Sixteenth Annual

Fall Student Research Symposium

September 21, 2014
St. Thomas Campus
College of Science & Mathematics
University of the Virgin Islands

16th Annual Fall Student Research Symposium

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The Emerging Caribbean Scientists (ECS) Programs increase research training and promote excellence for STEM (science, technology, engineering, and mathematics), psychology, and nursing students at the University of the Virgin Islands.

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Pharmological Evaluation of Desformylflustrabromine (dFBr): A new α4β2 Positive Allosteric Modulator in Mice

Allena Clifford and M. Imad Damaj
VCU Department of Pharmacology and Toxicology

Nicotine is a very addictive substance found in tobacco products. Over 500,000 people die every year in the US from smoking-related diseases. As nicotine use continues, its effects can damage your heart, arteries, and lungs, increasing the risk for heart attack, stroke, and chronic lung disease. Nicotine acts as an agonist on specific receptors in the brain called α4β2* nicotinic acetylcholine receptors. The current treatment available for smoking dependence have limited efficacy. Therefore, new and more efficacious treatments are needed. In this project, we explored if positive allosteric modulation of α4β2* nicotinic acetylcholine receptors (nAChRs) would be a viable approach for nicotine dependence. For that, desformylflustrabromine (dFBr), a putative α4β2 nicotinic receptor positive allosteric modulator, was tested in a mouse model of acute nicotine injection. Desformylflustrabromine (dFBr) was tested to see if it acts as a PAM after in vivo administration in the mouse and will enhance nicotine pharmacological effects after acute injection: Antinociception-pain tests using tail flick and hot plate assays and Anxiolytic-like effects -using plus maze test. Results show that dFBr is not a Positive Allosteric Modulator and acts as an antagonist in hot plate and tail flick assays and dFBr has no effect in the plus maze test. Discrepancies with results to *in vitro* data could be due to the difference with expressed vs. native receptor systems, metabolism of dFBr and where dFBr was injected/injection technique/handling of animals.

This research is funded by the UVI NIH-RISE Program Grant #GM061325
and the Caribbean Exploratory NIMHD Research Center.

Threats to Our Reefs: Changes in Lionfish Prey Consumption and Biometrics

Amelle Williams, Elangeni Yabba and Omani Tuitt
Dr. Bernard Castillo II and Kynoch Reale-Munroe[1] (mentors)
[1]University of the Virgin Islands

The red lionfish (*Pterois volitans)* is an invasive species that is originally from the Pacific Ocean. Lionfish have no known natural predators in the Atlantic and Caribbean. They are excellent predators and feed on herbivorous fish that live on coral reefs. The two primary objectives for this project were to collect lionfish biometrics and to conduct gut analyses. Specifically, we were interested in returning to the same location in the west end of St. Croix, US Virgin Islands where a study in 2011 was conducted to assess potential changes in prey consumption. We were also interested in detecting potential changes in the length and weight of lionfish found at the same site over time. Our first hypothesis was that a significant difference in gut contents would be observed between 2011 and 2014, due to overconsumption of preferred prey. The second hypothesis was that lionfish lengths and weights would have increased significantly from 2011 to 2014. In 2011, the top three identifiable lionfish prey were juvenile wrasse (47%), damselfish (33%) and crustaceans (20%). Our data this year showed the top three identifiable prey species to be crustaceans (77%), damselfish (13%) and juvenile wrasse (7%). The data suggests that between 2011 and 2014, there has been a drop in the number of damselfish and wrasse as well as a substantial increase in the number of crustaceans. It is postulated that the observed change in diet is a reflection of available prey on the reef. The potential ecological implications of a shift in reef fish needs further study. Our biometric data showed that lionfish were becoming heavier per millimeter of body length. Because lionfish are getting heavier, they will need to eat more to sustain themselves at their current bodyweight.

This research was funded by NSF HBCU-UP (Grant Number HRD – 1137472).

Adsorption Studies on a Clinoptilolite Packed Column for Treatment of Septic Tank Effluent

Ariane Ramsundar[1], Laura Rodriguez-Gonzalez[2], Dr. Sarina Ergas[2]
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The main goal of this project was to investigate the effectiveness of clinoptilolite for the removal of nitrogen from onsite wastewater treatment systems. Other medias such as lava rock, sand, experiment clay, glass, plastic, and vermiculite were tested in adsorption experiments to determine which one is best at absorbing nitrogen. Onsite wastewater treatment systems have some issues such as variable loading rates and limited to no nitrogen removal. Excessive nitrogen loadings in water can cause many effects such as eutrophication in water which can lead to many health effects and be harmful to aquatic species and even humans. The goal was centered on enhancing nitrogen removal by combining two removal processes. These processes included biological, by nitrification and denitrification and physical processes by adding an adsorptive or ion exchange media. Column experiments were conducted to study the sorption of ammonia from onsite wastewater treatment systems. A glass column of 40.64 cm height and volume of 0.75L was used. The column was packed with 24.13 cm in height of clinoptilolite and 5.08 cm in height of sand. The feed was used by using a pump with constant flow rate of 4 ml per min. The feed solution was prepared using 0.4000g of NH_4Cl for 2L. The ammonium concentration is 67 mg/L. The sampling ports were spaced evenly on the height of the clinoptilolite and samples were collected once a day from every port. Based on previous adsorption studies performed on the clinoptilolite it maximum adsorption capacity is 27 mg of ammonium per gram of media. It is expected that the first layer of the column will reach saturation (C=0.9C0) within 5 days and the whole column within 20 days.

This research was funded by NSF HBCU-UP Grant #1137472.

Perceived and Projected Alcohol and Drug Use Among College Students

Ayanna Fredericks, University of the Virgin Islands, St. Thomas, USVI
Dr. Kimarie Engerman (mentor), University of the Virgin Islands, St. Croix, USVI

In the United States, alcohol and drug use by college students has led to an increase in violence, illegal activities, risky behaviors, and death. The purpose of this research is to examine the relationship between the frequency of *perceived* and *projected* alcohol and drug use by students at the University of the Virgin Islands. The CORE Alcohol and Drug Survey was administered to 53 students between the ages of 18 to 24 who were enrolled in lower-level courses. The questions analyzed in this study were, "Within the last year about how often have you used alcohol and marijuana?" and "How often do you think the average student on your campus uses alcohol and marijuana?" Results from Spearman's rho Correlation revealed a statistically significant moderate direct relationship between the frequency of perceived alcohol use and projected alcohol use, ($r=.49$, $p<.05$). However, there was no statistically significant relationship ($p=.448$) between the frequency of perceived marijuana use and projected marijuana use. The findings from this study can help create programs that aid in reducing the use of alcohol and drugs among college students. These programs are critical to increasing the general well- being and success of college students, affording them a better opportunity to excel in their studies decreasing the probability of the occurrence of negative repercussions of excessive alcohol and marijuana use.

This research was supported by MBRS-RISE Grant #5R25GM061325 and SP020211.

