Seventeenth Annual

Summer Student Research Symposium

August 2nd, 2019
10:30am to 12:30pm
St. Thomas Campus Library
University of the Virgin Islands

17th Annual Summer Student Research Symposium Abstract Book

Friday, August 2nd, 2019
Ralph M. Paiewonsky Library
St. Thomas Campus
University of the Virgin Islands

Event Organized by

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

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Undergraduate Student Research Abstracts
Available online at http://ecs.uvi.edu

Predictors of Body Mass Index in USVI High School Students

Laurie Armstrong
Mentor(s): Dr. Noreen Michael and Dr. Aletha Baumann
Caribbean Exploratory Research Center, University of the Virgin Islands

The research question for this study was “Do soda consumption and exercise predict body mass index (BMI) in US Virgin Islands high school students?” BMI is not only used to indicate body fatness but also can be an indicator for health problems. These health-risk behaviors can contribute to the leading causes of morbidity and mortality (Redfield et al., 2017). Data were obtained from 1,210 students from 4 high schools in the US Virgin Islands who participated in the Youth Risk Behavior Survey (YRBS) in 2017. BMI was calculated from self-reported height and weight, estimated age (questions 6, 7, and 1, respectively) using the Centers for Disease and Prevention calculator. Slightly more than half of the participants had BMIs in the healthy category. Soda consumption and exercise was acquired from self-report based on question 76 and 79 of the YRBS. A multiple regression was run to predict BMI based on soda consumption and exercise. A significant regression equation was found ($p = .046$), with an $R2$ of .005. BMI is equal to $24.772 – (.014 \times$ soda consumption$) – (.180 \times$ exercise), where for soda consumption is coded as 0 = no soda, 1 = 1-3 in 7 days, 2 = 4 -6 in 7 days, 3 = 1 per day, 4 = 2 per day, 5 = 3 per day, and 6 = 4 or more per day and exercise is the number of days a week the participant reported having done physical activity (0-7). Only exercise was the statistically significant predictor, $p = .013$. This suggests that there are other variables that can predict BMI. Such variables which should be investigated to increase the predictability of BMI are medication, disease, calorie intake, metabolic disorder, or syndrome. Given the significant predictor of exercise for BMI, an area of concern is that the reduction of physical activity in the amount of Virgin Islands in the public-school system. The impact of this reduction should be researched. Recording actual activity level, perhaps electronically, should be done in another study. Consideration should be given to adding a question on consumption of local drinks and actual date of birth in the next YRBS.

This research is funded by UVI RISE grant # GM061325.

Enhancing End-to-End Mangement Capabilities of the USVI Climate Monitor

Ulric Baptiste Jr.
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University of the Virgin Islands

The ever present and ongoing need for a deeper understanding of the climate within the community of the US Virgin Island USVI, has brought up the need for a dedicated monitoring system. The University of the Virgin Islands and OrangeWave Innovative Science, LLC have partnered to meet this need, and installed 16 weather stations across the islands of St. John and St. Thomas—dubbed the USVI Climate Monitor. Our study developed tools to ensure the long-term consistent operation of USVI Climate Monitor stations, as a reliable, regularly maintained, and portable USVI climate database is central to understanding and mitigating territorial impacts from climate change. We developed standard operation procedures (SOPs) for station maintenance and installation, documentation that describes data stream and anomalies within hardware or remote data, and a procedural guide book for subsequent researchers. Additionally, we built a software framework to parse USVI Climate Monitor data to the US Drought Monitor. Throughout the course of this project several unit level issues in weather stations were identified and resolved. Work was also carried out towards building a prototype device that can stream line future unit level maintenance. The work of this project enhanced the accuracy and preservation of the USVI Climate Monitor program.

Funding: NNX15AP95A

Population Characteristics of the Velvety Free-Tailed Bat

Deslyn Bartlett, Creightanya Brewley, and Dijani Laplace
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University of the Virgin Islands, St. Thomas

There are 5 species of bats native to the Virgin Islands. *Molossus molossus* is a small insect eating bat and the main focus for this study. The Virgin Islands Bat Team has been monitoring populations of these local bats since 2008, and our aim was to analyze this data to evaluate population characteristics and to add to previous knowledge on a generally understudied fauna in the scientific community that are susceptible to modern ecological pressures. Using Microsoft Excel, we conducted a meta-analysis on *Molossus* capture data for the past 10 years to better identify any obvious trends/ relationships. We hypothesized that the mean *M. molossus* captures per survey would decrease across years (particularly before and after the hurricanes), the mean Body Condition Index (BCI) would show variation between years and would be lower in bats with higher ectoparasite load. Moreover, we expected that there would be significant differences in the population size and sex ratios between different survey sites. Population estimates were made using the Jolly-Seber CMR method, and tests of statistical significance were done using One Way-ANOVA, Chi-square and t-tests where appropriate. The results showed that there was no significant difference between mean *M. molossus* captures per survey two years before and after the hurricanes, while the BCI of *M. molossus* captures shows a slightly declining trend, and is significantly lower in 2019 than in 2009. Also, BCI in *M. molossus* was not negatively affected by ectoparasite presence. Furthermore, there is a significant difference in mean BCI, sex ratio, and age group ratio of *M. molossus* captures between Magen's Bay and Stumpy Bay. *M. molossus'* insectivorous diet may have allowed it to suffer only minimal impacts due to the hurricanes, while differences in the resource availability and habitat use by gender may account for the difference seen between the sites. Ectoparasites and *M. molossus* also may have coevolved, explaining the lack of negative effect on general bat health.

Acknowledgements: ECS Honors Fund, NSF HBCU- UP ACE grant award #1623126 and the Virgin Islands Bat Team

Exploring the Marine World: An Introduction into STEM-based Careers for Virgin Islands Youth

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University Of the Virgin Islands, Center for Marine and Enviromental Studies

Many students in the Virgin Islands have not had access to marine science education. Although it is only offered in public highschool, students in private schools or homeschooling programs,do not have access to this. The Youth Ocean Explorers, allows students from grades 7th through 12th to be exposed to authentic marine science-based research and career opportunities within this field. This four-week program uses a combination of classroom presentations and interactive outdoor activities to highlight to students the connection between each component of STEM (Science Technology Engineering and Mathematics) with marine science. Students' knowledge, attitudes and commitment to Marine and environmental concepts and actions are assessed using a pre and post survey modified from the CHEAKS (Children's Environmental Attitudes and Knowledge Survey). We compared 2017 data to 2018 pre and post test data and found that the number of students that would see themselves in a science or research career, as well as showed interest in a science career, increased between 2017 and 2018. The Youth Ocean Explorers increased participation in Marine science enrichment during the summer months, where students would experience "brain drain".

