19th Annual
Fall Student Research Symposium

ABSTRACT BOOK

September 22, 2018
St. Thomas Campus
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University **of the** Virgin Islands

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The Nineteenth Annual
Fall Student Research Symposium

September 22, 2018
University of the Virgin Islands
St. Thomas Campus, U.S. 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), psychology, and nursing students at the University of the Virgin Islands.

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PTEN Phosphatase Activities in Large Unilamellar Vesicles

Shabree Anthony,
Dr. Alonzo H. Ross
Mentor(s): Dr. Arne Gericke
Worcester Polytechnic Institute

The peripheral interactions between lipids and proteins have been shown to be vital in a number of biochemical pathways. Phosphoinositides (PIPs) are very minor components of the plasma membrane (2 mol%), but they are essential molecules in a large array of biological processes such as cell signaling, protein transport, and cell migration. It is well established that phosphatase and tensin homolog located on chromosome ten (PTEN) is a tumor suppressing protein deleted on chromosome 10 in human cancers. PTEN plays a critical role in the Phosphatidyl-3-Inositol kinase (P13K) pathway by converting phosphatidylinositol (3,4,5) trisphosphate (PIP3) to phosphatidylinositol (4,5) bisphosphate (PIP2), inhibiting PIP3-dependent kinases, such as Akt. Therefore, we hypothesized that in large unilamellar vesicles, the hydrolysis of PIP3 by PTEN should be observed. To mimic the inner leaflet of the plasma membrane, the model was composed of POPC (phosphatidylcholine), POPS (1-palmitoyl-2-oleoyl-sn-glycero-3-phospho-L-serine), PIP2, and PIP3 (54/30/8/8). In this project, we successfully demonstrated the phosphatase activities of PTEN in these model membranes. Following the fabrication of the model membrane through extrusion, we used a rapid colorimetric phosphatase assay to demonstrate that both POPS and PIP2 are essential for PTEN to bind to the vesicle and/or to find its substrate (PIP3), which allows it to be converted into PIP2.

The Blood Traveller: Apicomplexan Blood Parasite of Dusky Damselfish

**Antonae Anthony, Makeda Mills, D'Shaunique Walters,
Makeda Mills, D'Shaunique Walters, Antonae Anthony**
Mentor(s): Dr. Jenilee Robinson
University of the Virgin Islands

Apicomplexa is a phylum that consists of intracellular protozoan parasites responsible for several human diseases including malaria, toxoplasmosis, and cryptosporidiosis. These parasites can also infect a wide range of other animals including Caribbean damselfish in the genus *Stegastes*. Visualization of intracellular parasites in Giemsa-stained thin smears is currently the method used to detect infection in fish blood samples. A specific polymerase chain reaction (PCR) assay targeting the 18S rDNA was evaluated to replace microscopy, enabling rapid screening of blood samples for infection. **We hypothesize that the detection of fish infection by microscopic analysis will correlate with PCR results using specific 18S rDNA primers**. To test our hypothesis, we captured 10-15 dusky damselfish from their natural reef habitat at different sites and times, collected blood, and released them. We screened fish for infection using both microscopy of Giemsa-stained thin smears and DNA extraction followed by the 18S rDNA PCR and later compared the results of each method. By microscopy, we detected nine fish collected in June 2018 to be uninfected. However, the PCR primers amplified a product of about 500 base pairs from each DNA extract. Our findings do not support our hypothesis that PCR and microscopy results would match one another. This indicates that we cannot yet use this PCR assay in place of microscopy to screen for presence of infection in fish blood. In the future, we plan to use qPCR for an absolute quantification of the blood parasite DNA. As the lifecycle, including stages of the blood cell infection, is unknown, we may be missing infective stages in the Giemsa-stained thin smear that we do not recognize. To resolve this, we plan to develop an IFA assay to stain and visualize parasites in a more specific manner. These techniques can be used for future experiments to identify the range of tissues and hosts infected, towards mapping the lifecycle and transmission routes of these apicomplexan parasites. The positive impact of our research will be significant, as our findings will facilitate the application of this naturally occurring infection to the study of human disease.

Quick, Catch!…Preparing For LVC O3 with the VIRT and Zadko

Jonisha Aubain,
Bruce Gendre
Mentor(s): Dr. Bruce Gendre
University of Western Australia

To prepare for the LIGO Virgo Collaboration 3rd observation run (LVC O3), techniques for doing more efficient observations of large sky areas where a gravitational wave source is located are investigated. One major way of performing more efficient observations is to reduce the region of the sky where gravitational wave sources are least likely to be formed. A search algorithm code was tested using data from GW170817 to find possible improvements to the current method of gravitational wave search. Six parameters that affect efficiency and their possible improvements were discovered. When applied we expect a significant reduction of imaging time compared to a blind search.

The Search for Metabolite Structure formed in *Atropa belladonna* Plants that make Scopolamine and Hyoscyamine

Hairol Elias Breton,
Thilani Anthony, Arthur Daniel Jones, Matthew Bedewitz, Steven Hurney
Mentor(s): Thilani Anthony and Arthur Daniel Jones
Michigan State University

Plants synthesize a wide variety of compounds called specialized metabolites which aid plant survival in ways varying from defenses against insects to recruitment of animals that aid seed and pollen dispersal, These metabolites can be used in the development of pharmaceuticals. The *Solanaceae* family, which includes *Atropa belladonna* (Deadly Nightshade), produces a class of specialized metabolites known as tropane alkaloids. Tropane alkaloids are identifiable via their 8-azabicyclo[3.2.1]octane ring system. The tropane alkaloids scopolamine (303 g/mol) and hyoscyamine (289 g/mol) are examples of medicinal compounds formed by the tropane alkaloid pathway. The identities of specialized metabolites can be revealed through analysis of plant tissue extracts using liquid chromatography-mass spectrometry (LC-MS). In *Atropa belladonna*, two metabolites of unknown structure (291 g/mol) are formed in parallel to scopolamine and hyoscyamine production. Thus, my objective is to determine the structures of the 291 g/mol metabolites. For this project, an *Atropa belladonna* root extract which was previously purified through an anion exchange column was provided. Several *A. belladonna* metabolites were purified using semi-preparative High Performance Liquid Chromatography (HPLC). Furthermore, characterization by mass spectrometry (MS), isolation via fraction collection and solvent evaporation are being utilized to obtain 2-3 mg of several *A. belladonna* metabolites for structure elucidation using nuclear magnetic resonance (NMR) spectroscopy. Structure elucidation of *A. belladonna* alkaloids will assist in better understanding the tropane alkaloid biosynthetic pathway and enable bioassays to be performed with purified compounds.

The Effects of Anthrophony on the Red-Eyed Coqui

Jahnyah Brooks,
Jessica Nagel
Mentor(s): Dr. Renata Platenberg
University of the Virgin Islands

Frogs are vertebrates that use sound to communicate for breeding and territorial defense. While vocalizing, there are other sounds in the environment that can influence frog behavior, such as wind blowing, crickets chirping, or cars driving by. We want to know if sounds produced by humans, specifically those of cars, have any influence on frog calling activity, which could affect breeding success. If frogs are disturbed by cars enough to reduce calling activity, this may decrease their ability to attract females, and breeding success may decrease. We tested the hypothesis that the sound of cars does not influence frog calling activity by recording frogs in two locations with moderate traffic, using an SM3BAT bioacoustics recorder set to capture sound within the audible frequency range of frogs. We recorded for three consecutive nights at both sites to ensure a large enough sample size. Using the bioacoustics analysis software Kaleidoscope, we counted the number of frog vocalizations ("chirps") in four-second intervals within a ten-minute window before, during, and after the passing of a car. The number of chirps decreased as the car approached and passed the location of the recorder for both sites and across all three nights. These results showed a significant influence of car sounds on frog calling activity (ANOVA, $p<0.001$). This means that something that occurs so frequently, such as cars driving by, has the potential to influence the activities of wildlife. On more busy roads, the sounds of cars can potentially cause a shift in the species behavior. With more interruptions it might mean less time for reproduction, which can translate to potential population decreases and loss of fitness. By showing that cars do have an influence on frog activity, we can start a dialogue about the extent of our influences on their activities.