Validation of a Computational Model to Predict Eye Irritation

Ayanna Hogan
Ronald Brown, CDRH, Food and Drug Administration (mentor)

Eye irritation is typically assessed as part of the biocompatibility testing strategy of ophthalmic devices. It would be useful to be able to predict the eye irritation potential of compounds released from ophthalmic devices to help guide the testing strategy and to select the most biocompatible materials for the devices. The goal of this project is to assess the predictive ability of the eye irritation module in the publically available Toxtree computational model. The model was validated using 90 compounds from the ICCVAM data set with known eye irritation potential. After determining that the model was unable to predict the eye irritation potential of most of the compounds in the validation data set a more in-depth analysis was conducted to investigate why the model was unable to reach a decision for these compounds by examining the step-by-step results of the algorithm for specific compounds in the validation data set. Further evaluation of the predictive ability of the eye irritation module in Toxtree revealed that the model is not able to accurately identify the structural class of some compounds. As a result, this model has limited utility as a tool to support regulatory decision-making.

This research project was support by the Food and Drug Administration.

Towards the Accurate Calculation of Passive Membrane Permeability

Chantel Ible and **Murchtricia Charles**
Dr. Ross Walker (mentor)
San Diego Super Computer Center

A key stumbling block in modern drug design is controlling the distribution of small drug molecules. The issue that arises is the preference for drug molecules to partition within water surrounding the cell. This affinity can limit the ability for a drug to cross the hydrophobic portion of a cell membrane. Researchers involved in drug discovery are currently measuring drug permeability in two ways. These methods, while they have been useful in pharmaceutical studies for years, can be cost prohibitive and do not always illustrate how drugs will interact with specific lipid bilayer compositions. Molecular dynamics computer simulations provide a complementary view of drug diffusion, which provides an atomic level of detail that is not accessible by experiment. Using Assisted Model Building and Energy Refinement (AMBER) Molecular Dynamics Software, our goal is to create a method that will provide accurate measurements of membrane permeability, while giving insight into factors that regulate it. This method, developed within the Walker Lab at SDSC, constraint algorithm that, coupled with GPU acceleration, provides a way to fix a molecule at a specific depth within a lipid bi-layer. By combining simulations at different depths we hope to be able to construct a free energy profile for the molecule crossing the membrane and from this estimate its permeability. Ultimately this technique will allow comparison of different drug molecules, dissimilar lipid membranes, and asymmetric phospholipid bilayers.

This research projected was supported by
NSF HBCU-UP Grant #1137472 and by the NIH MARC Grant #T34GM008422.

Benthic Competitors Influencing Coral Competition and Aggression Interactions on Palmyra Atoll

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Coral reefs are highly complex and taxonomically diverse. Corals are constantly contending with adjacent benthic competitors due to space on coral reefs being a limited resource. Coral competition can be seen through numerous ways such as coral aggression by means of mesenterial filaments, overgrowth and shading. The interactions of these competitive zones can be categorized into win, loss, and neutral interaction zones. Understanding the complex interactions of corals will allow for better comprehension of formations and arrangements on the reef. We were interested to see if the identity of the benthic competitors influence the outcome frequency of interaction and if there is a difference in the frequency of outcomes between different coral growth forms. To determine this, photos were collected from September 2009 to September 2012 along four transects with ten permanent photoquadrats per transect along the fore reef at Palmyra Atoll. All hard corals and major algal groups were digitized and designated using Photoshop. Interactions between focal coral species (*Pavona varians* and *Favia stelligera*) representing two dominant growth forms (encrusting and massive) and adjacent benthic functional groups were scored as coral win, neutral, or coral loss to determine frequency of interactions. Photos from 2009 were examined as an individual time point along with analyzing the photo time series. Chi-square analysis suggests that the identity of benthic competitors influence the outcome of the interactions for both growth forms. We plan to use linear measurements and percentage of colonial interactions with adjacent benthic functional groups to ascertain possible rates of change such as growth and mortality fluctuations.

This research was funded by NSF HBCU-UP Grant #1137472.

Antioxidant Activity in Commercial Spices

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Mentors: Bernard Castillo II, Ph.D.,[1]
Kynoch Reale-Munroe and Michael Renfroe, Ph.D.,[2]
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Antioxidants can be used as a prevention method of harmful degenerative diseases, such as cancer, cardiovascular and neurological diseases. The purpose of this research was to quantify antioxidant activity in commercial spices and to determine which spices had the highest antioxidant activity. Based on previous published work, our main hypothesis was that the hydrophilic antioxidant activity will be greater than the lipophilic antioxidant activity for all spices. Five different spices (basil, oregano, thyme, parsley and cilantro) were purchased in St. Croix, USVI. Antioxidants from these spices were extracted in both aqueous and organic solvents. The antioxidant activity was determined using an ABTS/ H_2O_2/ HRP decoloration method and monitored at 730 nm using a UV-VIS spectrophotometer. The antioxidant activity was reported as Trolox equivalent per grams of fresh weight. Our results have shown that oregano has the highest total antioxidant activity (529.15 ± 9.87 µmol TE per g of fresh weight) and parsley has the lowest (52.66 ± 12.52 µmol TE per g fresh weight).

This research was funded by NSF HBCU-UP (Grant Number HRD – 1137472).

Malware Signature Detection: A Comparison Between E-Brute Force And Boyer-Moore Algorithms

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National Science Foundation

The internet allows millions of users to communicate, share media, download applications, purchase online services, and store personal data. Unfortunately, nefarious individuals use malware (computer programs that have malicious intent) to take advantage of people who rely on internet services. Malware creators have the ability to remotely monitor other individuals, steal their personal information, and exploit their computers sometimes without a target's knowledge. As a result, malware detection has become a serious security concern. Signature detection is one method used in combating malware. A signature is a sequence of bytes that can be used to identify known malware within a file. This project uses signatures to automate malware detection within files. Signatures of varying length have been inserted into files of various sizes. Our Java program uses a brute force algorithm and a collection of signatures to detect malware within files quickly. We compare our approach against the Boyer-Moore algorithm in order to determine the limitations and benefits of our approach. We anticipate that the Boyer Moore algorithm is more efficient in term of time; however, for specific scenarios our program is just as efficient.

This research was funded by NSF HBCU-UP Grant #1137472.

Chlorophyll A Concentration in Bioluminescent Mangrove Lagoon, St. Croix, US Virgin Islands

Gejae Jeffers,[1] Bernard Castillo II, Ph.D.,[1]
Kynoch Reale- Munroe[1] and James Pinckney, Ph.D.[2] (mentors)
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Mangrove Lagoon is a semi-enclosed shallow man-made embayment created in 1960's as part of hotel marina/project. The lagoon has been a very popular tourist attraction for St. Croix, US Virgin Islands. This bioluminescent phenomenon is caused by a marine dinoflagellate, *Pyrodinium bahamense*. The amount of dinoflagellate is known to have a correlation to the chlorophyll A concentration. We used a data sonde to measure the chlorophyll A concentration for a period of 8 months as part of a yearlong water quality study at the bay. Day and night chlorophyll A measurements were collected from the surface and near the bottom of the bay. A comparison of day and night profiles suggests higher chlorophyll A in the bottom waters during the daytime and a more homogeneous distribution at night. Our data also showed diel phytoplankton vertical migration for the study period.

This research projected was supported by the NIH MARC Grant #T34GM008422.