Acknowledgements: ECS, SEAS, & UVI

A Literary Review: In silico Molecular Docking Analysis of Natural Marine Products as Anti-cancer and Anti-inflammatory Agents

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Mentor(s): Dr. Neelam Buxani
University of the Virgin Islands

Protein-ligand docking infers the position of the main binding sites of a ligand when it binds to a protein receptor. Docking studies have been proven to be a crucial tool that aids in the structural diversity of natural products to be utilized in an organized manner for drug discovery. Several software programs have been developed to perform molecular docking such as Schrodinger Glide, AutoDock Vina, Chimera, SwissDock, GalaxyPepDock, and MOLS 2.0. In our research, we are focusing on assessing anti-cancer and anti-inflammatory potential of marine natural products obtained from online chemical databases or research articles, by using Schrodinger's Drug Discovery Software package and results will also be counter confirmed with Chimera. In our study, based on Schrodinger Glide's energy score, the compounds showing strong interactions with target protein in terms of hydrogen bond and hydrophobic interactions would be selected for further laboratory studies.

Acknowledgements: Summer Undergraduate Research Experience Program and NSF HBCU- UP ACE grant award #1623126

Comparison of Four Leafy Green Vegetable between Two Nutrient Solution in NFT Systems

Makayla Cariño
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Nutrient Film Technique (NFT) hydroponics is a vegetable production system that uses inorganic nutrients dissolved in water instead of soil. Initial nitrogen levels in these systems are 200 mg/L. Aquaponic systems is an integrated fish and vegetable production system uses low nitrogen of 50 mg/L. This research compares high and low nitrogen levels in the production of leafy green vegetable (Muir and Tropicana lettuce, Genovese basil, Mei Qing Choi pak choi) in NFT systems. We had six identical NFT systems that consist of ten 6.1 meters long channels, a reservoir tank filled up to 400 L of water. Three systems containing 200 mg/L of nitrogen in the control systems and three systems containing 50 mg/L in treatments systems. Our goal is to determine if low nutrients reduced growth and production. Here we report that we saw no significant difference in plants heights for all varieties. Chlorophyll was significantly low for Muir and Tropicana lettuce in the 3rd week (Muir control: 14.54 treatment: 9.11, Tropicana control: 22.16 treatment: 13.12, $P = < 0.05$). The average plant weight of Tropicana and Muir treatment performed better than the control (Tropicana control: 52 treatment: 83, Muir control: 69 treatment: 87), the Genovese basil and Mei Qing Choi pak choi were not significantly different between control and treatment. We show that for the lettuce crops yield better in the treatment with low nitrogen 50 mg/L.

Acknowledgements: NSF HBCU- UP ACE grant award #1623126

Bullying, Sexual Identity, and Suicidal Ideation in V.I. High Schoolers

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Nationally, 17.2% of students reported they have seriously considered attempting suicide in the last 12 months according to the 2017 Youth Risk Behavior Survey (YRBS). Also found was that 19.0% of students have been bullied on school property, and 14.9% of students were electronically bullied. 85.4% of students identified as heterosexual, 2.4% identified as gay or lesbian, 8.0% as bisexual, and 4.2% were not sure of their sexual identity. This study examined the relationship among bullying, sexual orientation and suicidal ideation for school students attending public schools in the U.S. Virgin Islands. Secondary data from the 2017 V.I. YRBS were used to address the research question of interest. Of 1,782 high school participants, 1,678 (94.2%) responded to the four survey questions of interest. 73.4% reported they were not bullied on school property; whereas, 11.0% students reported being bullied on school property. 90.5% said they were not bullied electronically; alternatively, 9.5% of students did report being bullied electronically. 87.1% of students identified as heterosexual; whereas the remaining 12.9% of students identified as gay or lesbian, bisexual, or not sure. Of all respondents, 16.9% had suicidal ideations. Using SPSS 25, three chi-squares for independence were used to assess the association between each of the following independent variables and suicidal ideation. Each independent variable was found to show significant relationships to suicidal ideation (< .001 level). Suicidal ideation is three times as likely among youth who reported being bullied on school property and electronically than those who were not. Students who identified as bisexual were three times more likely to report suicidal ideation than their heterosexual counterparts. Gay, lesbian, and youth who reported not being sure about their sexuality were two times more likely to report suicidal ideation compared to heterosexual students. This is approximately the same percentage of youth in the V.I. compared to national statistics from the YRBS. Because this is a correlation and not a causation study and gives one reason for future research on suicidal ideation in the V.I. youth. In the V.I., bullying on school property and electronically, as well as not identifying as heterosexual have shown an association with suicidal ideation. Studies have shown that victims of bullying express high levels of suicidal ideation, and the risk for attempted suicide is high compared to non-bullied-victims (Shireen, et al., 2014). Further research is needed to establish a better understanding of the causes of suicidal ideation and suicidal behaviors in the Territory. Protective climates, as discussed by Hatzenbuehle et al. (2014) should be explored as a prevention for suicide ideation and suicide.

This research is funded by UVI RISE grant # GM061325.

Post Hurricane Assessment of the Invasive Species *Halophila Stipulacea*

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Halophila stipulacea is an invasive seagrass species that is currently present in the local waters of the United States Virgin Islands. Its native ranges include the Indian Ocean and the east coast of Africa, and it was first reported in the USVI in 2012. This seagrass is capable of rapid expansion, which displaces our native seagrasses and affects the diversity of our fish communities. The purpose of this study is to continue an ongoing study of *Halophila stipulacea* by conducting a post-hurricane assessment of the seagrass at Brewers Bay in St. Thomas. We hypothesize that there will be multiple genotypes of *H.stipulacea* found in Brewers Bay. We also hypothesize that there will be a difference in the proportion of the genotypes at Brewers Bay when compared to pre-hurricane data. We performed PCR on our DNA samples which was followed by gel electrophoresis. Lastly, the concentration of the DNA libraries created were quantified. Due to the fact that we are awaiting the sequencing results, DNA library concentrations from last year were analyzed and compared to sample sets from previous years using a one-way ANOVA and Tukey HSD test. The ANOVA test showed that one or more of the sample sets were significantly different. The post hoc Tukey HSD test showed that each sample set was significantly different from each other. An increase in the mean concentration was observed over the years. This may imply an improvement in our lab techniques over the years. Another analysis will be conducted when the sequencing results are retrieved to test our hypotheses.

