18th Annual
Fall Student Research Symposium

ABSTRACT BOOK

September 25, 2016
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University of the Virgin Islands

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The Eighteenth Annual
Fall Student Research Symposium

September 25, 2016
University of the Virgin Islands
St. Thomas Campus, U.S. Virgin Islands

Event Organized by

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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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Fall 2016 Research Symposium Presenters

Plant and Animal Relationships in Elmer Street Biofilters (Los Angeles, California)

Zandria Acosta and Jennifer Le

Mentor(s): Dr. Lisa Levin

UCSD Scripps Institution of Oceanography

As the effects of global climate change become more apparent, organizations and governments are creating environmental policies to make urban development more compliant with nature. Urbanization modifies water flow and introduces contaminants that cause increases in polluted runoff, ultimately leading to decreases in surface and water quality (Nelson 2002). A possible alternative to decrease excessive sedimentation in runoff is to create biofilters in urban and coastal communities. Biofilters, also known as bioretention systems, use natural processes to capture storm water for the removal of organic particles, nutrients, metals, and pathogens through interactions among their structural and biological components (Levin 2015). This project aims to explore the relationship between the faunal community and floral percent coverage on Elmer Avenue biofilters in Los Angeles, CA in order to better understand how biofilters function and the services they provide. Two questions where asked to help lead this study: Does the percent coverage of floral affect the fauna composition in the Elmer Avenue biofilters, and How do plants found in biofilters perform relative to each other in terms of heavy metal removal? The null hypothesis states that the percent coverage of flora does not affect the fauna composition in the Elmer Avenue biofilters. While, the alternative hypothesis states the percent coverage of flora does affect the fauna composition in the Elmer Avenue biofilters. To complete this research one must sort through soil samples for fauna retained on a 0.3 mm and 0.042 mm mesh and identify each individual. Secondly, estimate the total percent coverage of flora for each biofilter and identify dominant plant species. Lastly, determine if there is a relationship between the plant and animal communities using a linear regression. As a result, there is no evidence that floral percent coverage affects the fauna composition in the Elmer Avenue biofilters. A linear regression test yields results of percent coverage explaining only 4% of the variation in faunal abundance. This information helps us understand that there still is not a clear indicator of how the community interacts as whole. To further this study, more samples will need to be taken periodically so floral and faunal species can be monitored over a course of time. This can help scientists understand changes in biological communities over seasonal variation, e.g. changes in precipitation.

Acknowledgements: University of California San Diego

Determining Lipid Content

Shabree Anthony

Mentor(s): Dr. Edwin Cruz-Rivera

University of the Virgin Islands

Lipid quantification is critical for understanding phenomena as different as the choices of consumers, the potential of algae for biofuels, health disparities related to obesity, and the onset of multiple diseases. This research aims to determine the most accurate method to measure lipid content on algal and plant material by comparing three widely used methods: 1) the gravimetric method of Folch et al. (1957), 2) the colorimetric vanillin method, and 3) the colorimetric charring method. These methods will be used to quantify predetermined amounts of purified commercially-available lipids, lipid content of field-collected algae and plants, and lipid content of edible market-bought seaweed, for which results can be compared to label nutritional specifications. Algae/ plants from St. Thomas will represent all major eukaryotic algal groups: *Ulva fasciata*, *Acanthophora spicifera*, *Sargassum polyceratium*, *Padina gymnospora* and *Halophila stipulacea*. It is predicted that the vanillin method will allow for better elucidation of lipids because it allows quantification over a very wide range of lipid amounts.

Acknowledgements: National Institute of Health RISE grant #GM061325

Identification of Nassau grouper eggs in the plankton: is size a valid metric?

Lauren Arnold, Brian C. Stock, Lynn Waterhouse, Ron Burton, Croy M. McCoy, and Christy V. Pattengil-Semmens