Swift Observations of the Recent X-ray Activity of Eta Carinae

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The extremely massive Luminous Blue Variable binary star, Eta Carinae, lies 7,500 light years away deep within the Homunculus nebula. Vigorous Wind-Wind collisions between the primary star and the companion star generate high-energy gases that produce X-rays. Complex X-ray variations occur near periastron, point of least stellar separation between two stars. Understanding the changes of the high-energy photons give scientists a better understanding of *η* Carinae's physical and stellar properties. Processing and analyzing weekly observations done with the X-ray Telescope on Swift allow the spectrum changes, flux levels, and column density trends to be examined meticulously. In over 18 years of observing with RXTE/Swift, the maximum X-ray flux of *η* Carinae in the 2-10keV band occurred on June 21, 2014, at a level of $3.53\pm0.13\times10^{-10}$ ergs $s^{-1}cm^{-2}$. On July 20, 2014 a flux of $8.3\pm0.5\times10^{-11}$ ergs $s^{-1}cm^{-2}$ as seen in the quicklook data strongly suggests that the 2 –10keV flux is declining as *η* Carinae approaches periastron. Every 5.54 years, the X-ray activity enters a minimum stage that we predict will last a shorter time than observed in previous cycles. Understanding the mechanisms of the deep minimum stage time and closely examining the differences in column density in each cycle would give scientists reason to believe that the mass-loss rate of the system has changed.

This research projected was supported by Grant # NNX12AI12A.

Complexometric Titrations using a Platinum Indicating Electrode

Jonique George and **Tonya Bartlette**
Stanley Latesky, Ph.D. (mentor)
The University of The Virgin Islands
St. Thomas, U.S. Virgin Islands

In a complexometic titration, the end point of the titration is marked with an indicator. EDTA is a strong metal binding agent, which makes it ideal for the titration of metallic ions. Based on the fact that the reduction potential for a metal ion can change upon complexation of a ligand such as EDTA, we propose that this can be used to detect the endpoint of the titration of a metal ion using EDTA and a platinum-sensing electrode. Our experiment was broken into two methods. For the indicator method, we weighed out the solution in a flask, added water, buffer, and some indicator and then added EDTA from a burette. For the electrode method, we followed the same steps but instead of indicator, we used a small platinum-sensing electrode to monitor the changes and added the EDTA in increments, using a pipette. There was a color change with the indicator method and there was a sharp change in the graph of the electrode method. The experiment was successful. The sharp rise in the graphs meant that the platinum sensing electrode successfully monitored the titration and spotted the endpoint.

This research was funded by NSF HBCU UP Grant #1137472
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Feeding History in Relation to Foraging Preference of Solar Powered Sea Slugs

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The sea lettuce slug (*Elysia crispata)* sometimes called the solar powered sea slug, are creatures that we are just beginning to learn about. They are referred to as solar powered due to their ability to store chloroplast from their food in their parapodia (frills) to capture energy from the sun using photosynthesis. Over the period of six weeks we observed two groups of *Elysia crispata*, collected in St. Thomas, in order to understand what factors affect their feeding/foraging preferences due to a variety of studies coming up inconclusive on this topic. We collected the first group of slugs at the beginning of the six weeks and conducted tests on them. We hypothesized that *E. crispata*, would forage mostly for *Caulerpa sertularioides* algae, due to an author that suggested it to be a primary food source. However, if they foraged for various algae, it brings up the question of how they handle the various forms of chloroplast. While our methods changed over time, we stuck to the basic method of placing a slug in a container with two or three species of algae, then recording the slug's activity for 5 – 10 minutes. We initially were starving the slugs in between experiments, but then began to feed them due to a scientific paper we read. Over the course of a few weeks and multiple experiments, we noticed that the slugs were now mainly/only eating the algae *Bryopsis* during the experiments. We hypothesized that the slugs became ingestively conditioned to the *Bryopsis* because that's all we fed them between trails. This became especially obvious when we looked at data from trails' 1 and 6 (Trial 1 p-value>0.05, Trail 6 p-value<0.001). Due to this result we decided to collect a 2nd batch of slugs and fed them, *Caulerpa sertularioides*, to see whether they too will become ingestively conditioned to the *Caulerpa sertularioides*. If the same pattern occurs then it is safe to assume that ingestive condition is happening, if not, we believe that while it may have happened, it may only be possible for the slugs to become ingestively conditioned to certain algae.

This research was funded by NSF HBCU UP Grant #1137472.

Spillover Effects in Catalysis by First Principles

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Heterogeneous catalysis is important in today's industry, and catalysts are added to a chemical process in order to speed up the chemical reaction. Heterogeneous catalysts consist of small metal particles which carry the chemical activity dispersed on an inert support. A good active phase will bind the reactants strongly enough so that they produce reaction intermediates but weakly enough so that products can leave the surface thus allowing more reactions to occur at that site. At the same time, a good support material should not bind the reactants, allowing the chemical reaction to happen in the active phase. However, in realistic environments, spillover effects are present and reactant molecules tend to bind to the support, hence decreasing the overall activity of the material. Despite the recent advances in rational catalysis, the mechanism of spillover in most systems remains poorly understood. In this project, we will study the spillover effect of O_2 molecules on MgO supported Pd_4 clusters. Our final goal is to study the spillover effect of O_2 molecules on MgO-supported Pd_4 clusters. As a starting point, we use a combination of density functional theory calculations and atomistic ab initio thermodynamics, and compute the energetics of O_2 adsorption on a gas-phase Pd_4 cluster. We report binding energy changes with coverage and we estimate the pressure and temperature conditions for O_2 to adsorb into the cluster.

This research was funded by NSF HBCU UP Grant #1137472.

The Investigation of Lemongrass in the US Virgin Islands

Khalin Nisbett; Royer, Lesa
Dr. Yakini Brandy (mentor)
University of the Virgin Islands, St. Thomas, US Virgin Islands

Cymbopogon citratus, Lemongrass, is abundant in the US Virgin Islands. Ancient medicinal remedies use this tea bush for its medicinal benefits. Citral, the most prominent ingredient, is a mixture of two isomers, Geranial and Neral, which are believed to contribute to the medicinal capabilities of lemongrass. Fifty gram aliquots of diced lemongrass leaves and stems were steam distilled resulting in the extraction of 5 grams and 11 grams of lemongrass oil, respectively. Geranial (3,7-dimethylacta-2,6-dienal) was synthesized in 61.4 % yield by the oxidation of Geraniol using sodium dichromate dihydrate under acidic conditions. Structural elucidation using IR and Proton NMR proved that the Geranial was successfully synthesized. This is a preliminary study to determine the anti-prostate and anti-breast cancer activities of natural lemongrass oil, synthesized Geranial and Neral.

Acknowledgements:
Lemongrass was provided by the University of the Virgin Islands Co-operative Extension Service on the St. Thomas Campus. This research was conducted with the financial assistance from the NSF SSRI-SURE summer research program.