Acknowledgments:

We would like to thank our mentor Dr. Stanford for assisting us with our research this summer. We would also like to extend a special thank you to Helen Ratchford and Ford George for dedicating their time to helping us with completing our project. We acknowledge the support of the ECS program in affording us the opportunity to be able to do research. This research was funded by VI EPSCoR through grant #0814417, NIH RISE through grant #R25GM061325, NSF-HBCU-UP ACE through grant #1623126 and the donors to ECS Honors Fund. We thank you for the funding that made this study possible.

Marine Water Chemistry & Suspended Sediment Concentration in the Salt River Bay National Historical Park and Ecological Preserve, St. Croix, USVI

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Mentor: Kynoch Reale-Munroe, M.S. [1]
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Salt River Bay National Historical Park and Ecological Preserve was created in 1992 with the intent to preserve, protect, and nationally interpret the natural, historical, and cultural resources in the area. The area includes a mangrove forest, a submarine canyon, coral reefs, seagrass beds, coastal forests, and is rich in indigenous and modern cultural history. Salt River Bay falls into Class B waters and was listed on the U.S. Environmental Protection Agency (EPA) approved U.S. Virgin Islands' 2016 list of impaired waters. Listed impairments included Dissolved Oxygen (DO), Turbidity, Fecal Coliform and Enterococci. The main objectives of this study were to assess the quality of the water and determine if parameters tested met current regulations. Over a three-month period, water samples were collected at six sites within Salt River Bay. Samples were tested for suspended sediment concentration (SSC), nutrients, water temperature, salinity, and DO. Results showed that SSC ranged from 4.10 mg/L– 9.07 mg/L, with a mean of 6.39 mg/L. Combined mean water temperature, salinity and DO were 30.1°C, 38.5 ppt, and 5.0 mg/L, respectively. Nutrient results were still in process. Results from this study suggested that temperature, salinity, and SSC were within normal limits; however, DO fell below the current minimum regulations of 5.5 mg/L.

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A Population Analysis on the West Indian Topshell Snail

Nicholas C. Durgadeen and Samuel Gittens Jr.
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University of the Virgin Islands

The West Indian Topshell snail or more commonly known as whelk (*Cittarium pica*), is a species of marine gastropod that lives in the intertidal zones along rocky shorelines. They are important for our culture by providing us with cultural dishes like whelk and rice, and they contribute to our ecosystem. Whelks are going through a population decline, and if we do not manage this problem with importance, they risk becoming extinct in the U.S. Virgin Islands. Whelks were measured at four sites within the East End Marine Park, in its No-Take Zone. The 2019 data was then compared to data on whelks that was previously collected in 2003 and 2004 by Toller & Gordon. Overall, we collected 569 whelks within our six weeks' time span; previous data had a sum total of 398 whelks within the four sites we surveyed. Similar to the previous study, whelks of a legally harvestable size were rarely present. There was a noticeable difference in size distribution of whelks from the data collected in 2003-2004 and the new data collected in 2019. Once the population densities for all four sites were compiled, there was a bimodal distribution in two of our categories, whereas there was only one significant peak from Dr. Toller and Dr. Gordon's data.

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Family Reunification: Clustering Malware Variants

Rhonda Forbes
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Every couple of seconds, a new malware program is created. Traditional anti-malware software relies on malware signatures to recognize malware. To avoid it being detected, authors use different techniques to change the malware signature, though retaining the same functionality. Researchers are looking into various ways to combat this by combining several features of malware to identify malware variants faster. In this research, we will be focusing on the features represented as strings extracted from the portable executable (PE). Strings were chosen because they can give a hint to the programs' behavior. We want to see if it's possible to use string features to discern if programs that have similar behavior can be grouped together in the same family. This research seeks to determine: if strings can be clustered into their respective groups based on the Jaccard distance. If they can be clustered, then the malware comes from the same family. We applied the following methodology: feature extraction, strings were collected from 16 malware and 16 benign in the same families. We then preprocessed the PE to clean the data. Next, the Jaccard distance was used to create a dissimilarity matrix between all the programs. Hierarchical clustering was used to cluster based on the average distances between them. We experimented with a different number of clusters. The results with the two clusters show the program accurately clustered the malware and benign groups. As we increased the number of clusters, the benign programs remained in the same group, while the malware were reassigned to different clusters. These results suggest that malware reassigned to the same group are derived from the same family.

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Computational Molecular orbital and computational spectral Analysis for 1,4-Diazobicyclo 2.2.2 Octane

Xuxa Garroden, T' Leah Serieux and Fatima Suid
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1,4- Diazabicyclo[2.2.2]octane (DABCO), or triethylenediamine, has the chemical formula, $N_2(C_2H_4)_3$. This organic reagent is used as a catalyst in numerous industrial processes. The reagent is known to easily form a free radical and because of this can be used as an antioxidant free radical scavenger in several different chemical processes. Numerous groups have found that the radical cation, generated in-situ using a variety of chemical, spectroscopic or electrochemical methods, demonstrates delocalization of the free-radical electron through the sigma () carbon-nitrogen framework (ESR or UV-Vis spectroscopy). Using computational computer programs (in our case, Gaussian), we have performed computational Molecular Orbital (MO) calculations, determining the orbital energies for the complete set of molecular orbitals, and comparing the energies of the Highest Occupied Molecular Orbital (HOMO) and the Lowest Unoccupied Molecular Orbital (LUMO), using a variety of computational methods (Hartree-Fock Self Consistent Fields (H-F SCF) or Density Functional Theory (DFT), using a variety of different basis sets) to experimental results. Our computational results are consistent with what has been seen spectroscopically using ESR or UV-Vis spectroscopy.

Acknowledgements: NSF-HBCU-UP ACE grant ##1623126 and SLL Foundation.