Phenolic Content and Antioxidant Capacity in Virgin Islands Plants

Angel Cedeno,
Anthony Jolly
Mentor(s): Dr.Bernard Castillo
University of the Virgin Islands

Phenols are a type of antioxidant that specifically consists of a hydroxyl group bonded to an aromatic hydrocarbon. Phenolic compounds are present in different sources of food like, plants, fruits, vegetables, etc. Phenolic compounds have various health benefits such as anti-inflammatory and anti-allergenic properties. Other health benefits include the reduction in the occurrences of sudden diseases like Alzheimer's disease, and boosts metabolism. The main purpose of this study was to determine the Total Phenolic Content (TPC) of plants found in the Virgin Islands, which are used in food and local drinks. The plants used for this study were Bay Leaf (*Laurus nobilis*), Common Thyme (*Thymus vulgaris*), Moringa (*Moringa oleifera*), Mint (*Mentha spicata*), and Lemon Grass (*Cymbopogon citrates*). We hypothesized that there would be a significant difference in the TPC between each plant. We determined the TPC in each plant by Folin-Ciocalteu's method, using a UV-Vis Spectrophotometer to measure the absorbance at 765 nm. Total phenolic contents were reported as mg per grams of Gallic Acid Equivalent (GAE) per grams of dry weight (mg/g GAE/g DW). Out of all our plants, Common Thyme had the highest TPC (55.463 ± 4.792 mg/g GAE/g DW) while Lemon Grass had the lowest TPC (8.564 ± 1.212 mg/g GAE/g DW). A one-way ANOVA test showed significant difference between the mean TPC of each plant ($p = 8.0 \times 10^{-8}$). A Tukey *post hoc* test revealed that there was no statistically significant difference between Mint and Bay Leaf (*p = 0.878*), Bay Leaf and Moringa (*p = 0.053*) and Lemon Grass and Moringa (*p = 0.310*), while every other treatment showed a statistically significant difference between each group (*p < 0.05*). For future research, we want to continue investigating total phenolic contents in local crops such as okra, spinach, etc. We also want to test how synergism in Virgin Island plants affects the TPC levels.

Random Sampling of Nodes in Polynomial Interpolation

Nikkoiya Cromwell,
Darryle Cyrille and Tione Grant
Mentor(s): Dr. Andrew Gard
University of the Virgin Islands

Polynomial interpolation is a method used to approximate unknown functions based on small numbers of data points. One advantage of polynomial interpolation is that error can be computed explicitly. In many cases, the most important part of this error function is a polynomial $w_n(x)$ defined entirely by the x-values of the sample points.

This raises the question of how large $w_n(x)$ can be expected to be. We numerically evaluate the average size of the maximum value of this function, getting surprisingly small results.

The Effects of Rounding Errors on Polynomial Interpolants

Darryle Cyrille,

Mentor(s): Dr. Andrew Gard
University of the Virgin Islands

Polynomial interpolation is the construction of polynomials that pass through given sets of data points. In the real world, measurements and rounding errors are bound to happen. How large of an impact do such errors have on polynomial interpolants? Through experimentation, I found that the overall effect (measured using a definite integral) of vertically shifting an interpolation node depends only on the distribution of x -values of the nodes and never on the y-values. This fact can also be demonstrated algebraically.

Creating Everyday Energy Solutions

**I'Zhaneeh Deterville, Megan Grant,
Megan Grant**
Mentor(s): David Morris, Greg Guannell
University of the Virgin Islands

In the fall of 2017, the U.S. Virgin Islands were hit by two category five hurricanes that left thousands of people without electricity and running water for months. A portion of the population relocated to the mainland with the hope of better health care and home accommodations. The access to solar power technology, at a time like this, would have saved many people from the hassle and stress of relocating into a new environment. We have already built a solar water pump from materials donated to us. Different materials are being used to create a solar-powered water heater. Most of these materials can be bought in the Virgin Islands or shipped easily. Once all the material is acquired, these systems can be made in a week, as the solar water pump took us one hour to make. Our future goal is to create a price quote and instructional guide on how to build solar power technology.

The Search for a Disintegrating Planet Orbiting a White Dwarf.

Gerlinder Difo Cheri,
Andrew Vanderburg
Mentor(s): Andrew Vanderburg, Antonino Cucchiara
University of Texas, University of the Virgin Islands

The project involves the search for disintegrating planets orbiting White Dwarfs, namely using light curve data. A planet can begin to disintegrate either through destructive gravitational tidal forces or through vaporization of rocky surface material. The search utilizes White Dwarf databases which can provide coordinates for hundreds of confirmed White Dwarfs. The NASA Exoplanet Archive was chosen for the retrieval of light curve data for targets which had data recorded by the SuperWasp, KELT, and K2 exoplanet surveys. The light curve data was then processed using a Fast Fourier Transform which would potentially reveal dips in stellar flux, evidence supporting the conclusion of a planets orbiting the White Dwarf. With a planet(s) confirmed, the light curve is further analysed for signs confirming the planets disintegration. An example of such a sign is the presence of multiple even more slight (relative to that of the planet) dips in flux indicative of smaller pieces of rocky material which can be confirmed originate from the planet if said material has the same orbital period as that of the planet. Observation of such events provide researchers with a better understanding of the exact inner composition of planets through spectroscopic data of the White Dwarf's surface which would most likely have planetary material accreted onto itself. Since the chemical composition of the White Dwarf alone can be easily determined, the absorption lines of the planets material would easily stand out. Even though this specific survey failed to identify any disintegrating planets, the method is completely capable of detecting events which alter the observed object's flux as it identified stellar binaries which were already confirmed to exist. This project is a follow up on the work of Dr. Andrew Vanderburg and colleagues with their discovery of WD 1145+017, the first White Dwarf with a disintegrating planet.

Phenolic Content and Antioxidant Capacity in Virgin Islands Plants

Michael Doliotis and Selena Parrilla
Selena Parrilla, Angel Cedeno and Anthony Jolly
Mentor(s): Dr. Bernard Castillo II
University of the Virgin Islands

Antioxidants are found in a variety of plant based food sources. These compounds counteract the formation of free radicals, reducing the damage done to our cells caused by oxidation. When exposed to harmful environmental stressors over time such as pollution, herbicides, and radiation, cells begin to break down, which can set off a chain reaction leading to oxidative stress. Eating foods high in antioxidant activity such as berries, nuts, beans, and leafy vegetables can prevent diseases resulting from oxidative stress, and replenish our bodily cell functions. Hydrophilic antioxidants play a major role in this capacity, where water soluble antioxidants like ascorbic acid has been used to study other subsets of antioxidants. One of these subsets are polyphenols. Phenols are a type of antioxidant with an aromatic ring and hydroxyl group. They have a wide range of health benefits such as greatly reducing the risk of certain cancers, cardiovascular disease, neurodegenerative disorders, and improve memory. These phenols can be found in the aforementioned food sources, specifically berries and other fruits of citrus variety. In previous studies, phenols have contributed to overall total antioxidant activity, and there has been a correlation between water soluble antioxidants and phenols found in algae. In this study, we selected five Virgin Islands local plants namely, Lemon Grass, Moringa, Mint, Bayleaf, and Thyme. Our main objective of this study was to determine if there is a correlation between hydrophilic antioxidant activity (HAA) and total phenolic content (TPC). We hypothesized that there would be a correlation between HAA and TPC. The ABTS/H_2O_2/HRP decoloration method was used to determine HAA, and Folin-Ciocalteu's method was used to assess TPC. Values were reported as μmol Trolox equivalent (TE)/g Dry Weight for HAA and mg/g Gallic acid equivalent (GAE)/ g Dry Weight for TPC. According to results, Thyme and Lemon Grass had the highest and lowest HAA (89.71 ± 61.37, 15.07 ± 5.64) and TPC (55.46 ± 4.79, 8.57 ± 1.21) respectively. A one-way ANOVA showed no statistical difference between HAA and TPC (p = 0.164). Pearson correlation analysis showed strong evidence of correlation between HAA and TPC (r = 0.935). Lastly, linear regression analysis showed a linear relationship between HAA and TPC (R^2 =0.874). From this study, we found that there was a correlation between HAA and TPC. For future work, we would like to study correlation in other local herbs, vegetables, and fruits such as cilantro, spinach, and sour sop.