Low Level of Chytrid Fungus on the Island of St. Thomas

Krislen Tison, Sherika Alexis, and **Sheresia Gumbs**
Dr. Alice Stanford (mentor)
University of the Virgin Islands
National Science Foundation

Major insect predators such as frogs, function in maintaining a balance in the insect food chain. Populations of these amphibians are declining worldwide. A contagious fungus known as *Batrachochytrium dendrobatidis* (*Bd*) has been affecting frogs by disrupting their respiration and osmotic regulation. When the frog loses its ability to breathe, death is inevitable, and this contributes to the drop in the amphibian population. The decline has already been noted in the Caribbean, primarily on the island of Puerto Rico. Recent studies were done on the island of St. Thomas in 2011 where three out of one hundred amphibian samples tested positive for the fungus. Therefore, the aim of this 2014 study is to learn whether the chytrid fungus is still active, and how it may negatively affect the amphibian population on St.Thomas. We predict the 2014 study to yield similar, if not heightened results. To test this, frogs of the *Eleutherodactylus coqui* (*E.coqui*) and *Eleutherodactylus antillentis (E. antillentis)* species were captured from various sites and swabbed to collect any possible fungus present on the skin. After acquiring the possible *Bd* DNA, the frogs were released. Any DNA present on the swabs or on the frog collection bags were extracted. Lastly, PCR was done to amplify any possible *Bd* DNA. One sample yielded a very low positive result that contradicts the hypothesis and shows that the frogs here are not infected as the *E. coquis* on Puerto Rico. The seasonal time of testing may have possibly affected the results so further testing will be conducted in other seasons and the data shall be compared with the data from the summer of 2014.

This research was funded by NSF HBCU-UP Grant #1137472

Posttraining Optogenetic Modulation of Basolateral Amygdala Projections to the Ventral Hippocampus Influence the Consolidation of Emotional but not Spatial Learning for Contextual Fear Conditioning

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The basolateral amygdala modulates memory consolidation for multiple types of learning including contextual fear conditioning (CFC). One of the BLA's downstream targets, the ventral hippocampus (vHPC), has previously been shown to process emotion-related aspects of learning but whether the BLA→vHPC pathway modulates memory consolidation is unknown. The current study used a modified CFC task, which allows separation of the context and footshock learning, followed by immediate optogenetic modulation of activity in the BLA→vHPC pathway.

Male Sprague-Dawley rats received intra-BLA injections of an adeno-associated virus containing the gene for either the light-sensitive membrane-bound cation channel channelrhodopsin-2 [ChR2(E123A)] or the outward proton pump archaerhodopsin-3 (eArchT3.0). For the CFC task rats received 3 min of pre-exposure to the entire apparatus on day 1. On day 2, rats were confined to one end of the apparatus, received an immediate footshock, and were quickly removed. Rats received 15 minutes of optogenetic immediately following pre-exposure on day 1 or footshock on day 2. Retention was tested on day 4.

The findings indicate that optical stimulation of the BLA→vHPC pathway following context pre-exposure had no effect on retention but manipulation using trains of 40 Hz light pulses following footshock training enhanced retention. eYFP-control rats who received similar light pulses following footshock training exhibited no effect on retention. Furthermore, optical stimulation of the BLA→vHPC pathway in rats that didn't receive context pre-exposure exhibited no effects on retention. Therefore, we conclude that BLA→vHPC projections influence the consolidation for the emotional, but not spatial, learning for a modified CFC task.

This research was funded by NIMH Grant MH097111 (RTL).
We would like to thank other members of the LaLumiere lab who contributed to this study.

The Genetic Basis of Phenotypic Variation in Threespine stickleback

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The threespine stickleback is an ideal model system to interrogate the mechanisms that underlie phenotypic evolution—a fundamental question in evolutionary biology. Across geographic space, ancestral, marine stickleback have repeatedly and independently invaded freshwater environments and over time have adapted to the local environment. While many phenotypes evolve in this transition, one of the more prominent phenotypic differences is the reduction in skeletal armor and variation in armor size. Lateral plate armor loss, an aspect of skeletal armor, is controlled by one gene of major effect, Ectodysplasin, and by several modifier loci. We, however, do not know the genetic basis of more fine-scaled lateral plate variation and covariation among plates. To address these questions, I used a genome wide association (GWA) approach and analyzed a natural population of stickleback variable in lateral plate number and size. I hypothesize that the genomic regions contributing to lateral plate variation will include regions previously implicated in lateral plate loss as well as other genomic regions. To characterize the phenotypic variability of hundreds of individuals in the McKenzie River, I measured lateral plate height, width, and area using ImageJ software and then statistically associated individual's genotypes to the phenotype with the software package GEMMA to identify the genetic basis for armor trait evolution. I identified several regions of association between one supporting lateral plate height and genotype on chromosome 5, 11 and 19. Assessing the covariation of supporting plates increased the statistical association on chromosomes 5, 11, and 19 and revealed more regions of association on chromosomes 3, 4, 13, and 20 which had not previously been implicated in lateral plate loss or plate height. This indicates that by utilizing natural populations we have more resolution to identify genomic regions with GWA studies than with standard laboratory mapping crosses.

This project is being funded by the NSF 1063144 REU Site Program, as well as two grants from the Cresko lab, the Transcriptomics grant through the NIH and Kristin Alligood's Doctoral Dissertation Improvement Grant through the NSF.

The Investigation of Lemongrass in the US Virgin Islands

Lesa Royer and Nisbett, Khalin
Brandy, Yakini, Ph.D (mentor)
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Cymbopogon citratus, Lemongrass, is abundant in the US Virgin Islands. Ancient medicinal remedies use this tea bush for its medicinal benefits. Citral, the most prominent ingredient, is a mixture of two isomers, Geranial and Neral, which are believed to contribute to the medicinal capabilities of lemongrass. Fifty gram aliquots of diced lemongrass leaves and stems were steam distilled resulting in the extraction of 5 grams and 11 grams of lemongrass oil, respectively. Geranial (3,7-dimethylacta-2,6-dienal) was synthesized in 61.4 % yield by the oxidation of Geraniol using sodium dichromate dihydrate under acidic conditions. Structural elucidation using IR and Proton NMR proved that the Geranial was successfully synthesized. This is a preliminary study to determine the anti-prostate and anti-breast cancer activities of natural lemongrass oil, synthesized Geranial and Neral.

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Spectroscopic Elucidation of the Equilibria Involving Pyridine and Its Analogues with Cobaloximes in Various Solvents

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The U.S. Energy Administration states that the United States alone consumed a total of 6.89 billion barrels in 2013.It should also be noted that the amount of fossil fuels in reserves are approximately 1.3 trillion barrels. An important objective related to this research is the transition away from fossil fuels as the world's primary energy source, to renewable-generated power to produce storable fuels. An ingenious option is exploring the use of solar fuels, one source can be the use of hydrogen as a solar fuel produced from photo-assisted water splitting or artificial photosynthesis. The focus of this study is to use first-row transition metal complexes, specifically cobalt(II) complexes called cobaloximes, and study their interaction with pyridine in various solvents. UV-visible studies were carried out on the cobalt(II) complex, $[Co(dmgBF_2)_2(H_2O)_2]$ **1** (where $dmgBF_2$ = difluoroboryldimethylglyoximato**)** in the presence of pyridine (py) in acetonitrile, water, and methylene chloride. Throughout this study, the main hypothesis is as follows: **The water ligand in the axial position of $[Co(dmgBF_2)_2(H_2O)_2]$ will be substituted with pyridine or one of its analogues.** The studies in the various solvents were carried out by maintaining a constant concentration of the cobaloxime, while varying the concentration of pyridine or its analogues. UV-visible spectroscopic studies showed that in acetonitrile and water, both of which are coordinating solvents, as the concentration of pyridine increased, the absorbance marginally increased at wavelengths longer than 300 nm which could be caused by the solvents' competing ability to coordinate on the cobaloxime. In methylene chloride, which is a non-coordinating solvent, various absorbance changes were observed, with a blue shift from 440 nm to 420 nm. A spectrophotometric titration in methylene chloride proved that the stoichiometric ratio of pyridine to the cobaloxime was 1.00 ± 0.05, thus proving, that a complex with the formula $[Co(dmgBF_2)_2(H_2O)(py)]$ **2** was formed. The equilibrium constant in methylene chloride was calculated as 1.33. The results showed that in the presence of a non-coordinating solvent such as methylene chloride, pyridine substituted one of the water ligands in $[Co(dmgBF_2)_2(H_2O)_2]$ **1**.