Total Phenolic Content and Synergistic Properties of Plant Mixtures

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Phenolic compounds are phytochemicals that are found in various plants species, as well as in fruits and vegetables. Phenols are aromatic organic compounds with the molecular formula C_6H_5OH. These compounds can be found in many different classes, including antioxidants, lignin, carotenoids, and flavonoids. Consuming plants that contain large amounts of phenols can be very beneficial to human health by reducing the chances of developing diseases like cancer, diabetes, and multiple cardiovascular diseases. People either consume individual plant products or in mixtures, like in tea, soups, etc. This is especially true in the Caribbean, where fruits and herbs are often combined to make drinks and teas. For this study, we collected three different plants in the Virgin Islands, namely: Lemongrass (*Cymbopogon citratus*), Cuban Oregano (*Plectranthus amboinicus*), and Spinach (*Spinacia oleracea*). The main objective of this study was to determine the synergistic effect by combining multiple plant extract and determine its total phenolic content (TPC). We also wanted to determine any differences between the calculated and experimental TPC values between mixed plant extracts. The Folin-Ciocalteu method was used to determine the TPC (mg GAE/g DW) of plant extracts, while the absorbance was measured in a UV-Vis spectrophotometer at 765 nm. Our results showed that Spinach had the highest mean TPC (4.475 ± 0.410 mg/g GAE/g DW) while Lemongrass had the lowest value (4.073 ± 0.044 mg/g GAE/g DW). A one-way ANOVA test showed that there was no significant difference between the TPC values of each plant tested ($p = 0.4288$). The mixture with the highest experimental TPC was Lemongrass and Spinach (5.698 ± 0.224 mg/g GAE/g DW), while the mixture of Oregano and Lemongrass had the lowest value (2.873 ± 0.000 mg/g GAE/g DW). One-way ANOVA analysis showed a significant difference between all the experimental values for the plant mixtures ($p = 7.0 \times 10^{-5}$). Comparison between calculated and experimental TPC values of Lemongrass and Spinach ($p = 0.00239$), Oregano and Lemongrass ($p = 0.00482$), and Oregano and Spinach ($p = 0.00414$), all showed statistically significant differences. When comparing calculated and experimental TPC values for the mixture of all the plant samples, one-way ANOVA analysis did not show any significant difference ($p = 0.7502$). Throughout our study, there was no clear pattern showing that the paired mixtures of different plants were significantly different for each combination. Moreover, it was not definitive that the calculated values were higher when compared to the experimental values. We can conclude that there is a positive synergistic effect if all the plant extracts were combined rather than a mixture of two samples. These results showed that it would be more beneficial to consume these plants separately rather than consuming them as mixtures.

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Method Validation for Microplastic Extraction from Beach Sediment

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With the increase in mass accumulations of *Sargassum* seaweed or “Golden Tides” as they are called today and the increase in microplastic pollution, golden tides could potentially have huge negative effects on food webs by influencing the influx of microplastics (Gutow et al. 2015; Phillips and Bonner, 2015). Here, we have decided to investigate *Sargassum* as a vector for microplastics pollution on Caribbean beaches. The goal of this part of the project is to validate methods proposed for microplastic extraction, to determine the best methodology for microplastic extraction from beach sediment. Two different methods were tested, the NOAA methods for microplastic extraction (2015) and the methods from Besley et al. (2016). We found that the methods from Besley et al. (2016) showed significantly more microplastics extracted from sediments, compared to the extraction methods published by NOAA (2015). Each sample was analyzed under a microscope for microplastic pieces and each particle was categorized into fibers, fragments or beads. Our findings will allow us to choose the best methods for microplastic extraction, for the project that is currently being conducted regarding microplastic extraction from *Sargassum* seaweed samples in the water.

Acknowledgements: NSF HBCU- UP ACE grant award #1623126

The White Plague: A Closer Look at the effects of Water Temperatures

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Coral reefs are essential to both aquatic life and man. They provide habitats to many marine organisms, protect coastlines from damaging effects, and are great for the economy. Sadly, due to many environmental factors, one being fluctuations in water temperatures, reefs in the Caribbean are experiencing bleaching events making them more susceptible to diseases such as the white plague. Fortunately, a cellular automata (CA) can be used to assist in addressing this issue. To create this model, we used an extended Von Neuman Neighborhood consisting of 25 neighbors which can either be Healthy, Bleached, Diseased, Mortality (Dead), or Empty. We then created probabilistic rules using a probability matrix to determine the likelihood of the initial cell changing state. So far, we have found that the probability of disease spread is; probD= .184, meaning it will take approximately 10 days for disease to grow to a 25 cm^2 circular patch. We also found that the probability of healthy is; probH= 0.0045, which means that it should take about a full year for an infected reef to become healthy again growing into to a 25 cm^2 circular patch. The results from the cellular automata are very informative thus far. It gives us an accurate representation of how the white plague is spreading within reefs as well as show the likely hood of recovery, which may help scientists improve the results of the reefs in the Caribbean. In the future, our goal is to complete the model and incorporate the effects of the reef when bleaching and death happens within the environment.

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Apicomplexan parasites in Damselfish

Raquel Hill and LeAnn Horsford
Mentor(s): Dr. Jennilee Robinson
University of the Virgin Islands

Apicomplexa are a diverse Phylum composed of intracellular protozoans including parasites like *Plasmodium spp.*, the causal agent of Malaria. Malaria is a life-threatening disease vectored by the *Anopheles* mosquitoes. Apicomplexa infect the red blood cells of coral reef fishes including *Stegastes adustus,* the dusky damselfish in the Caribbean. The life cycle, mode(s) of transmission and host effects are unknown. For example, while intracellular protozoa are found in the blood of damselfishes, it is not known whether they infect the other tissues of these hosts. Many Apicomplexa, such as *Toxoplasma gondi*, cause distributed infections throughout their host's tissues. We hypothesize that fish with parasites in their blood are also infected in their organs, and that the quantity of intracellular blood parasites negatively affects the fish's condition. In this study, twenty *S. adustus*, which are known to harbor blood infections, and three sympatric fish, which are not known to harbor blood infections (one parrotfish *Halichoeres bivittatus,* and two French grunts, *Haemulon flavolineatum*), were collected from near-shore reefs in Brewer's Bay St. Thomas, USVI and anesthetized in a clove oil solution. Blood was collected from the sinus venosus, thin smears were prepared for microscopy and remaining blood was placed in a citrate-anticoagulant buffer. The fish were housed in storage tanks and were later either dissected to collect the organs (liver, heart, brain and gut) or released back to the reef. Several methods of analysis were employed to identify, isolate, and quantify the protozoa. Microscopic analysis of Giemsa-stained thin blood smears enabled detection of intraerythrocytic infections. PCR analysis employed three apicomplexan specific primer sets for the 18S rRNA and one fish-specific primer to screen DNA extracts. Percoll density gradients were useful in separating blood cells, and we also successfully cultured infected blood samples. Giemsa-stain analysis indicated (12 out of 20) 60% infection in damselfish blood whilst the sympatric French grunts were uninfected. However, PCR identified infection in all twenty damselfish and the French grunts. PCR analysis of the damselfish organs indicated Apicomplexa infection in the liver, heart, brain, and gut of all fish tested, even those without visible blood infection. Apicomplexa DNA was also detected in the organs of sympatric fish (the French grunts' liver, heart, and brain and the parrotfish's liver and gut). Apicomplexan parasites can cause either catastrophic damage or relatively little impact to their hosts. However not enough is understood about the parasite- host interaction. Future studies to identify parasite proteins and histology of parasite infected cells will help us gain a better understanding of the parasite-fish interaction and characterization of this novel apicomplexan.

