the cell is to analyze fluorescence microscope images of the cell.

The objective is to gather information from the images, and later create a model of the protein in the cell. In particular, this study will build a generative model that will be able to recreate the shapes of the object within the protein image. First, the different objects in the cell are identified and the shape of each object is analyzed. Random pairs of points are selected from the edge of the objects and the distances between the points are calculated. A probability distribution plot is created to assess the values of the distance that are more likely to occur. Based on the probabilities for the different range of distances, a randomly generated distance matrix can be constructed. Using multidimensional scaling techniques, points on the exterior of the object can be recreated which will be used to determine the shape of objects. Future work will be to test if the generated object shapes are correct.

Most Young U.S. Virgin Islanders Have Some Understanding of Coral

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It is very important that people possess some knowledge of coral. By understanding what coral is, how useful it is to the environment, and how our actions can affect coral in positive or negative ways, people may be able to alter certain behaviors and help protect the corals. To understand how much Virgin Islanders know, a representative sample survey was conducted in the summer of 2008 by interviewing VI residents, both in person and by web, about their knowledge of corals and the ocean. I wanted to see if males of the age range 18-30 knew more about corals than females of the same age range, or vice versa. Most young Virgin Islanders do have some understanding of coral. For example, 82% females and 74% males could correctly explain what a coral was. And when presented with three photos of ocean organisms, males correctly identified them with an average of 2.28, while females correctly identified the photos with an average of 2.45. The sexes did not differ significantly in knowledge of coral ($p=0.247118$ t-test ($p>0.05$), $p=2.210454$ chi-square test ($p>0.05$)). This suggests that most young Virgin Islanders have some knowledge and understanding of coral. This contrasts with a similar study in coastal Brazil in which only 60% knew what a coral was.

Identification of Candidate Genes that Sensitize Cells to Taxol in *Chlamydomonas reinhardtii*

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Taxol is a natural product that acts to arrest dividing cells and is used as a chemotherapeutic agent. It blocks the breakdown of microtubules during mitosis. The purpose of this study is to use the ease of mutant isolation in the unicellular, green alga *Chlamydomonas reinhardtii* and to identify mutations that sensitize cells to Taxol. These genes will be mapped using molecular markers. Following mutagenesis, *Chlamydomonas* cells were screened for flagellar defects and then for supersensitivity to Taxol. Approximately 400 cilia defective mutants were isolated and 16 of these also conferred supersensitivity to Taxol. Previous work from the Dutcher laboratory has shown that mislocalization of the microtubule severing protein, katanin p80, causes Taxol supersensitivity. Consequently, each of the taxol supersensitivity strains was mated with a strain carrying an epitope tagged katanin p80 transgene to examine the localization of this protein in the mutants by immunofluorescence microscopy. Using a polymorphic strain, the mutant phenotypes will be mapped using derived CAPS (dCAP). This study will identify mutations that fail to depolymerize microtubules as monitored by the increased sensitivity to Taxol. Genes that have homologs in humans are candidates for determining appropriate pharmacological doses of Taxol in cancer treatment.

Photochemical Reaction Screening of Santonin

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The aim of this research is to utilize α-santonin and its derivative, lumisantonin, as scaffolds for reaction discovery and chemical diversification. Our initial efforts to make lumisantonin resulted in the formation of two compounds: (i) ethyl ester of isophotosantonic acid (50.6 %) and (ii) a tri-cyclic derivative containing a seven-membered ring (11.7%).   The former was proposed to have formed via a ketene intermediate while the latter from a carbocation intermediate. With this in mind, we decided to build a small library, by trapping the ketene intermediate leading to isophotosantonic acid with dienophile nucleophiles which could possibly set the stage for intramolecular Diels Alder reactions). The carbocation intermediate leading to the seven-membered ring product could be trapped by bisnucleophiles which could effect intramolecular Michaels addition to the α,β-unsaturated carbonyl moiety, increasing the structural diversity of this set. In addition to building a library of complex, diverse derivatives, the newly synthesized structures will also be screened for novel bioactivity.

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