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Neurogenesis In Adult Zebrafish Requires Two Nights

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Circadian rhythm is an internal, endogenous, biochemical, behavioral and physiological 24-hour timekeeping mechanism that corresponds to the time it takes the earth to orbit on its axis. Circadian rhythms are driven by a biological clock synchronized by external cues called Zeitgebers such as photoperiod or food. Circadian rhythms control the body's sleep rhythms, core temperature, hormone release, and feeding patterns in animals and humans. Although the cell cycle has been shown to oscillate as a function of circadian rhythms, its contribution to adult neurogenesis remains uncertain. The objective of this project is to investigate how circadian rhythms affect the rate of neurogenesis by observing the length of the cell cycle in the zebrafish. We will study this process through the use of the zebrafish, *Danio rerio*, because similarly to humans, they are diurnal vertebrates. Cell cycle phases are moderated by check points called cyclins that form complexes with Cyclin Dependent Kinase (CDK). We hypothesized that cell cycle occurs over the course of two-nights with a cycle of about 24-hours. Using a CDK4/6 inhibitor, we were able to show a decrease in the number of bromodeoxyuridine (BrdU) labeled cells the following night. Thus, two consecutive nights are needed for cell proliferation in zebrafish brain. Lastly, determining the length of cell cycle phases would help us to understand optimal times and conditions for proliferation. Potentially, this information could be applied to time treatments of patients with neurodegenerative diseases or traumatic brain injuries.

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Seagrass Cultivation for Conservation

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The purpose of this research is to assist Coral World Ocean Park with the development of a sea grass exhibit. This project tested whether or not the sunny or shady tanks would make a better habitat for sea grass. *Thalassia testudinum* (native) and *Halophila stipulacea* (invasive) in Brewers Bay and UVI tanks were sampled and measured for shoot density, leaf height, fluorescence, light intensity and temperature in the summer of 2014. From the results it can be seen that the height of both sea grasses decreased over the time period of four weeks. However, the shoot density for both sunny and shaded *T. testudinum* increased whereas the *H. stipulacea* decreased. Furthermore, results displayed that the fluorescence for *T. testudinum* sunny was higher than that compared to *H. stipulacea*. Fluorescnece is much lower in the sunny tanks than in the field and shady tanks. This indicates that the stress levels are highest in the sunny tanks. We concluded that the better habitat to grow the seagrasses would be the shady tanks because the temperature is not as high as the sunny tanks.

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Smart Visual Diet Tracking System for Institutional Setting

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Approximately, 50,000 people in the United Kingdom have died as a result of malnutrition.

Majority of that population were infants and the elderly. This, as well as the increase in malnutrition rates world wide has risen awareness , not only among health practitioners and Scientist but the general public. Scientist are particularly interested in finding a solution. This project focuses on elderly people in institutional settings , such as nursing homes and rehabs, tracking their daily consumptions in hopes of improving longevity. The research project involves the creation of a graphic user friendly interface, the creation of image matching/image processing algorithm whose main source input is a Microsoft Kinect 3D camera and the use of an everyday scale. The system is structured like this, a scale is located about 2feet below the Kinect 3D camera. The camera will take an image of the food on the scale when placed on it simultaneously the weight will be recorded. The image that is taken will then be linked (using image matching) to a previously stored image in the file (of that same food item) which is linked to the nutritional information of that food item. Every item on the plate will separated as type following scanning. For example, a plate containing potato and chicken will be scanned separating the two items and visiting the file to find its match, there it will be categorized as a potato and chicken with all its nutritional information. The Kinect doesn't only take the image but it produces volume which would aid in generating the actual calorie and nutritional intake. The plate will visit the system twice before they have eaten and after in order to produce an exact calculation as to what was consumed. This project hopes to be expanded from its original audience (institutional setting) to everyone in their everyday lives.

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Narrow Gap Detector Testing

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The Gravity and Extreme Magnetism Small explorer (GEMS) team have modified the design of the detector assembly inside the polarimeter to improve the sensitivity to X-ray polarization. After the modification was made, the design had to be re-validated against Technology Readiness Level (TRL)-6 qualification requirements. Along with TRL-6 testing, additional testing was done to demonstrate that the new design will remain satisfactory throughout the life of the mission. Types of testing performed on the detector were: Vibration testing, Thermal Shock testing, Creep testing and Thermal Cycle testing. Vibration testing was successful with no major issues found during post testing inspection. Thermal Shock testing showed no indication that the extreme temperature had a significant effect on the detector. Creep testing shows no positive or negative trends in flatness. Thermal Cycle Testing is still on going. As of now, all the requirements have been met and the team expect the Narrow-Gap detector to reach TRL-6 by summer's end.

This research project was done at the NASA Goddard Space Flight Center
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Myostatin Inhibition Alters GDNF Expression in Skeletal Muscle Cells in Culture

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Sarcopenia (age related muscle wasting) amyotrophic lateral sclerosis (ALS), muscular dystrophy and cachexia (muscle wasting as the result of disease) are very common occurrences in society today. These various muscle-wasting syndromes decrease the quality of life for everyone who is afflicted by them. Results of recent studies suggest that altered neuromuscular communication may be a critical element in the loss of muscle strength and muscle mass observed with aging and disease. Studies conducted in this lab have shown that exercise causes muscle hypertrophy and increase glial cell line-derived neurotrophic factor (GDNF) content in skeletal muscle. Glial cell line-derived neurotrophic factor causes beneficial changes in motor neurons which, include axonal regeneration and provides motor neuron support. GDNF has the potential to be used as therapy in treating various neurological disorders. Treatment with anti-myostatin causes muscle hypertrophy in the absence of exercise, so we used this treatment to cause hypertrophy without exercise and examined whether GDNF expression increased. The purpose of this study was to test the hypothesis that treatment with anti-myostatin will cause muscle hypertrophy and increase GDNF production in skeletal muscle cells in culture. If GDNF production increases, this would provide a link between muscle hypertrophy and processes regulating GDNF expression and neural plasticity. For this study we used the C2C12 skeletal muscle cell-line in order to test our hypothesis. Myotubes were treated with anti-myostatin ranging from 20ng/ml-2000ng/ml. Results show that treatment with anti-myostatin inhibited differentiation of myoblasts into myotubes and altered GDNF production by myoblasts and myotubes. Results from the enzyme-linked immunosorbant assay (ELISA) showed a decrease in GDNF production while the results from the Western Blot showed an increase in GDNF production. The apparent discrepancy may be a result of the antibody used in the ELISA seeing only one form of the GDNF molecule and the antibodies used in the Western Blot seeing multiple iso-forms of GDNF. The results show that signaling pathways activated by myostatin also affect GDNF production by skeletal muscle, providing a possible link between signaling pathways regulating muscle hypertrophy and those regulating neural plasticity.