Characterization of Metastatic Progression

Torhera Durand,
Saeed Akhand
Mentor(s): Dr.Michael Wendt
Purdue Univeristy

During breast cancer metastasis cancer cells break off from the primary tumor and invade other tissue and organs throughout the body. Metastasis causes increased cancer virulence and disease progression, and accounts for 90% of all breast cancer related deaths. One oncogenic pathway proposed to be a driving force behind cancer cell metastasis is epithelial to mesenchymal transition (EMT). EMT is caused by growth factors, drugs and cytokines that disrupt the polarity of epithelial cells and initiate their transition into morphologically altered mesenchymal cells that possess an increased ability to metastasize and invade surrounding tissue. These mesenchymal cells have lowered immunogenics and can remain dormant for years before reverting to their normal epithelial state and establishing a secondary tumor. Induction of EMT enhances the presence of fibroblast growth factor receptor (FGFR), and programed death ligand 1 (PDL1) on metastatic breast cancer cells. These proteins are linked to increased metastatic burden and decreased anti-tumor immunity. In this work we investigated the presence of EMT, FGFR and PDL1 markers within our 4T07 metastatic progression series, which consists for three isogenic cell lines of increasing metastatic potential, derived via sequential *in vivo* tumor growth and subculture. We hypothesized that EMT-driven expression of FGFR1 and PDL1 contributed to increased metastasis and proliferation of the 4T07 cell lines. We used Western Blot analysis, immunohistochemistry, and flow cytometry to determine the presence of EMT, FGRF1 and PDL1 within each cell line. Primary H&E staining observations reveal that 4T07 metastatic cells appear morphologically different from both edited and parental lines. Post western blot analysis parental cells showed no difference in the levels of E-cadherin and vimentin, immune edited cells showed higher levels of E-cadherin compared to vimentin and metastatic cells showed higher levels of vimentin. Bands for FGFR1 and PDL1 were not apparent. Through the presence of Vimentin and E-Cadherin we were able to conclude that epithelial to mesenchymal transition was in fact taking place, but no definitive conclusion could be made on whether FGFR1 was responsible for cellular metastasis. By identifying the mediators of metastasis, we hope to devise therapeutic strategies capable of preventing the progression of breast cancer metastasis.

Dynamically Influenced Visual Authentication System

**Angie Estien, Thalia Guadalupe, Rhonda Forbes,
Thalia Guadalupe and Rhonda Forbes**
Mentor(s): Dr. Johnathan Graham
Norfolk State University

As organizations, both government and industry strive to keep vital information from getting into the hands of the wrong people, they are faced with the "password problem". In efforts to keep users' information safe, password policies are put in place to encourage users to make passwords that are both difficult to hack, but easy to remember. As a result, the "password problem" arises as users will likely create weak vulnerable passwords or complex passwords that will be handled carelessly. Amethyst Edmond, a student at Norfolk State University, proposed a solution to the password problem using a Dynamically Influenced Visual Authentication System (DIVAS). For this project, we will develop a desktop application using DIVAS concept as a blueprint. DIVAS is an image-based challenge-response system that removes the traditional passwords while remaining both secure and convenient to use. The authentication system will present users with four grids containing images, in which 3 of the images has been pre-selected by the user. The user will then mentally compute a response to the challenge based on the position of the pre-selected images on the grid. The response will serve as the temporary password as the images will appear in random location each time users login. After implementing DIVAS, we tested the applications' usability using 10 participants and a post survey was administered to get users' feedback. The applications' usability will be determined by the percentage of successful first-time logins. The successful implementation of DIVAS may be beneficial to government, private entities, and average users.

Smart Meters in CPS

Jasiem Everington,
Jasiem Everington
Mentor(s): Professor Timothy Kentopp
University of the Virgin Islands

Research this season focused on smart meters as part of Cyber-Physical Systems (CPS). CPS are combinations of computational and physical processes used to build complex systems. Initial work determined the version, class, and type of smart meters that VI WAPA deployed in most residential neighborhoods on the island. WAPA uses Itron smart meters that are connected to Advanced Metering Infrastructure (AMI) towers using cellular communication, specifically ViYa cellular towers. A Nighthawk wireless router with enhanced settings was used to establish a safe and reliable baseline to use for the smart meter assessment. In the second phase of research, tests verified if the cellular communication present in the smart meter could be detected through a personal mobile hotspot (or MiFi) that also utilizes cellular data networks. The ViYa MiFi applied a simple Nmap scan to view network activity in the local neighborhood. Results affirmed that although Mi-Fi service shares the cell network and towers, tests did not reveal any exposed smart meters. An interesting discovery of ViYa residential Internet service resulted during basic Nmap scans using the -sn option. More than 4,400 hosts were visible on the same ViYa IP range. Further investigation is justified to assess the nature and extent of these unexpected exposures.

Tight Junction Dysfunction: Altered ZO-1 and Occludin in the Diabetic Cornea

Anayah I Ferris,
Annie Londregan, B.S.
Mentor(s): Vickery Trinkaus-Randall, Ph.D
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The cornea is the outermost part of the eye and, as a result, can be damaged by debris and other irritants. The cornea can repair itself from minor injuries; however, improper wound repair can further complicate the issue. Type II Diabetes is known to hinder the body's wound healing ability, and in the cornea recurrent erosions are common, with complications in epithelial wound repair being detected in the corneas of diabetic rats. Tight junctions are multiprotein complexes involved in cell proliferation and differentiation, processes required for proper wound healing to occur. Occludin, a transmembrane protein, and ZO-1, a scaffolding protein, are found in the tight junction complex. Prior studies have documented that occludin plays an important role in corneal wound healing and that damage to occludin impairs tight junction integrity. Additionally, our lab has evidence that Crumbs3 (Crb3), a polarity protein associated with ZO-1, is altered in the diabetic cornea. We hypothesized that occludin and ZO-1 localization would be altered in the diabetic tissue. Our lab uses the diabetic induced obesity (DIO) mice as a model for Pre-Type II diabetes. Previously we demonstrated a peripheral neuropathy and impaired wound healing in the DIO tissue. Corneal epithelium cells from DIO mice were examined 7.5 and 15 weeks (wk) after onset of a high fat diet and compared to WT C57BL6 mice. Corneas were wounded and allowed to heal for 18 hours after injury. Wounded (W) and unwounded (UW) cells were fixed in 4% paraformaldehyde before staining with antibodies to occludin and ZO-1. Fixed corneas were imaged on a Zeiss LSM 700 Confocal Microscope using a 40x- and 63x-oil objectives and analyzed using FIJI/NIHImageJ. We demonstrated that the localization patterns of occludin and ZO-1 were altered in the UW and W DIO tissue at both the apical and basal cell layers of the corneal epithelium. The change in continuous ZO-1 occurs prior to changes in occludin. Our results support the results demonstrating that Crb3 is altered. Since Crb3 mediates trafficking of ZO-1, our data suggest that there is an irregularity in tight junction stability and membrane polarity in the diabetic tissue.

Multiple Genotypes of *Halophilia stipulacea* Found Around St. Thomas, US Virgin Islands
University of the Virgin Islands

Kwame Forbes
Kwame Forbes, Michael Caracciolo,

Mentor(s): Dr. Stanford, Dr. Boumedine
University of the Virgin Islands

Halophila stipulacea, a species of seagrass native to the Indian Ocean, has been rapidly invading the Caribbean. *Halophila stipulacea's* ability to displace the local marine flora makes it a potential threat to the biodiversity of invaded regions. Published literature on *H. stipulacea* is limited, and its effect in the Caribbean have not been thoroughly documented. Information that is known about the species, however, is that it seems to reproduce asexually within the Caribbean. It should be noted that in its native region *H. stipulacea* is a high-volume seeder, but in the Caribbean, this is not the case, as no published literature shows findings of seeding. Our main research goal was determining how many genotypes are present within the area. Since we were fairly certain of asexual reproduction, we hypothesized unique genotypes would be low. To shed light on this, DNA sampling was used to determine the clonality of the seagrass in 8 bays. We used the 2bRAD method to generate SNP data. The data were then processed on the computing cluster and analyzed using GenClone to determine the samples' relation to one another. Of the 64 individual that were sampled on the beaches of St. Thomas, St. John and Water Island, 15 had unique genotypes. The remaining 49 were shown to be clones. Now that we know that there are distinct individuals within the population, we are preparing to test new hypotheses about *H. stipulacea* migration. For instance, the species may have been introduced to the bays numerous times

Mathematical Learning and Language of Instruction in the U.S Virgin Islands

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Mentor(s): Christopher Plyley
University of the Virgin Islands

What effect does the language of instruction have on students when learning new mathematical concepts? For example, will Crucian speakers in the U.S. Virgin Islands develop a better understanding of mathematical concepts when these are presented in Crucian rather than in standard academic English? Although the use of creole and other non-standard language varieties in educational environments is often criticized (Torres and Torres 2012), linguistic research in education often shows positive outcomes in students' learning when they are taught in their native language variety (Wigglesworth et al. 2013). In this study, participants watched video tutorials presenting mathematical topics in academic English and their home language variety (either Standard English or Crucian creole), after which they were assessed on their level of proficiency with the mathematical idea. They were also assessed qualitatively on their perspectives and attitudes towards the use of Crucian an educational setting, as well as their perceived effect of language on their understanding. Our research does indeed suggest that Crucian speakers may develop a better understanding of mathematical concepts when learning in their home language variety. Research is scheduled to continue into the fall in order to increase sample size and to verify and expand upon these preliminary findings.