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Twitter Sentiment Analysis

Wed-Rouffaet Jaboin
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Social media are rich platforms to learn about people's opinion and sentiment regarding different topics as they can communicate and share their opinion actively on social networks like Facebook and Twitter. Sentiment Analysis also known as opinion mining falls under Natural Language Processing (NPL) which is a process of computationally identifying and categorizing opinions expressed in a piece of text, in order to determine the writer's attitude towards a particular topic. With twitter, it works to analyze the emotions, moods, opinions, and sentiments which are shared tweets.

There are different opinion oriented information gathering systems which aim to extract people's opinion regarding different topics. Unsupervised Lexicon-based approach and Supervised Machine Learning approach are the two strategies used for analyzing sentiments from text. In my research, I try to analyze twitter posts about car manufacturers BMW, Audi, Mercedes Benz using the lexicon-based approach. I will be able to quantify the sentiment with a positive or negative value. The overall sentiment is determined as positive, neutral or negative from the sign of the polarity score.

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UVI-GREAT: CubeSat Mission To Launch

Brianna Lawrence (BCB) and Kia'Constance Phipps (IEKHS)
Mentor(s): Antonino Cucchiara, Ph.D
University of the Virgin Islands

Gamma Ray Bursts (GRBs) are extremely energetic explosions that have been observed in distant galaxies. They are the brightest electromagnetic events known to occur in the universe. Gamma-ray Bursts can last from ten milliseconds to several hours. We can't detect these bursts from earth because the gamma-ray interact with the Earth's atmosphere and they never make it to the planets surface. The gamma-rays that are being detected also in other energy bands (e.g. optical, X-ray, radio). The reason we think gamma-ray bursts are important is because they are known to occur at huge distances from Earth, towards the limits of the observable Universe. Study them will allow us to study in detail the formation of the Universe from the very beginning. In order to study GRBs the University of the Virgin Islands is building UVI-GREAT (University of the Virgin Islands: Gamma Ray Experimental for Astrophysical Transients), which is a Gamma Ray nanosatellite designed to be launched in 2022 and orbit in 1 year. UVI-GREAT will detect gamma-rays coming from GRBs using a 'scintillator', which collects gamma-ray photons and transform into UV or optical light. The satellite will record this light and send messages on Earth about the GRB explosion. In order to test the scintillator in the UVI Physics lab we built a "light tight box", which is a box containing a digital camera (the CCD), a scintillator and a radiation source (which produces gamma-rays). The main purpose of us building the Light-Tight Box is to test the scintillator and radioactive elements and make sure it is functioning correctly before we can launch it into space. We tested a single scintillator made of plastic with different configuration and different radiation sources.

Funding: AEOP Research Engineering Apprenticeship Program and DoD Research and Engineering Apprenticeship Program (REAP)

Assessment of Post-Hurricane effects of Post-Traumatic Stress Disorder in St. Thomas

Dalissa Lettsome
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In September 2017, hurricanes Irma and Maria struck St. Thomas as a category 5 with its powerful rains and winds. Although the hurricanes occurred two years ago, St. Thomas still faces the consequences, especially the mental health division. There was a 19% decrease in the USVI mental health sector between loss of staff and hiring new staff which would sequentially harm residents that struggle with mental stress from the hurricanes. As a result, it is believed that there are a great number of residents that show symptoms of Post- Traumatic Stress Disorder (PTSD). Furthermore, females will be more susceptible to displaying symptoms of PTSD compared to men. The goal of this study is to analyze the impact that hurricanes Irma and Maria had on the mental health of St. Thomas residents through a PTSD Checklist-Stressful Event (PCL-C) self-administered survey completed by 130 residents of St. Thomas. More than half (63%) of the respondents showed little to none symptoms of PTSD, 27% responded to showing moderate to moderately high symptoms of PTSD and 9% of the respondents showed high symptoms of PTSD. Results also indicated that there was no significant difference (p=.062225) between the severity of PTSD in males and females. Two years after the hurricanes, despite the tremendous loss that many residents have faced and the struggles faced by the mental health division, the prevalence of PTSD in adult residents post-storm has shown to be minimal.

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Control Flow Hijacking: Impacts on Smart-cars

Kenique Liburd and Matthew Wilkinson
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As early as the late 1970s, computers were used in vehicles to control sensors, combustion and interactions between electrical systems. More recently, vehicles like Tesla's Model 3 support over-the-air updates, which transmit bug fixes, firmware updates, and new software/features, in the same way smart-phone and laptop companies provide system updates and bug fixes. GM President Mark Reuss says "We're not going to do this without highly thought-out cybersecurity measures, which I'm not sure gets enough attention". Therefore, the question is posed: Is the technological advancement safe, specifically from cyberattacks? We believe that it is possible to infect a technologically advanced car with malicious software that can alter the general functionality of the vehicle, by hijacking the control flow of the program that controls said vehicle. This research - through the use of a model car, Arduino board, and a few additional electronic components - serves the purpose of discovering and demonstrating possible results of such a malicious software after it has been injected into the vehicle's Arduino board and smart system. For this project, an actual smart-car could not be afforded, therefore we assemble an Arduino model car, which deploys some basic smart car-like features (i.e. proximity sensors, bluetooth/remote control, autopilot mode, I/O device connections, and etc.). In order to interact with the vehicle, we utilized Arduino C/C++ code in the Arduino IDE and Atmel Studio 7 IDE. Through two processes - one for each IDE - we were able to obtain the assembly code as output files. The main purpose for this research is to show that it is possible to hijack the Control Flow of a smart car by using an Arduino robot that has similar mechanical and programmable features as smart cars. In our experiments we have hijacked the Control Flow of smart-car features such as sensors, steering and direction, and taking control of auto pilot mode. These results raised awareness that smart systems must be carefully protected against cyber-attacks to avoid future catastrophic events.