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Analysis of Private Well Water Quality and Well Owner Education in Maryland

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About 33.3% of Maryland's population uses private wells for drinking water. However, private wells that serve fewer than 25 people are neither regulated by federal laws nor regularly tested for contaminants associated with adverse health outcomes. With no required monitoring, little is known about testing performed by private well owner sand; knowledge regarding well maintenance and testing; and private well water quality. Given the number of Maryland residents relying on private wells, addressing these knowledge gaps could have important health implications for Marylanders. A collaborative team of extension professionals, University of Maryland (UMD) researchers, and other partners have launched a pilot project for a well water education program in four of Maryland's 24 jurisdictions, Cecil County, Kent County, Montgomery County and Queen Anne's County. Our overarching goal is to improve health and prevent disease related to compromise well water quality. This study set to analyze and compare the quality of water that private well owners use with the EPA's standard for public wells used for drinking purposes. A prior knowledge needs assessment survey was used to capture the current knowledge base of participating private well owners. Trainings were conducted on properly collecting well water samples, interpreting water testing results, and finding solutions for high levels of contaminants. A total of 150 well water samples were collected from kitchen or bathroom faucets in private homes. Samples were analyzed for total coliform bacteria, fecal coliform bacteria, *E. coli, Enterococcus* spp. and *Salmonella* using standard U.S. EPA membrane filtration methods. Total dissolved solids and pH were measured using probes and commercially available kits from Hach Company. Total arsenic and nitrate were analyzed by the Maryland Department of Health and Mental Hygiene. Total coliforms and fecal coliforms were present in 25% and 15% of all samples, respectively. Only 5% of samples contained *E. coli* and 5% contained *Enterococcus.* 75% of wells were outside of the recommended range for pH. The average nitrate level was 2.3 mg/L. All wells had arsenic levels below the EPA's allowed limit. However, private well owners are advised to test well water quality at least once a year, and should maintain both well water systems and septic systems. Cooperation between experts on the many facets of well water safety, including water testing, needs assessment, program evaluation, and family-based health education, is essential to making a difference in the health of Maryland's communities.

This research was funded by the UMSTAR program in Maryland directed by Dr. Hagberg, PhD – Professor, Department of Kinesiology, University of Maryland School of Public Health.

Distribution and Movement of Two Conch Species, *Strombus costatus* and *Strombus pugilis,* in Brewer's Bay

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Conch are large sea snails that are harvested for food and shells. Over the past few months we have noticed a large population of both milk conch (*Strombus costatus*) and West Indian fighting conch (*Strombus pugilis*) in Brewer's Bay. It is possible these two smaller, lesser studied species are replacing the overfished queen conch (*Strombus gigas*) thus prompting our initial research: to determine their distribution and movement. In order to determine their distribution we snorkeled northeastern Brewer's Bay using 240m^2 transects and 480m^2 point counts and we found that the fighting conch were densely packed (0.73/m^2) in a small area (~2400m^2) of silt like sand while the milk conch were more widely distributed (0.073/m^2 over 10500/m^2) either in the *Syringodium* sea grass or in the sand flats. While in the lab we used time lapse video recordings to observe these slow-moving snails. We found that fighting conch buried themselves more than milk conch did. Also the conch moved less during the morning than in the afternoon and night. To confirm this diel change in behavior in the field, we tagged and flagged conch and recorded their displacement over a short period of time (35-72 minutes) in the morning and afternoon and then calculated and compared their speed. Our first observation revealed that the conch tend to move faster in the afternoon than in the morning which agrees with our observations in the lab. A week later we found no difference in displacement, possibly due to the exclusion of mating pairs, egg laying, and buried conch during this second set of observations. We repeated the flag and tag techniques to determine if milk conch speed may be correlated with their habitat. We placed milk conch in a lugworm patch and in a *Halophila* patch, (where we do not find them) and on the sandy plain (where we do). We found that the conch moved more on the sandy plain and move very little in the lugworm and *Halophila* patches. Future studies may include: changes in their distribution by season, movement and behaviors at night, causes of low movement in *Halophila* and lugworm mounds, mating behaviors, as well as factors affecting burial.

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Neutron Stars

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We present preliminary work on identifying the nature of X-ray sources in the globular cluster NGC6717. Previous work has suggested that one or more of the detected X-ray sources may be quiescent low-mass X-ray binaries, a binary star system comprised by a main-sequence star in orbit with a neutron star. Studying neutron stars gives us access to exotic jurisdictions that we can't explore here on Earth. A neutron star is a compact object that has roughly the mass of our Sun crammed in a ball approximately 10 kilometers in radius. A teaspoon of neutron star matter would weigh a billion tons on Earth, and they have magnetic fields trillions of times as strong as Earth's. Since we cannot sustain such conditions in laboratories, we observe neutron stars with telescopes to determine their properties and better understand these exotic forms of matter. Using NASA's Chandra X-Ray Observatory, SWIFT, and Hubble Space Telescope, we determine the flux of all X-ray binary sources in the NGC6717 globular cluster. We also analyze the X-ray variability of each source and search for any significant outbursts. I will display my results in examining this globular cluster using the data I analyzed from these telescopes. These data, together with previous studies of qLMXBs in other globular clusters (e.g. Guillot et. al. 2009), will help to constrain the dense matter equation of state.

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Evaluation of Weaning Age on Parasite Burdens of Hair Sheep Lambs in an Accelerated Lambing