Space Debris
Harmonie Hanley
Mentor(s): David Coward, Dr. John Kennewell

The number of debris in space is steadily increasing. Currently, there are thousands of trackable pieces and millions that are untraceable due to its size that are all moving at very high speeds. This can cause many hazards in space making it difficult to perform various space operations. With some programming, photometry, and analyzing time series graphs, we have tracked Australia's first communication satellite, Aussat 1 and were able to determine how this satellite is rotating. We have found that the satellite has a rotational period of 1.66 seconds with an exposure time of 10 seconds. In the future we hope to use photometry to determine the satellites orbit, take a closer look into how close Aussat 1 is to it's break up point and repeat these procedures with a more sensitive and bigger telescope, Zadko.

Blurring Images to Train Neural Networks for Object Recognition

Azhar Hussein,
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Mentor(s): Xavier Boix
Massachusetts Institute of Technology

Deep learning, also known as deep neural networks, is a subset of machine learning in Artificial Intelligence (AI) concerned with algorithms inspired by the structure and function of the brain. Deep neural networks use sophisticated mathematical modeling to process data in complex ways. A shortcoming of deep neural networks is that they require a vast amount of data to train. An example of this is object recognition, a computer vision technique for identifying objects in images or videos. We hypothesized that, when training with few data examples, blurring the input images would cause the neural network to perform better, in comparison to non-blurred images, because of the removal of unnecessary details. We trained a convolutional neural network on the blurred images, varying the amounts of blur. Our preliminary results suggest that blurring the images does not help when learning from few examples; however, this requires further experimentation with other data sets and models. In the future, we can use image blurring to study eccentricity dependence, a property of the human visual system that standard convolutional neural networks do not currently replicate.

Gamma-Ray Bursts Light Curve Fitting with Swift XRT

Fatimah Hussein,
Judith Racusin, Amy Lien
Mentor(s): Judith Racusin, Amy Lien
NASA Goddard Space Flight Center

Gamma Ray Bursts(GRBs) are extreme explosions that occur in the Universe. Some release more energy in 10 seconds than what the Sun emits in its entire 10 billion year lifetime. GRBs are electromagnetic emissions that consist of flashes of gamma rays that last from milliseconds to minutes. They produce jets of material moving at nearly the speed of light. They produce a short burst of prompt emission followed by an afterglow which radiates across the electromagnetic spectrum. There are sharp increases of flux in the X-ray spectrum which are known as flares which occur in about 50% of afterglows. The Swift X-ray telescope (Figure 1) records the afterglow emissions, which are fit using the Norris function (Norris et al. 2005) and power laws (Racusin et al. 2009). The Norris Function and the power laws fit the XRT data and go on to show the residual which indicates how good a fit it is. The purpose of this research is to figure out how flares are produced by finding a pattern within the flares and looking for similarity to the prompt emissions.

Impacts of light and food availability on metamorphic cycle of upside-down jellyfish *Cassiopea xamancha*

Kyle Jerris,
Karli Hollister
Mentor(s): Monica Medina
University of the Virgin Islands

The symbiosis between cnidarians and photosynthetic algae of the genus *Symbiodinium* is a complex relationship that is vital to the sustenance of coral reef ecosystems. The upside-down jellyfish, *Cassiopea xamachana,* is a model system that is often used to study this important symbiotic relationship. Due to its practicality for growing in a laboratory setting, *C. xamachana* is a preferred alternative for laboratory research over stony corals. Using this model organism, this 10-day experiment investigated how light and food availability affected the metamorphic cycle of *C. xamachana.* Polyps were exposed to three different light treatments: high light, medium light, and low light. Within each light treatment, polyps were separated into two additional groups based on food availability: high food availability (fed once per day) and low food availability (fed once per week). We hypothesized that the polyps exposed to high light and high food availability would undergo strobilation faster than those exposed to dark conditions with low food availability because they would have more energy available for metamorphosis. Although only one medusa was formed by the end of the experiment, there was a difference in the amount of polyps that were produced in each treatment. The polyps in the high food availability treatment group produced more polyps than the low food availability group regardless of light treatment. This indicates that food availability is an important factor driving asexual reproduction in *C. xamachana,* with higher food availability resulting in the production of more polyps.

Population Dynamics and Differences Between Deep (Mesophotic) and Mid-Shallow *Orbicella spp* corals in the U.S.V.I

Josette John,
Dr. Robert Stolz; Dr. Marilyn Brandt
Mentor(s): Dr. Robert Stolz
University of the Virgin Islands

Rising temperatures and anthropogenic stressors such as pollution have resulted in the bleaching and dying of coral reefs in the Virgin Islands. Understanding the population size dynamics of the different coral habitats will better show how these stressors affect coral reefs. The stressors of deep (mesophotic) coral reefs differ from that of shallow coral reef habitats which leaves the possibility of the future health of coral reefs to be more reliant on deep coral reef habitats. Coral reefs in mesophotic reef habitats are likely to experience reduced temperatures and lower pollution levels. In this study the areas (sizes) of 156 *Orbicella faveolata* and *Orbicella franksi* (Orbicella spp) colonies observed between 2010 and 2011 with a few in 2013 from six reef sites around the Virgin Islands were analyzed. The main aims of the study were to determine the long-term population behavior of the *Orbicella spp* species, and to examine differences in population dynamics between offshore deep (depth) and mid-shallow coral reef habitats. To determine the population's long-term behavior, the corals in various classes were categorized based on sizes and placed into groups based on reef habitat. Size-dependent matrix models of population dynamics were developed based on sizes and reef habitats, from which the dominant eigenvalue (λ) and eigen-vector determined the population dynamics for the offshore deep, mid-shallow coral reef habitats, and the combined population of corals. The dominant eigenvalue ($\lambda<1$) indicated that the *Orbicella spp* species has a decreasing population but stabilizes over a 25-year period. Data for this research suggest that mesophotic corals have a higher survival rate over mid-shallow corals. Projections indicate that all mesophotic corals will transition into a stable size distribution, while mid-shallow corals population will decrease and have an overall stable size distribution. While the overall *Orbicella spp* population appears to be decreasing, it is likely that mesophotic coral reefs are less susceptible to rising temperatures or other stressors than mid-shallow corals, and that the long-term health of this species is dependent on the transitions of deep coral reef habitats repopulating the shallow corals reef habitats.

Local Cyberspace Should be Safe!

**Lorenzo LaPlace,
Timothy Kentopp**
Mentor(s): Timothy Kentopp
University of the Virgin Islands

Many Internet users are needlessly exposed on the Internet. Their devices may not have full port filtering/stealth enabled or available, such as mobile devices that have no built-in firewall. Many people often wonder how they get hacked online. This research was conducted to bring attention to the problem of hackers and their avenues of attack. To begin this research, I performed system resets using best practices to establish a known baseline. Tests using several devices across varying networks in St. Croix were performed. The objective of this research was to assess the level of user exposure given the known state of recommended measures: stateful firewall (FW), subnetting, and Network Address Translation (NAT). A variety of network scanning tools were utilized such as nmap and GRC ShieldsUp. We attempted to understand the level of security many locals may experience using the Internet. Results were exceptional indicating broad security exposures. While many users have a moderate level of protection on their network, they are still vulnerable to probing by hackers. Research on this should continue with public service recommendations. We should also develop solutions to some of these network risks.