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Assessing Decontamination and Sterility Protocols for 2019 Rocksat Astrogenomics Program

Shakilah Liburd
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Life, on earth, is said to be ubiquitous. That applies, specifically to microscopic life that have evolved to survive and grow in some of the most extreme environments. In truth its very hard to encounter an environment on earth that is not colonized by some tenacious microscopic life or another. In addition, removal of life, specific of the vestiges of any life, is also very difficult. It as been hypothesized that some microorganisms can in fact, can survive for long periods in time in space like environments, in a putatively quiescent state or dormant phase. Various studies have sought to address the possibility of extraterrestrial life, particularly in the form of detailed biochemical examination of earthbound or surface recovered meteorites, which underpins a theory postulated by Berzelius (1834) called Panspermia. The UPR NASA 'RockSat' team aims to collect and analyze micrometeorites sampled from beyond the Karmen Line, the technical definition of outer space(Turbopause). To do so, the team built a payload designed to be launched on a Sounding Rocket in Early August. This payload has various components controlled by electronics and computer system to collect, record and safeguard the samples. This payload is divided on three main subsystems: video, collection and decontamination. As part of the program, this project focuses on the aspects of decontamination and sterility effectiveness through viability, replication, background controls and independent assessments. The overall objective is to use ultra-sensitive technology to detect the trace biomolecular evidence of life, in particular DNA/RNA in outer space that would demonstrate that life could exist in space. However, the ubiquitous nature of life and its persistence, even in extreme environments, the underlying basis to this program, is also the great difficulty. The issue about sampling for life, without contaminating the sample with life on earth, and being able to demonstrate this. Background contamination is a consistent concern and issue from assembly, launching, sampling to final recovery and analysis processes. The methodological approach in this program in 2019 will focus on using whole payload oven baking for pre-launch sterility and in-rocket mini UV quartz lights for deployment, preflight and inflight payload sterility. This project focused on determining the effectiveness of these new systems on the Payload under different contamination scenarios, demonstrating limits and design restraints where present, but ultimately to ensure the genetic material sampled is, without a doubt from outer space.

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Global Transient Solar Activity Catalog Maintenance and Historical Expansion

Juan Carlos Martinez
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Solar activity is the primary driver of space weather, and its impact on space exploration to everyday communication, is enormous. Modern-era observations of Sun have improved our understanding of the nature of solar activity, but capacities to reconstruct and forecast solar activity remain outstanding. Using the Solar Dynamic Observatory's Atmospheric Imaging Assembly and Helioseismic Magnetic Imager, we expanded an existing database (2010-2018) for coverage of phenomena—coronal holes, quiet Sun, and active regions—that form the basis of solar activity during 2018-2019, at an approximately 3 day cadence. Using the Solar Heliophysics Observatory's Extreme ultraviolet Imaging Telescope, and Michelson Dopper Imager, we additionally analyzed such global scale transient activity during 1996--2010, at a similar temporal scale. The +20yr magnetic photosphere through coronal observational records of global scale activity built by our project will benefit future efforts to deepen our understanding of solar activity, and the long-range photosphere-corona connection.

Acknowledgement: NASA grant NNX15AP95A

GRB 190202A: A Study of the Most Energetic Cosmic Explosions from the U.S Virgin Islands

Kervin Mathurin
Mentor(s): Dr. Antonino Cucchiara
University of the Virgin Islands

Gamma Ray Bursts (GRB) are the most powerful events that takes place in the Universe. They result from either the explosion of a star at the end of its lifetime or the collision of two neutron stars. These devastating events last just a few milliseconds to a couple of minutes. My goal was focusing on GRB 190202A and creating a light curve that shows both its optical and X-ray light activity over a time period. Data were acquired by the Las Cumbres Observatory telescope network (LCO), from this data I was able to measure the amount of energy emitted by the GRB through time (Magnitude).

I created a Python code to easily import publicly available optical and X-Ray data (taken from satellites) to build a multiwavelength light curve. I used a linear curve fit with both optical and X-ray data and compared it with the GRB theoretical models. The fit presents a visible break in all the data around 10^5 seconds after the explosion. This behavior is rare among GRB's, and with this we could potentially determine the opening angle of the jet through which the GRB energy was emitted. If this behavior is confirmed, we will conduct a more detailed study to collect more data and compare our results with larger samples of GRBs.

UVI students and faculty have access to LCO and the V.I. Robotic Telescope (in St. Thomas) and are building their own Gamma-ray satellite (UVI-GREAT) in order to discover more GRBs in the incoming years.

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Classifying Malware: What Machine Learning Techniques are Most Effective?

Joel Mwambungu
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Machine Learning is one of the most important underpinnings in modern research and technology. It is the field of Computers Science that uses mathematical techniques to enable computers to do specific actions without the need for explicit instruction from a programmer. Malware is a computer program designed with the intent to damage computers. Cyber-attacks from malware are one of the most imperative issues facing law enforcement agencies as well as the general populace, and the need for innovative solutions to address these attacks is exigent. The advent of Machine Learning means that it can be used to develop software solutions that effectively classify malware. But what Machine Learning algorithms are most effective at classifying malware samples? This is the main focus of this research. I hypothesize that Decision Tree algorithms are more effective at classifying malware than Random Forest algorithms. In order to test this, a training dataset with vectorized malware samples was obtained. Next, utilizing the data analysis tool Weka, the malware data was mined. By using the number of samples and features as parameters, experiments were performed to determine which of the two algorithms had a higher classification rate. Based on the preliminary results obtained from the experiments, Decision Trees were more effective at classification than Random Forests. However, further investigation is required since there is a distinct possibility that the type or combination of features being investigated may have an effect on the effectiveness of an algorithm. In addition, research has shown that including more features will yield a higher classification rate for both algorithms.