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St. Croix White (STX) hair sheep have a high tolerance to gastrointestinal nematodes (GIN) compared to other breeds of sheep. *Haemonchus contortus* is a parasitic nematode that causes anemia. STX sheep have a natural parasite tolerance compared to DRPX sheep, it is hypothesized that GIN burdens will be higher in Dorper X St. Croix White (DRPX) ewes and lambs pre- and post-weaning. The objective of the study is to evaluate the impact of weaning St. Croix White and Dorper X St. Croix White lambs at 63 (control) 90 or 120 days of age on GIN burden of ewes and lambs pre- and post-weaning. Ewes (n=46) and lambs (n=63) were used. Lambs were assigned to treatment groups based on breed and litter size. Treatments consisted of weaning lambs at 63, 90, or 120 days of age. Prior to weaning, ewes and lambs grazed (*Panicum maximum)* pastures in a rotational grazing system. After weaning, lambs were weighed weekly and fed a concentrate diet while grazing guinea grass pasture. Ewes were weighed weekly throughout the data collection. Jugular blood samples used to determine packed cell volume (PCV), FAMACHA score (1 = no anemia to 5 = high level of anemia), fecal samples and weight were collected from each ewe and lamb at 63, 90 and 120 d of age of lamb. Fecal egg counts (FEC) were determined using the modified McMasters technique. Prior to analysis FEC was transformed using $\log_{10}$ (FEC + 1). Data was analyzed using general linear models procedures using breed and treatment as main effects. The STX lambs had a lower FAMACHA score than DRPX lambs (1.8 ± 0.1 vs. 2.4 ± 0.1, respectively). The PCV was not different (P > 0.10) between STX and DRPX lambs (30.9 ± 0.4 vs. 32.7 ± 0.4 %, respectively) or among lambs weaned at 63, 90 or 120 d (31.7 ± 0.5 vs. 30.9 ± 0.5 vs. 32.7 ± 0.5 %, respectively). There was no difference in FEC between STX and DRPX lambs (1,518 ± 240 vs. 1468 ± 214 egg/gm, respectively) or among lambs weaned at 63, 90 or 120 d of age (1,369 ± 269 vs. 1,174 ± 284 vs. 1,936 ± 283 egg/gm, respectively). There was no difference (P > 0.10) in FAMACHA score between STX and DRPX ewes (2.4 ± 0.1 vs. 2.7 ± 0.1, respectively). The PCV was not different (P > 0.10) between STX and DRPX ewes (27.3 ± 0.5 vs. 27.9 ± 0.4 % respectively) or among ewes weaned at 63, 90 or 120 d of age of lambs (27.4 ± 0.6 vs. 28.8 ± 0.6 vs. 26.5 ± 0.5 %, respectively). The STX ewes had lower (P < 0.005) FEC than DRPX ewes (170 ± 231 vs. 998 ± 175 egg/gm, respectively). There was no difference (P > 0.10) in FEC among ewes that had lambs weaned at 63, 90 or 120 d of age (350 ± 251 vs. 382 ± 258 vs. 1,020 ± 244 egg/gm, respectively). In conclusion, weaning age does not affect the parasite burden of either breed of lambs or ewes, further supporting the use of later weaning ages of hair lambs in an accelerated lambing system.

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Limiting Magnitude of the Virgin Island Robotic Telescope (VIRT)

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We present a limiting magnitude of the Virgin Island Robotic Telescope (VIRT) located at the Etelman Observatory. The goal of the limiting magnitude study is to determine the required exposure time to detect a source of a given brightness. Due to the brightness of the night sky, the relationship between exposure time and brightness sensitivity is not linear. This study will also identify the point of "diminishing returns" for the telescope, the point at which an increase in exposure time no longer produces a significant increase in brightness sensitivity. A graph of brightness versus exposure time with an asymptote to the limiting magnitude will be the main method of determining this value. Data reduction and analysis was accomplished primarily through the use of NOAO's IRAF utilities and the Smithsonian Astrophysical Observatory's DS9 image viewer.

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The Mechanism of Nurse Cell Degradation by Follicle Cells in the *Drosophila* Ovary

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Drosophila melanogaster serves as a great model for studying cell death in mammals; 75% of the disease causing genes in humans has a homolog in *Drosophila*. Our system for studying cell death is the *Drosophila* ovary. Each female has two ovaries, which consist of 15-20 strings of progressively developing egg chambers. Each egg chamber has only three cell types: the germline-derived nurse cells and oocyte, and the somatically-derived follicle cells, which surround the germline. When flies are deprived of nutrients, the germline undergoes apoptotic death and the follicle cells synchronously enlarge and engulf the dying germline. Little information is known about the mechanism through which the large nurse cells are degraded by follicle cells, but corpse processing has been studied extensively in *Caenorhabditis elegans*. We hypothesized that the corpse processing pathway in *Drosophila melanogaster*, may use the endocytic machinery similar to *Caenorhabditis elegans.*

I knocked down two genes that we predicted could be involved in corpse processing in the follicle cells: *Rab7* and *deep orange* (*dor*). I investigated both $Rab7^{dsRNA}$ and dor^{dsRNA} egg chambers using an antibody raised against active Dcp-1, which marks the dying and engulfed germline. Preliminary results suggest that loss of *Rab7* or *dor* causes an increase in the number of vesicles engulfed, but the increase is much more severe in dor^{dsRNA} egg chambers. These results indicate that *Rab7* and *dor* are required for degradation, but further work is needed to investigate these and other corpse processing genes in *Drosophila*. *dor* may also be responsible for sending an inhibitory signal during engulfment to limit the number of vesicles taken up at any one time.

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Exploring Microclimates on St.Thomas

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Microclimates are local zones where the climate is different from the surrounding area. Climate is the yearly pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. St. Thomas has wet and dry microclimates on the west and east ends of the island. This research assessed the available climate information to search for microclimates on St. Thomas. We collected data from the seven Davis Vantage weather stations located at Botany Bay, Antilles School, Coral World, Cowpet Bay, Pinkwhale Road, Chez Jobsis, and Njelteberg. The data were downloaded and converted into Excel format and corrected for missing information. Using the corrected data, we examined correlation plots and created regression models to see if temperature at the stations could be predicted by geography (latitude, longitude, and elevation) and other climate variables (precipitation, humidity, and barometric pressure). The results that were found were of the correlation analysis that showed most stations were positively correlated with each other, negatively correlated, and some was not correlated. Correlation analysis shows that Botany Bay is not well correlated with the other stations, suggesting it has its own microclimate. Coral Bay also seems to have its own microclimate having no correlation to some other stations. Regression analysis showed that geographic factors explained 27 percent of the variability in temperature. When other climate variables were added the model explained 67 percent of the variability. Regressions analysis shows that more than geography is necessary to fully explain the differences in the temperature with the stations. In the future, work should include adding more stations to collect data from more locations, checking stations to make sure they are operating properly, constructing regression models with better geographic and climate factors, and using of the regression modeling to create climate maps that can be coupled with land use to assess the potential for erosion.

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DeFCoM: A Novel DNA Footprinting Method for Accurately Detecting and Analyzing Transcription Factor Binding Sites

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A significant fraction of the human genome consists of regulatory elements - regions of DNA where proteins called transcription factors bind and regulate gene expression. Methods for predicting the binding sites of specific transcription factors have been developed to better understand regulatory DNA-protein interaction, binding site biological significance, and the role of transcription factor binding site mutation in pathogenesis. In related studies, experimental sequencing methods have been used to gather information on DNA-protein binding events. In particular chromatin immunoprecipitation sequencing (ChiP-seq) identifies binding sites genome-wide for a single factor. Alternatively, DNase I hypersensitive site mapping (DNase-seq) more generally identifies regions of nucleosome-free open chromatin where nearly all types of factors bind. Due to the timely and costly nature of ChiP-seq experiments, algorithms using DNase-seq data have been developed to predict the location of individual transcription factor binding sites (TFBS's), referred to as DNaseI footprints. We hypothesized that a more accurate method of predicting specific TFBS's could be developed by using a novel background model in our DNA foot-printing algorithm. Our research presents evidence that our novel statistical method for predicting specific TFBS, named DeFCoM, is more accurate than existing methods. We calculated the accuracy of DeFCoM in identifying TBFSs for multiple factors, as identified by ChIP-seq, using DNase-seq data. We compared these results to those of existing methods run on the same data. Results showed that our method more accurately and efficiently predicted true positive binding sites than that of existing DNA foot-printing methods (CENTIPEDE, Wellington, FOS, PIQ). Taken together, this suggests DeFCoM will enable us to better investigate mechanisms, solutions, and treatments for diseases involving transcription factors and their DNA–protein interactions.