Bile duct-on-a-chip Device to study Cholangiocyte and Fibroblast Interactions in the Peribiliary Extracellular Matrix

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Mentor(s): Yu Du, PhD. and Rebecca G. Wells, M.D.
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Biliary Atresia (BA) is a severe disorder that is distinguished by rapidly progressive fibrotic destruction to the extrahepatic biliary tree of neonates. The nature of the initial damage done to cholangiocytes, which are the epithelial cells of the bile duct, and how damaged cholangiocytes interact with cells like fibroblasts in the peribiliary extracellular matrix remain unknown. To study the interactions between cholangiocytes and peribiliary fibroblasts under the pathological conditions associated with BA, we designed a bile duct on-a-chip with microfluidic techniques to recreate a bile duct. First, we microfabricated a cylindrical channel in either a basic collagen gel or a collagen gel mixed with fibroblasts. Afterwards, we seeded the collagen-only ducts with both cholangiocytes and fibroblasts and seeded the fibroblast-containing collagen ducts with cholangiocytes. The monolayered duct structure in the device was first characterised using immunofluorescent staining (K 19, Phalloidin and DAPI) and confocal microscopy. Then the barrier function was confirmed not only by the expression of junctional molecules, like ZO-1 and E-cadherin, but also by a permeability assay using FITC labelled Dextran with different molecular weights. Results so far have demonstrated that we have created a phenomenal in *vitro* bile duct model with cholangiocytes and peribiliary fibroblasts. The cells in this model will then be treated with biliatresone, an environmental toxin which causes a BA-like phenotype in neonatal mice and larval zebrafish. Under these conditions, the behavior of both the cholangiocytes and fibroblasts can be further studied and will allow us to achieve the true objective of this study.

Stimulation of Inflammasomes in Isolated Human B-Cells

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Matthew Yorek, Dr. Prajwal Gurung
Mentor(s): Matthew Yorek, Dr. Prajwal Gurung
University of Iowa

When an individual becomes sick they have two lines of defense. First, is the innate or non-specific immunity and second is the adaptive or acquired immunity. The innate immune system uses Pathogen Recognition Receptors (PRRs) to recognize Pathogen Associated Molecular Patterns (PAMPs). One such PRR is known as the Nod-like receptor protein-3 (NLRP3); which is essential to defend the body from pathogens and to regulate the homeostatic balance within cells. Once a person is infected or has received the primary signaling from a PAMP, the NLRP3 inflammasome becomes stimulated. When the PRR receives a secondary signal from a Danger Associate Molecular Pattern (DAMP), the pathogen is recognized. An adaptor protein, apoptosis-associated speck-like protein containing a CARD (ASC), binds the complex after activation of the NLRP3 inflammasome and recruits pro-caspase-1 which will be cleaved into caspase-1. Caspase-1 is an inflammasome associated protein that enzymatically processes cytokines, a requirement for immune cell regulation and for alerting other inflammatory cells of invasions. On the other hand, in adaptive immunity B-cells create antibodies that will bind to foreign molecules and either signal to dispose of the pathogen or signal to dispose of the infected cells. The goal of this study was to discover if human B-cells have an inflammasome and if it would function similarly to the NLRP3 inflammasome. Based on this, we hypothesized that if we stimulate human B-cells with known PAMP lipopolysaccharide (LPS), and then perform a secondary stimulation with several DAMPs we may be able to achieve the same response in B-cells as seen in the NLRP3 inflammasome in Macrophages. First, a trained phlebotomist collected sterile peripheral blood mononuclear cells (PBMCs) and we performed B cell isolation. Next, we treated the cell with LPS and after 4 hours we stimulated with our chosen DAMPS (ATP, Salmonella, Nigericin or Citrobacter). Then, we chose time points in which we would remove the samples from incubation and freeze them at -80 °C. We performed enzyme-linked immunosorbent assays (ELISA), protein gel electrophoresis and western blots which were imaged by chemiluminescence, and RNA Isolation with quantitative PCR. We observed that when stimulated with LPS+ATP and LPS+NIG we would see pro-caspase-1 bands at 48kD and when samples were stimulated with LPS+SAL and LPS+CITRO we see pro-caspase-1 bands at 48kd and an intermediate band at 37kd. Additionally, in cells stimulated with LPS+SAL and LPS+CITRO we observed a 30kD band. We have not seen any caspase-1 bands at 20kd. Based on our results, we can assume that while the tests show that stimulation and activation are occurring we do not know to what extent.

Experimenting with Object Classification

Kaleb Liburd and Kenique Liburd
Kaleb Liburd and Kenique Liburd

Mentor(s): Dr. Marc Boumedine
Computer and Computational Science Department, College of Science and
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Object recognition is the area of artificial intelligence (AI) concerned with the abilities of computers to recognize various entities. This is an important computational feature in on-going development. Our ultimate goal is to optimize object classification techniques to accurately identify bottles underwater (and elsewhere). Our techniques may be used alongside underwater ROVs to improve accuracy in identifying bottles, other harmful waste products, different species of corals or anything else for that matter. These abilities may prove useful in providing assistance to marine biologists. For example, it may help with identifying or tracking different animal species or, on a slightly different spectrum, help in finding harmful trash in our reefs.

We began experimentation with the Haar algorithm which is available in OpenCV-Python. Many different methods of training and image preprocessing were attempted. One of these methods was an attempt to cause the Haar algorithm to focus on just the general shape of bottles and be able to identify them by this. We decided to preprocess the images to a point where only the objects' outlines remained. After many different training and testing trials, we came to the conclusion that the Haar algorithm and Haar-like features may not be the best suited for the problem. In the future, we plan to look at other promising classification algorithms to experiment with, using various techniques. We want to modify or adapt the ones that show the most promising results in order to further increase the classifications' accuracies. If needed, we will create our own algorithms in an attempt to tackle our very specific problem.

Development and Delivery of CRISPR Ribonucleic Protein Complexes in
Macrostomum lignano

Samuel Liburd,
Peter Reddien
Mentor(s): Kathryn Malecek
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Flatworms (phylum Platyhelminths) have a remarkable ability to regenerate missing body parts. To better understand regeneration at the cellular and molecular levels using flatworms as models, we aim to develop genome editing to study discrete gene function in molecular detail. We seek to adapt CRISPR strategies for an accessible candidate Platyhelminth, *Macrostomum lignano*. Development and delivery of active CRISPR RNPs in *Macrostomum* would enable study of regenerative mechanisms, such as stem cell fate choice. To this end, we developed Cpf1 CRISPR guide RNAs for candidate marker genes of the eye and stem cells and validated their activity in vitro. We assembled these guides with a homology directed repair template into a CRISPR RNP complex. We optimized the microinjection setup to deliver this CRISPR RNP complex to early-stage Macrostomum embryos. We proceeded to genotype the injected embryos to detect editing using two sequencing methods. We observe variable deletion events suspiciously close to the end of our repair template in many of our injected embryos. While this observation needs to be explored further, the development of CRISPR in this system will be important to enable molecular dissection of the mechanisms underlying regeneration using Platyhelminths as models.

Tracking Spawns By Use Of A Brownian Bridge Random Walk Program

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Robert Stolz
Mentor(s): Robert Stolz
University of the Virgin Islands

The *Mycteroperca venenosa*, better known as the yellow-fin grouper makes up a valuable part of the commercial fishery throughout the Caribbean. Research has shown that due to overfishing of the species they are now at risk of extinction. A grouper spawning aggregate was discovered at the edge of an underwater shelf a few kilometers south of St. Thomas, U.S. Virgin Islands, and two protected areas were established, the Hind Bank and Grammanik Bank, to prevent fishing around the spawning aggregate during mating season. A program was developed that utilizes data, collected by way of Acoustic Telemetry, to probabilistically produce the specific location of the spawning aggregate by generating multiple Brownian Bridge random walks of the groupers' movement between each successive observations of the groupers. The simulations will then be used to improve the efficiency of the Hind and Grammanik Banks by adjusting their current size and location to one that will be providing sufficient protection to the groupers' spawn while still allowing fishermen to make a living without harming the reproductive rate of the spawns.