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St. Croix Seagrass Beds

Michael J. Niemeyer
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Seagrass beds are found in every ocean and play important roles for many marine species and the coastal environment. I studied the beds found between beaches and barrier reefs found on St. Croix. *Halophila stipulacea* is a non-native grass that was first found in the Caribbean in 2002 in Grenada. It was first found on St. Croix in September of 2016. I had two questions I wanted to find the answers to: 1) is there a difference in the density of the seagrass beds found in Teague Bay and the seagrass beds found in Columbus Landing, 2) could I find *Halophila stipulacea* in the waters by Hotel on the Cay, West of Altona Lagoon. I predicted that the beds found in Columbus Landing would be less dense then the beds in Teague Bay. Also, there would be the presence of *Halophila stipulacea* in the beds by Hotel on the Cay. The tools used to collect my data consisted of a fifty meter tape measure and a one meter by one meter quadrat. The quadrat is divided into 100 ten cm by ten cm boxes by strings. At the seagrass beds I unrolled the tape twenty-two meters. It stayed in place with weights on both ends. I placed the quadrat so the center was over the five-meter mark. I observed the grass inside the quadrat noting the different species and recorded areal percentage of each species. I also counted the individual blades of grass in the four boxes in center and recorded the density, repeating this process every five meters. The blade density in the beds by Teague Bay were very similar to the beds by Columbus Landing. In Teague Bay the average density in 400 cm^2 was 57.25 blades, in Columbus Landing the average density was 46 blades. I could not confirm the presence of *Halophila stipulacea* by the beach at Hotel on the Cay in the Christiansted harbor. I also collected dates, times, depth and location. Using this, other scientists can duplicate my findings and compare it to future measurements.

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Investigating Public Network Exposure using GRC ShieldsUp

Milan Philbert
Mentor(s): Timothy Kentopp
University of the Virgin Islands

The technological world as we know it is advancing at a steady rate. While this may seem very promising for the future, there are also various drawbacks that come with it. The presence of technology is becoming quite prolific, and the need for defences against hackers is increasing. Studying network exposures provides information that can be interpreted to aid in preventing cyber attacks. This research aims to investigate what exposures can be discovered on a network, if common patterns emerge for a given location, and whether certain measures can be adapted and developed for use by broader sections of the population. Through the use of GRC ShieldsUp, a popular website, we tested ports and recorded the data from them on various networks at different intervals. We then compared and analyzed the results between them. We determined that the use of Unfiltered Port Analysis (UPA) facilitates finding any sort of change in a network. We also determined that this method can be, and should be adapted by local and even organizations around the world. The use of this method can provide results which can then be used to help save companies from hacker attacks and prevent other network breaches.

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UVI GREAT CubeSat Satellite: Gamechanger for Astrophysical Studies

Jordina Pierre
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University of the Virgin Islands

The CubeSat project was originally developed to provide university science communities the opportunity to create a space program and have affordable access to space. In this project, I worked on The University of the Virgin Islands Gamma Ray Experiment for Astrophysical Transits (UVI-GREAT), which is a 3 Unit (3U) CubeSat that will enable us to study Gamma-Ray Bursts (GRBs) in space. The purpose of UVI-GREAT is to detect, localize, and characterize GRBs which help scientists understand more about the beginning of the universe as well as learn more about the creation of chemical components. A key element of UVI GREAT is a scintillator crystal. When the GRBs occur, the light interacts with the crystal which then produces UV light that is converted into a digital signal. During the summer, we tested different configurations with the light tight box, scintillator crystals, and the Charged Coupled Device (CCD) Camera. The light-tight box was used to simulate the dark space environment which allowed us to test the scintillators to guarantee their effectiveness. In order to do this, we used the CCD camera to take pictures of the scintillators and the radiation source to determine whether light was actually being produced. Because we are in the lab, we used radioactive sources such as Cesium-137 and Sodium-22 which produce Gamma-Rays and play the role of the GRBs in space. We also used a CCD Camera in the lab instead of a Silicon Photomultiplier (SiPM) which will be used to convert the GRB signal onboard UVI-GREAT.

Acknowledgement: NASA MIRO program grant #NNX15AP95A

Calculating Uncertainties in VIRT

Silene Prentice
Mentor(s): Dr. David Morris
University of the Virgin Islands and Etelman Observatory

Etelman Observatory is home to the Virgin Island Robotic Telescope (VIRT). Donated to UVI in the 1970s, VIRT is a 0.5m Cassegrain Telescope and is primarily operated by UVI professors and students. This research facility focuses primarily on astrophysical investigations, but how precise are the data VIRT gives us? The focus of my research is to make observations of known variable stars, stars with irregular brightness, and a Gamma-ray Bursts (GRBs), beams of extremely energic explosions. These observations will help us to better characterize the capabilities and systematic uncertainties of the VIRT. To begin, I created a list of Delta Scuti variable stars, a particular class of high-amplitude, short-period variable stars. I didn't need to make a list of GRBs because they happen at random but frequently. After following the VIRT instrumental procedures to begin observing and collecting calibration images, I entered the coordinates into VIRT and collected a series of over 250 and 800 images on the Delta Scuti and GRB, respectively. Next, I ran my series of images through astrophotometry software, AstroImageJ and SAOImageDS9. Astrophotometry software are used by astronomers to make brightness measurement of their target and to make graphs of how it changes over time, known as light curves. For the known variable star, I used the light curves from my data and compared it to established catalogs. My observations verified the brightness of the Delta Scuti star to be 12.76 magnitudes, the amplitude variation to be .024 and the period to be 0.057 days with an uncertainty of +/- 0.005. In addition, we made measurements of the newly discovered GRB 190627A, a star that exploded approximately 10.31 billion years ago, with a brightness of 18.38 magnitudes, recorded by VIRT at 13h 11m 19s after the initial GRB detection by the Swift satellite.

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Self Sufficient Solutions for Island Communities

J'Nique Ronan and Kiwanee Smith
Mentor(s): Dr. Greg Guannel and Megan Grant
University of the Virgin Islands

Sunlight and water are two of the most abundant renewable resources in the world, especially in the Caribbean. When properly used they are among the most efficient ways to produce energy and additional resources for anyone who implements them. One example of this is through a solar water heater. With the use of solar energy and some carpentry, we were able to construct a working solar water heater and test, at different weather types (overcast, sunny, cloudy, etc.) and with different collector hose types (rubber and steel), how this affects the heating and efficiency of the heater.