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Assessing Land Cover Change on Saint Thomas

Stephen Santana

The RUSLE (Revised Universal Soil Loss Equation) describe the important factors in the soil erosion process. Land cover is one of these factors. Development changes natural areas to impervious surfaces that have different resistance to erosion natural. Land cover can be mapped using current available aerial photography and then comparing it to older photographs to quantify the direction of changes caused by human activity. We used ARC Desktop to map land cover changes for two watersheds on ST. Thomas.

We obtained aerial photography for Saint Thomas for the years 2010 and 1994 and the USGS watershed map for the territories. The two watersheds used were the location including the airport and UVI and to the immediate west. The land was classified as water, forest, open canopy, Rooftop, Runway, and Lawn using the 2010 photographs and compared with the 1994 photographs.

Some areas changed from forest to roads and buildings.

We have aerial photography dating back to the 1940's that could be included in this analysis to further our research and possibly allow us to gain a better understanding on some changes that occur from events such as hurricanes. Once completed an analysis of the entire territory could be done.

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Motivation in Digital Game-Based Learning

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Typical classrooms are comprised of students with various learning styles. Therefore, it is reasonable to have multiple teaching strategies that ensure maximized accommodation of each student's learning needs. The school systems, for a long time, have often neglected logical-quantitative modes of instruction among others and have been bias toward linguistic modes. Howard Gardner's Multiple Intelligence theory suggests that each student has a different mind and consequently remembers, performs, understands and learns in dissimilar ways (Gyan-Mante, 2013). If students' needs are appropriately met, then learning is better facilitated—leading to higher occurrence of positive reinforcement—and motivation eventually increases. Digital games provide means of incorporating the main intelligence learning styles such as visual/spatial, bodily/kinesthetic, musical/rhythmic, interpersonal, intrapersonal, linguistic and logical/mathematical into everyday teaching. Therefore, H_a: Effective use of educational digital games as instructional tools positively increases students' motivation and engagement during learning and performing educational tasks. To test this hypothesis, a 14-item questionnaire adapted from the Motivated Strategies in Learning Questionnaire (MSLQ) (Pintrich & DeGroot, 1990) was administered to 12 students, generally between 6-9 years old, as a pre-test and then as a post-test after having them play an educational digital game based around the concept of friction in relation to speed, "Bugs on a Plate." The adapted version of the MSLQ measured intrinsic motivation, extrinsic motivation and task value. The pre-test vs. post-test T-TEST showed statistically significant values at the $p \leq 0.05$ confidence interval for task value, but not intrinsic and extrinsic motivation, therefore, the null hypothesis was rejected. For further investigation, future studies of a larger sample size and more longitudinal in nature are anticipated.

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Surface Segregation in Metal Oxides

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The composition of the surface differs from the actual bulk of the material. This phenomena is known as surface segregation. With the use of quantum mechanical modelling techniques, we study the surface segregation energy of several mixed oxides. We have used the real grid-based projected augmented wave (GPAW) code to run the density functional theory (DFT) calculations [JJ Mortensen, PRB Vol. 71, 035109,]. The main contribution to the surface segregation energy is given by the difference in the surface energies of the impurity and the host [A.V. Ruban, Physical Review B (1999) – APS, (59) 24]. Our results have allowed us to gain insight on the actual composition of the elements with the oxides. These results will help us to obtain an understanding of each impurities catalytic properties in chemical production.

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Intrusion Detection System: Effectiveness of Regular Expressions for Detecting Malware Signatures

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Cyber Security is a growing field within the computer science community. One important research area is malware detection and prevention. Malware steals and disrupts data, causes computer systems to crash and can create catastrophic events, if not monitored for daily. Because malware programs have malicious intentions, it is often possible to characterize harmful behavior using patterns or signatures within the executable files. One way to detect the presence of these signatures is through regular expressions. Regular expressions are patterns that are used to match character amalgamation in strings. By using regular expressions searching, text processing and data validations are easier to manage saving time and effort when it comes to automating pattern matching processes. This work evaluates the application of regular expressions for the detection of malicious codes. The Java programming language is used to express the signatures and find malicious patterns. In order to test the effectiveness of my approach, I experimented with five different sized files ranging from ten kilobytes to thirty-five megabytes. I calculated the execution time for the detection program to find the signature. The signatures to be discovered inside has five characters that will be used to find within the five files provided within the experiment. As a result it gives the matching text, the starting and ending indexes, as well as the total time it took for the program to run through. The execution time is recorded and compared to the results of my research partner who is using another set of algorithms. Four different files were used during a one-week span. As a result the program was successfully completed and is now under further development to be able express more sophisticated patterns.

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Frequency of Fission and Fusion in Colonies of *Madracis mirabilis*

Zola Roper[1]
Mentors: Marlene Brito-Millan[2] and Stuart A. Sandin Ph.D.[2]
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Scleractinian corals (stony corals) are the principal reef building organisms in coral reef systems. In coral population ecology, it is important to study fission/fusion events, how they change through time, and ultimately their role on coral persistence. This research focuses on the frequency of fission and fusion in colonies of the pencil coral, *M. mirabilis,* from the Caribbean island of Curacao across a 5 year period. As a secondary aim, qualitative comparisons of fission/fusion frequency data to local weather patterns were also undertaken to explore the hypothesis that there will be significantly more fission and fusion in *M. mirabilis* colonies when there are unfavorable weather conditions. Five year bi-annual photographic time series taken from permanently marked locations (quadrats) in the Caribbean island of Curacao. PhotoQuad, a free downloadable program, was utilized to digitize the photos. Data analysis was done in Excel. Fusion occurs, but is rare (<0.1% at all times). Less than 0.1% of the colonies broke apart (fission) in all the time series except for one period (2010-2011). This spike in fission can be correlated to the sudden increase in rainfall from 2009-2011. Average proportional colony growth shows that most surviving colonies experienced net growth. This exploration is important for understanding the relationships between environmental and ecological demographic events happening within a Caribbean coral reef. Future studies should include continuing long term monitoring and calculating other demographic rates such as survival and recruitment.

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Judges

Jan-Alexis Barry	Dr. Stanley Latesky
Dr. Marilyn Brandt	Dr. Frank Mills
Dr. Yakini Brandy	Glen Monticeux
Dr. Gloria Callwood	Dr. Donna Nemeth
Dr. Andrew Campbell	Dr. Renata Platenberg
Dr. Bernard Castillo	Dr. Avram Primack
Chasda Clendinen	Dr. Jennilee Robinson
Danielle DeGain	Ludence Romney
Alexandria deJarnett	Dr. Lynn Rosenthal
Sarah Donovan	Dr. David Smith
Andrew Douglas	Henry Smith
Timothy Faley	Dr. Alice Stanford
Anthonio Forbes	Dr. Robert Stolz
Kari Gehrke	Dr. Teresa Turner
Haley Goodson	Clive Wyatt
Dr. Rita Howard	

Notes

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- Dr. Alice Stanford, MBRS-RISE Coordinator (STT)
- Dr. Velma Tyson, MARC & MBRS-RISE Coordinator (STX)
- Dr. Sandra Romano, Interim Dean of the College of Science and Mathematics
- Dr. Marc Boumedine, Judges Coordinator
- Ms. Paulette Stevens, Grants Program Manager
- Ms. Aimee Sanchez, Data Specialist

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