Using NASA Earth Observations to Monitor Land-use Change of Saint Croix (United States Virgin Islands)

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Tyler Smith PhD, Alem Ali PhD, Jospeh D. Ortiz PhD, Pedro Nieves, Rebecca Lehman, Bretton Alwood, Carrie Boyel, Erica Ta, Megs Seely, Fadwa Bouhedda, Brendan Lum, Tyler Anderson
Mentor(s): Juan Torres-Perez PhD, Jenna Williams, John Dilger, Marilyn Brandt PhD
NASA Ames Research Center

St. Croix is the largest island in the United States Virgin Islands (USVI) which is home to many important coastal and environmental habitats. Over the last several decades, the tourism industry has brought greater numbers of visitors to the USVI and as a result there has been increased human land-use and coastal development. In order to assess land-use change on St. Croix, Landsat 5 TM, Landsat 8 OLI, and Sentinel-2 MSI were used to map land-use and analyze land cover change using methodology developed by NASA Ames DEVELOP 2017 USVI Ecological Forecasting Team. This work produced land cover maps from 1985 to 2017 using Google Earth Engine (GEE). A composted image from each year was processed and analyzed for the following land classifications; Developed Open Space, Barren, Vegetation (Forest and Agriculture), Development, and Water. The results of this project will be used by the USVI Department of Planning and Natural Resources for future management and planning decisions as well as to help promote community awareness.

Large amounts of detached algae increase juvenile fish abundance

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Brewer's Bay has been impacted by an invasive seagrass (*Halophila stipulacea*) as well as two category five hurricanes. The hurricanes uprooted much of the native seagrasses, and *H. stipulacea* is spreading across the sandy-bottomed bay. From a recent study, the invasive seagrass has lowered fish diversity. This summer we noticed large volumes of detached algae over the shallow *Halophila* and sandy bottom. In order to measure the abundance and diversity of juvenile fish we compared the density of fish in the seagrass and the sand habitats to habitats impacted by the algae. Transects (30x2 meter) were laid at 13 nearshore locations to determine the amount of juvenile fish. Compared to the sand only, the algae that drifted above the sand quadrupled the abundance of juvenile fish and increased the diversity slightly. The algae that drifted over the *H. stipulacea* doubled the abundance of juvenile fish, but the diversity remained the same. The large amount of detached algae this summer has increased the abundance and diversity of juvenile fish living in it compared to normal habitats. The detached algae appears to be providing additional structural complexity, additional protection, and possibly a food source for juvenile fish allowing for a higher abundance of juvenile fish in these areas. Our next steps are to determine if there is detached algae and if it has an impact on other bays around St. Thomas and even other islands.

Characterization and Mitigation of Satellite Radio Frequency Interference

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Differentiating between signals from human technology (RFI) and signals emitted from a distant world is one of the most challenging tasks in radio SETI. We have tried to overcome this issue by placing telescopes in remote, protected areas such as Green Bank, WV. Nevertheless, we are unable to completely escape RFI. The myriad of operational satellites in Earth's orbit all contribute as sources of RFI. Fortunately, the position of a satellite can be accurately predicted thanks to well characterized orbital parameters that are publicly available for most satellites. We found examples of satellites impacting archival data taken using the Green Bank Telescope. Our main objective is to use these examples in order to identify characteristics in the data that coincide with particular satellites and then use this information to mitigate satellite RFI.

Hematological Impacts of Hypoxia on the Clearnose Skate (*Raja eglanteria*)

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Gail Schwieterman, Richard Brill, and Peter Bushnell
Mentor(s): Chris Chambers, Gail Schwieterman, Richard Brill, and Peter Bushnell
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Climate change is increasing the intensity of hypoxic events and pH variation in coastal estuaries. Hypoxic events can cause metabolic acidosis, or a decrease in blood pH, which may be exacerbated by ocean acidification. Acidosis affects numerous bodily processes including blood oxygen-affinity, which may decrease an individual's metabolic scope and thus their fitness. Understanding the physiological processes coastal and estuarine species use to overcome these environmental challenges is critical for predicting resilience to climate change. For example, to protect intracellular pH and blood-oxygen affinity, teleosts exhibit red blood cell (RBC) swelling. This phenomenon was believed to be absent in elasmobranchs, however, RBC swelling has been recently reported to occur in both sandbar sharks (*Carcharhinus plumbeus*) and epaulette sharks (*Hemiscyllium ocellatum*). This study further examines these unexpected findings by evaluating whether the clearnose skate (*Raja eglanteria*), a common elasmobranch species in western Atlantic estuaries, shows evidence of RBC swelling in response to both metabolic and respiratory acidosis. Blood samples (2 mL) were extracted from six individuals under resting, exercised, and air exposed conditions (with treatments presented in a randomized order). Hematocrit, pH, hemoglobin content, RBC count, and RBC size were measured. Preliminary results indicated that extracellular pH decreased and hematocrit percentage increased in both stressed treatments showing clear evidence of a hematological response due to acidosis. Both mean RBC count and mean hemoglobin had very little deviation from the control, suggesting a release of extra RBCs from storage organs such as the spleen had not occurred. RBC swelling was most evident in exercised individuals, suggesting that it may indeed be a common response to metabolic acidosis in elasmobranchs.

Mobile Forensics

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Mentor(s): Johnathan Graham,Akeem Wilkins and Erika Baker
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Technology has quickly become a necessity in our day-to-day activities. Smart devices have gained popularity and are becoming a key platform for accessing business and personal information. Everything from bank information to ordering takeout or hiring a private driver can be done on smartphones using diverse mobile applications.As technology becomes more accessible to the masses, important information stored on these devices are becoming increasingly appealing, but access to the sensitive information on smartphones requires proper authentication and identification such as a password and fingerprint identification. Mobile devices will continue to be used in more diverse ways, with the latest innovation being facial recognition, however, the steady growth and reliance on mobile devices, presents the risk for that same technology to be used for ill intent. As a result of the widespread use of mobile phones, the chances of a mobile phone being involved directly or indirectly in a crime have risen dramatically over the years. This would be of good assistance to forensic analysts in their pursuit of criminals. This presented the theory that mobile devices could be a valuable source of digital evidence. Mobile device forensics is considered a relatively new field compared to other digital forensics such as computer and database forensics. There are many tools that were created to obtain mobile forensic data such as Cellebrite and Autopsy. Some software range in cost from zero to ten-thousand dollars. Many of these software manufacturers claim that their software is capable of doing certain things and as a result, they apply top-tier price tags for their services, but do these software actually do what they are claimed to do, and if so to what capacity? The purpose of our project is to compare the performance of a few different types of software to determine which are most effective in several different criteria. The intent of our research is that it benefits any individual or organization that makes the decision to purchase one of the above-mentioned software and that they make the best possible business decision, based on knowledge presented on what the software truly can and cannot accomplish.

Characterizing Exoplanets

Silene Prentice,
Dr. David Morris and Dr. Jan Staff
Mentor(s): Dr. Lynnae Quick and Dr. Antonino Cucchiara
Smithsonian National Air and Space Museum

Every night, millions of stars light our sky. With ongoing exploration, we now know that every one of those stars is likely to have at least one planet orbiting it. Any planet that does not orbit our sun is called an exoplanet. The focus of my research is to characterize exoplanets by determining the heat output, radiogenic heating, and tidal heating. I used data observations from the NASA Exoplanet Archive to extract geological features of these planets such as the orbital period, densities, radius, etc. To rule out the possibility of thick atmospheres, I limited the exoplanets to <8 Earth masses and <2 Earth radii. Using Excel, simple and known scientific equations, as well as given data, I calculated, for each planet: a few missing densities; tidal heating - heating cause by tidal friction; radiogenic heating - the heat caused by the decay of radioactive elements; and the total heating - adding tidal and radiogenic heating together. Finally, I compared these values to our knowledge of the celestial bodies in the solar system, such as the planet Venus, Titan (Saturn's moon), Io (Jupiter's moon) and the planet Mars. My conclusion is that exoplanets tend to have a higher level of heating than planetary bodies in our Solar System. With some more research, I can use the data I calculated and furthermore make assumptions about the likelihood of habitable conditions.