A second example is through rainwater collection. We constructed shed-like structures with three different roofing materials to look at which one collects the most rainwater using pressure sensors and data loggers. We also considered having the roofs at different angles to see whether too much or too little of an angle would lead to less water in the catchment system.

Software architectures for systematic assessments of VIRT (Virgin Islands Robotic Telescope)

Belize Saunders
Mentor(s): Dr. N. Brice Orange
University of the Virgin Islands

The Virgin Island Robotic Telescope (VIRT) is the US's most southern and eastern robotic observatory. In support of multiple NASA grants, VIRT has a continuing need for optimal performance to meet its scientific research and educational objectives. This project contributed to the development of software infrastructures to meet these VIRT operational needs. We developed a graphical package for integration into a software architecture that assesses VIRT's pointing accuracy and generates error maps for its improvement. To benefit on-site and remote observation capacities of VIRT, structured exception handling improvements were developed for a procedural method used for focus calibration campaigns. We also commenced work on software to perform engineering analysis of hardware used during robotic tracking of astronomical objects. Our project contributed important traceable and dynamic software applications that will benefit the future operational capacity of VIRT to sustain its scientific research and educational portfolios.

Acknowledgement: NASA-MIRO grant NNX15AP95A.

Assessment of Water Quality in UVI—Albert A. Sheen Campus Drinking Water Fountains

Deon St. Jules, Alaysia George and Nafeesa King
Mentor(s): Bernard Castillo II, Ph. D.
University of the Virgin Islands

In 1974, the Safe Drinking Water Act was passed to protect the quality of the drinking water by providing a basis level of consumption of most contaminants. The Environmental Protection Agency (EPA) has set parameters for the quality of water towards the highest level of consumption of it. These parameters are most likely drawn from specific contaminants, which can be classified as any physical, chemical, biological, or radiological substances found in the water. Maximum Contaminant Levels (MCLs) are the highest level of contamination that is allowed in drinking water and has set standards that give permissible limits to all water systems. In the University of the Virgin Islands-Albert A. Sheen campus, students are skeptical of the water quality especially from the drinking fountains. In an informal survey to students on campus, not all students drink water from the water fountains. The purpose of this research was to test the water quality parameters in all the UVI-Albert A. Sheen campus working drinking water fountains using HACH kits. We also wanted to compare the water quality of the fountains to a commercial drinking water. We hypothesized that Albert A. Sheen fountains' water quality will have a significant difference in levels of metal and non-metal contaminants compared to commercial drinking water. Parameters tested were metals (Arsenic, Copper and Lead) and non-metals (Phosphate, Chloride and Nitrate). Samples were taken from 6 of 9 drinking fountains found from Residence Hall (RHC), Evan's Center (EVC) and the Northwest Wing (NWW) Trellis. Our results have shown that Arsenic is not present in all samples. Copper was highest (0.5 ± 0.28 mg/L) at RHC and lowest (0.14 ± 0 mg/L) at EVC. Lead was highest (2.67 ± 2.3 □g/L) at EVC and the lowest (1.0 ± 0.5 □g/L) at NWW and from the commercial drinking water. One-way ANOVA showed that there was no statistically significant difference between all the drinking water fountain samples and the commercial water for Lead ($p = 0.474$) and Copper ($p = 0.541$). Nitrate was the highest (5.1 ± 2.0 mg/L) in RHC and lowest at EVC (3.8 ± 6.0 mg/L). Phosphates highest was (0.23 ± 0 mg/L) at EVC and the lowest (0.223 ± 0.001 mg/L) at NWW. There was a statistical significant difference for Free Chlorine determined by one-way ANOVA ($p = 0.0351$) between all water samples. A Tukey *post hoc* analysis revealed that commercial water sample and RHC samples were significantly different ($p= 0.0241$). There was also no statistical difference between all samples for Total Chlorine ($p = 0.5855$). In all samples, Lead levels were above the EPA standard. Copper, Arsenic and all non-metal contaminants were below EPA standards. The water quality of the commercial drinking water was similar to the drinking fountains found at UVI based from the EPA Standards.

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Reef Restoration: Tracking Coral Growth on Different Nursery Structures

Brianna Swanston
Mentor(s): Ashlee Lillis
University of the Virgin Islands and The Nature Concervancy

Coral reefs are important coastal habitats for fisheries, tourism, and shoreline protection, but have been decreasing at an alarming rate for many decades. Because of this rapid decline, organizations like The Nature Conservancy (TNC) are working to apply different methods to actively restore coral. For the past eight years in St. Croix, TNC has been propagating endangered coral species in an effort to restore their populations. One approach TNC is using involves fragmenting corals into smaller pieces and growing them in underwater coral nurseries for 9-12 months until they are large enough to be outplanted back onto coral reefs. This has typically been done using a structure called a Tree but this year, TNC established a new coral nursery and is testing a new type of easier-to-build nursery structure, called an A-frame. The main goal of this project was to determine the difference in growth rate of the coral species Acropora cervicornis between the two different nursery structures within three different nursery sites. We hypothesized that there will be no difference in the growth rate of the coral on the two structure types. To determine this information, I analyzed photos of corals in their nurseries at different time periods following fragmentation. Coral size measurements were calculated using the system Image J. The data was then processed in an excel spreadsheet and pivot table to calculate average growth rates. It was found that over the first month after fragmentation, coral fragments at the Cane Bay West nursery site showed the highest average growth rate overall. After three months of monitoring, the Tree structures showed to produce a higher growth rate than the A-frame structures. Continued monitoring is needed to determine if these outcomes are consistent and to understand the reasons for differences in growth.

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Summer Program Descriptions:

- Math Behind the Science (MBS) Program - A residential, summer bridge program designed to enhance the mathematics readiness of college-bound STEM students by preparing them to enter the introductory calculus course and provide an enriching experience for transition to college life.
- Summer Undergraduate Research Experience (SURE) - A program that provides research experience for undergraduates to work closely with UVI faculty on challenging scientific research projects across a variety of STEM disciplines.
- Summer Boost Program— Provides skill building, creativity, growth mindset training, and innovation projects for freshmen and sophomore students to provide motivation and strengthen their academic performance

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