Using CRISPR-mediated Mutagenesis to Analyze Protein Phosphatase Regulatory Subunit Functions in Arabidopsis thaliana

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Dr. Alison DeLong
Mentor(s): Dr. Alison DeLong
Brown University

Ethylene regulates seed germination, fruit ripening, leaf senescence, and organ abscission. Protein Phosphatase 2A (PP2A) is conserved in all eukaryotes and regulates many cellular functions. In plants, it modulates the biosynthesis of the important signaling molecule, ethylene, and regulates diverse processes including cytokinesis, and pathogen responses. PP2A is a holoenzyme consisting of three subunits: a scaffolding (A) subunit, a catalytic (C) subunit, and a regulatory (B) subunit that is encoded by three conserved gene families (B55, B56 and B72) in plants, animals and fungi. Three members of the Arabidopsis B72 gene family (*B13*, *B16* and *B17*) have been identified as candidate regulators of ethylene synthesis and are highly expressed in leaves, roots, and seedlings. *B16* and *B17*, a duplicated gene pair located approximately 50 kb apart on chromosome 5, are likely to be functionally redundant. We used CRISPR-mediated mutagenesis to create a *b16 b17* double mutant. To test the hypothesis that these genes regulate ethylene-dependent phenotypes, we used a dark-induced leaf senescence assay. Leaves from *b16 b17* plants turned yellow more rapidly than the controls in the experiment, suggesting accelerated dark-induced senescence. This would be consistent with increased ethylene production or response. To quantify this effect, we assayed chlorophyll contents in senescing mutant and wild-type leaves. To allow the isolation of *b16 b17* deletion alleles, we generated two new CRISPR constructs using a two-guide RNA strategy. DNA sequence analysis confirmed that the CRISPR constructs were correct, and we introduced them into Arabidopsis via Agrobacterium-mediated plant transformation.

Characteristics of Mantis Shrimp Telson Armor

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Dr. Jennifer Taylor
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UCSD - Scripps Institution of Oceanography

Mantis shrimp are extremely aggressive crustaceans armored with powerful weapons. Spearers mantis shrimp have appendages that work like spears to capture fast moving prey, whereas smasher mantis shrimp have appendages that smash hard-shelled prey into pieces with high impact forces (Patek, S.N. 2015). Unlike spearers, smashers participate in ritualized fighting, where they take turns striking each other on the telson, using it as a shield. So, while it is known how the striking appendage is built to withstand high impact forces, very little is known about the telson. This experiment was conducted to compare telson structure, composition and material properties between a smasher and a spearer species in order to gain insight into the significance of telson morphology in the evolution of ritualized fighting. Hypothesizing that smashers will have a harder, stiffer telson carinae to resist the forceful strikes of conspecifics during ritualized fighting. *Neogonodactylus bredini* (N = 9) (carapace length 12.29 ± 1.05 mm) served as our smasher and *Squilla empusa* (N = 8; carapace length 20.33 ± 2.73 mm) a spearer. The telson were dissected from the animal and bisected using dissection tools. For mechanical testing, the central carina was cut from the telson and secured on an aluminum block with cyanoacrylate. The sample was indented on the dorsal, epicuticle surface using a Nanovea nanoindenter equipped with a Berkovich tip at a load of 40 mN. For morphological analysis, the second part of the telson was allowed to dry and was then secured to a scanning electron microscopy (SEM) tip to reveal the cross section. SEM images of the telson were taken to compart the cuticle structure and energy dispersive x-ray spectrography (EDX) was used to analyze cuticle elemental composition. Smashing mantis shrimp are thought to have evolved a more robust telson in conjunction with ritualized fighting. However, based on our results we failed to reject our null hypothesis (Hardness T-test, T= 1.78, df = 12, N=8. $P < 0.05$. Stiffness T-test, T= 1.76, df= 14 , N=8. $P < 0.05$). It is likely telson shape, rather than cuticle material properties that defines impact resistance. We plan to extend this study to more species to determine general patterns among spears and smashers as well as, relate telson morphology and material properties to mantis shrimp strike forces to determine potential correlation of weapon power and shield robustness.

Microplastic Pollution in West End Beaches, St. Croix

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Mentor(s): Dr. Marcia Taylor
University of the Virgin Islands

Microplastics are harmful to not only marine life, but human life as well. These small fragmented pieces of plastics, classified in this study as <5mm in total length, have been found in drinking water and seafood. This research quantified the microplastic load on three West End beaches on St. Croix, USVI. This study emulated the methodology of a previous study done in the East End Marine Park, allowing for the comparison of results. Sand samples were collected along transects at each site. Remote sensing imagery data, retrieved from Google Earth, was used to divide transects into ten equally spaced sample points, with the distance between sample points determined by the length of the beach. A quadrat was placed at each sample point where a liter and a half of sand was collected. Four microplastic items were found at Dorsch Beach, nine at Rainbow Beach, and 15 at Ham's Bay. The results support the initial hypothesis that the average number of microplastics per beach was greater at West End beaches than beaches sampled in the East End Marine Park.

Assembly of Van Der Waals Heterostructures with Strong Electronic Correlations

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Mathew Yankowitz, Augusto Ghiotto and Cory Dean
Mentor(s): Dr. Stoltz
Columbia University

The discovery of van der Waals materials which can be mechanically isolated into two-dimensional (2D) layers within the past two decades has opened new possibilities for exciting technological advancements in the modern world. The most notable of these 2D materials thus far is graphene, which was first isolated in 2004. Graphene has demonstrated excellent electrical and mechanical properties, particularly when encapsulated between hexagonal boron nitride (hBN), an electrical insulator which acts as a featureless dielectric. When two layers are stacked upon one another to form twisted bilayer graphene (tBLG), the resulting electronic properties depend crucially on the twist angle between the monolayers. When this twist angle is roughly 1.1^o – the so-called "magic angle" – new quantum phases such as superconductivity and correlated insulating states can arise. However, achieving this magic angle is challenging experimentally due to the small margin of error of about $\pm0.05^o$. Twisted bilayers of tungsten diselenide (WSe_2) – a semiconductor in the monolayer – have emerged recently as another promising platform for realizing novel correlated electronic phenomena, and are predicted to electronically hybridize differently from graphene. Consequently, it is anticipated that there should be a much wider range of twist angles for WSe_2 and other transition metal dichalcogenide (TMDs) over which these new electronic properties can emerge than in the case of tBLG. In this project, stacked devices comprised of twisted bilayer WSe_2 encapsulated between flakes of hBN will be constructed, and the electrical properties such as the electrical conductance (G) as a function of charge carrier density (n) will be investigated at low temperature. These devices are anticipated to exhibit robust novel superconductivity and correlated insulating properties. Furthermore, it is hoped that there is greater ease in fabricating these devices due to the larger margin of error in the twist angle when compared with tBLG.

Examining diversity of coral symbionts across depth for *Orbicella franksi* and *Agaricia lamarcki*

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Dr. Tyler Smith, Dr. Monica Medina
Mentor(s): Dr. Tyler Smith
University of the Virgin Islands

Tropical corals survive and grow through the use of obligate endosymbionts which rely on photosynthesis to provide carbon to the coral host for both energy and calcification. This relationship is maintained to even mesophotic depths, where light is severely limited relative to shallower reef environments, meaning that this same relationship must function in both a stressful excess of light and stressfully insufficient light. One approach to dual survival in the divergent environment is the evolution of different strains of the endosymbiont, which has much lower generation times and therefore likely faster evolution. Here, we investigate the genetic diversity of coral endosymbionts across depth around St. Thomas for two coral species: *Orbicella franksi* and *Agaricia lamarcki*, which are both important reef building species in shallow and deep reefs alike. Analysis of symbiont diversity indicates however, no difference in the symbionts collected, across location or depth, although sequencing success was low. This may suggest that differences in light are mediated another way, such as altered coral morphology or symbiont gene expression.

Body Self-Perception, Depression, and Obesity in a sample of USVI Youth

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Mentor(s): Dr. Janis Valmond
University of the Virgin Islands

The purpose of this secondary data analysis is to examine the association between body self-perception, depression and obesity in a representative sample of United States Virgin Islands (USVI) adolescents, using data from 124 11th grade students participating in the School Physical Activity and Nutrition Survey (SPAN), which was initially created to be a surveillance system to monitor the pervasiveness of overweight/obesity in school-aged children in Texas with some inquiries that examine body self-perception, depression, Body Mass Index (BMI). The SPAN survey, adapted for use with USVI youth, was conducted among public school students on the East End of St. Thomas, USVI during May-June 2015. Body self-perception is considered a part of self-concept and is defined as the mental image one has of oneself; depression is characterized as a mood disorder, lasting at least two weeks to two months; obesity in adolescents (kg/m^2) is determined using height (meters) and weight (kilograms) and age and gender-specific growth charts. Data analysis included frequencies, the chi-square test for independence, and logistic regression in SPSS 25. Sixty percent (60%) of study participants were female; 89.7% of study participants self-identified as African American; 23.8% of study participants were classified as obese; and 6.5% for males and 16.9% for females perceived themselves as obese. There was little to no association between depression and obesity, X^2 (1,n=117) = .37, p= .693, phi= -.037. The logistic regression analysis revealed that sex (p<.000) and female self- perceived obesity (p.<000) were significantly associated with obesity. Thus, females in this sample were more likely to be obese than the males and there was no significant association between depression and obesity. Future studies could involve having a larger sample of students and include more questions that would allow more in-depth investigation of psychosocial variables.

From trash to treasure to save the tides Project based learning in the mathematics classroom

Otensia Allamby,Cleopatra. J. Skerrit, and Tameca White,
Allamby Otensia,Cleopatra. J. Skerrit, Michele Guannel, Nadia Monrose Mills
Mentor(s): Dr. Monrose
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Teachers are constantly looking for new ways to excite students and promote their thirst for knowledge. In a mathematics classroom the challenge is greater as students seek excitement as well as a correlation between the lesson, their daily lives, and how it fits with their goals for the future. In an attempt to bridge the gap colleagues from the Charlotte Amalie High School (CAHS) and All Saints Cathedral School will be working on a Project-Based Learning (PBL) unit on marine debris, which will introduce and define mathematical concepts while raising awareness on how individuals' action can affect our environment. In both classrooms, the project's theme will revolve around reduce, refute and reuse. Students will collect data on trash collected. In the Charlotte classroom students will create questioners in an effort to understand the general public's view on marine debris. There will be a focus on algebraic concepts such as dimensional analysis. One activity will require students to engineer a leak proof reusable bag out of the sorted trash. In the All Saints classroom students will use algebraic and pre-calculus concepts to design and create a model of a bridge that is stable and symmetrical. With the help of UVI faculty through VI-ESPCoR, and community partners, students and teachers will have access to information and resources, which will help in the development of the PBL unit. The projects are aimed to take a mathematical engineering approach so that student can see how mathematics is the fiber and building blocks of our everyday life.

Antioxidant Capacity, Total Phenolic Content, and Phosphomolybdate activity of Vervine (*Stachytarpheta jamaicensis*) Methanolic Extract

Neelam S Buxani,
Anayah I. Ferris, Narome Belus, Torhera Durand, Shantae Lewis, Lewis Bennett, and Brianna Scotland
Mentor(s): Dr. Neelam Buxani
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Plants are a great source of beneficial and disease-preventative compounds. Antioxidants and phenols are highly remarkable chemical compounds known for their high medicinal capacity. In the present study, methanolic extract of Vervine (*Stachytarpheta jamaicensis*) was prepared by cold maceration method and different concentrations (250 µg/mL, 500µg/mL, and 1000 µg/mL) of prepared extract were tested for total phenolic content (TPC) by Folin-Ciocalteu reagent, while *in vitro* antioxidant activity was assessed via two different methods H_2O_2 scavenging activity assay and Phosphomolybdate activity assay. All assays were performed by using UV-Vis spectrophotometry and the results showed direct correlation of TPC and phosphomolybdate activity with concentrations of plant extract, but the same could not be proved for H_2O_2 scavenging activity. Furthermore results were compared with standard anti-oxidant Gallic acid , and were found to be quite promising.

In vitro Bovine Serum Albumin and egg albumin assay to determine Anti-inflammatory activity of Vervine (*Stachytarpheta jamaicensis*) leaves

Neelam S Buxani,
Sojourna Ferguson, Samuel Liburd, Khadijah Estrill, Anthony Henry and Elianna Paninos

Mentor(s): Dr. Neelam Buxani
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Plants prove a central component in the medicinal history of humans. By researching plant's pharmacological active phytochemicals new medications for numerous diseases and ailments are being discovered. *Stachytarpheta jamaicensis* (*L.*), commonly known as Vervine, is one such plant that has been traditionally used for human health benefits. *S. jamaicensis* has been known to treat allergies, respiratory problems, cough, cold, fever, constipation, digestive problems and dysentery through its anti-inflammatory properties. However, to scientifically validate *S. jamaicensis's* anti-inflammatory ability, in present study *in vitro* spectrophotometric assays were conducted using bovine serum albumin (BSA) and egg albumin. If *S. jamaicensis* truly possessed anti-inflammatory agents then the denaturation of each protein would decrease with increased amounts of *S. jamaicensis* extract. In general, our results confirmed this trend in both the BSA and egg albumin assays. Furthermore, for each protein, all *S. jamaicensis* extract concentrations proved a better protein denaturation inhibitor than the standard 1μg of ibuprofen. While, *S. jamaicensis* showed to have anti-inflammatory activity, a direct relationship with concentration of plant extracts could not be established from the results.

Amino Complex Binding

Ahmad Abdul-Samad, Kiwanee Smith, and Emely Henriquez
Mentor(s): Dr. Stanley Latesky
University of the Virgin Islands

Amino acids are organic compounds containing amine and carboxyl groups and are found in and around the human body (in certain foods and animals). Over time, your body can produce some of them and supplement the rest, but what if something goes wrong? We are testing to see how transition metal solutions can bind to two biochemical compounds and how they could possibly react in the human body. We started by creating a TRIS HCl (hydroxymethyl) aminomethane buffer of varying pH, the amino acid solutions, and the metal solutions to test by varying pH first, then by concentration in the spectrometer. When testing by pH, we took small beakers and measured specific amounts of each solution into the beaker, which would hopefully give some sort of noticeable chemical change/reaction. After this was finished, we took specific amounts of each metal and buffer and slowly added the amino acid after each measurement in the spectrometer to look at varying concentrations of the compounds. As a result, the graphs of some of the absorbances are very funny due to precipitation in some solutions. Also, there had been a definite change in absorbance levels for every solution tested. At the time of writing this abstract, we are still finding out where certain metals are binding and what would be their effect on the human body after binding them together. Hopefully in the future, researchers can come forward and continue the research that we've done and make greater discoveries.

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presentations. You have made a huge contribution to the success
of our students, symposia, and community. Your dedication
to the advancement of young Caribbean scientists is greatly appreciated.
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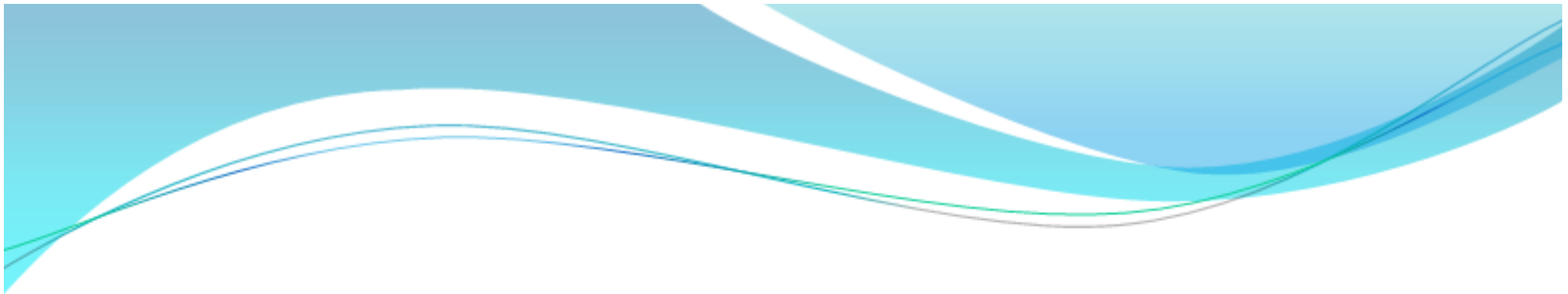Dr. Marc Boumedine, *Cybersecurity Program Director*
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