Mentor(s): Dr. Brice Semmens

University of the Virgin Islands, Scripps Institution of Oceanography

Nassau grouper are an important species in the Caribbean both in a fisheries context and because they contribute to tourism through enhanced diving experiences. However, the species has suffered dramatic declines through it range due to overfishing on fish spawning aggregations (FSAs) for the species. These spawning aggregations, occurring during the winter months in the central Caribbean, represent the total reproductive output for the species. It is thus important that we gain an understanding of the patterns of connectivity generated by FSA sites, and characterize the processes of egg/larval advection, diffusion, and planktonic ecology (feeding and predation). To do this, we evaluated the ability of a novel plankton sampler, the NetCam, to map the dispersal of Nassau grouper eggs from the FSA immediately post-spawning. The NetCam captures images of items passing through the cod-end of a plankton net. However, it is not clear what proportion of the eggs imaged by the NetCam are Nassau grouper. Using eggs from preserved samples taken during the NetCam deployment, we demonstrate at least 3 distinct size classes of eggs. Based on genetic analysis, these distinct classes belong to separate species. These findings suggest that images of fish eggs captured by the NetCam can reliably be identified to species, and are thus useful in characterizing the spatial ecology and early life history of Nassau grouper eggs.

Acknowledgements: University of California - Historically Black Colleges and Universities Initiative

The effects of blood meal from different Caribbean coral reef fish on first stage juvenile isopod Gnathia marleyi

Diana Ashhab

Mentor(s): Dr. Paul Sikket and Dr. Donna Nemeth

Center for Marine and Environmental Studies (CMES), University of the Virgin Islands

The correlation between blood meal source and Gnathia marleyi Z1 (1st juvenile stage) fitness is being examined using 8 different host species common to the US Virgin Islands. The host species belong to different families and have different susceptibilities to the isopod parasite. Unfed Gnathiids in their final juvenile stage (Z3) were collected from a colony and allowed to feed 5 different species of coral reef fish from different families. The gnathiids were combined, brood to adulthood and allowed to breed. When the females are fertilized, they will be isolated. the Z1 gnathiids will be collected once they are born, and placed in 8 different containers to feed on 8 different species of fish. The Z1 gnathiids will be observed and survivorship recorded on a daily basis to determine if there is a correlation between the blood meal source and fitness.

Acknowledgements: vi-EPSCOR

The Nature Of Solar Atmospheric Bright Points

Ulric Baptiste Jr.

Mentor(s): Dr. N. Brice Orange

University of the Virgin Islands

Continuous research and data collection of the solar atmospheric phenomena that occurs on the Sun will improve our understanding to many outstanding solar physics questions. Our project focused on the ubiquitous solar atmospheric transient events referred to as bright points (BPs). These phenomena are useful for understanding magnetic reconnection, plasma acceleration, heating processes, etc. Utilizing the Solar Informatics Network Via Temporally Uncovered Sources (SINVICTUS) and six years' worth of observational data , 370 of these BP's were analyzed from spectroscopic and narrowband observations provided by the Extreme Ultraviolet Imaging Spectrometer (EIS) and Atmospheric Imaging Assembly (AIA), respectively. Large number statistics that emphasized our BPs diverse temperature and plasma conditions, were derived.These results presented evidence in favor of self-similar plasma heating, across large temperature gradients as expected by the nanoflare model. Our work has enhanced our understanding to the role of multi-scaled self-similar heating of solar atmospheric plasmas particularly in the presence of dynamic small-scale transients, while further contributing to the growing evidence of its possible functional dependence on thermodynamic conditions.

Acknowledgements: HBCU-UP award #1137472 and NASA-MIRO

The Effects of Drying on Antioxidant Activity

Narome Belus, Torhera Durand, and Anayah Ferris

Mentor(s): Bernard Castillo II, PhD

University of the Virgin Islands

Antioxidants are substances that prevent the free radical oxidation of compounds. Free radicals are highly reactive unstable compounds that can cause harm to the cells. Antioxidants can be found in many different sources, such as fruits, vegetables and plants. Antioxidant compounds provide the missing electrons to the free radical then reduce it back to its stable form. The purpose of this study was to measure and compare the Hydrophilic Antioxidant Activity (HAA) of fresh and dry plant samples. Five different plant samples were used from two locally grown gardens on St. Croix, US Virgin Islands, namely: Laurus nobilis (Bay Leaf), Plectranthus amboinicus (French Thyme), Cymbopogon (Lemon Grass), Moringa oleifera (Moringa) and Carica papaya (Papaya). Fresh plant samples were weighed and extracted in an aqueous phosphate buffer solution and dry plant samples were placed in the oven before extraction. The drop in absorbance of each sample was monitored on the UV-VIS Spectrophotometer. The antioxidant activity was expressed as µmol of Trolox equivalent per grams of dry weight (µmol TE/ g DW). We hypothesized that the HAA of dry plant samples would be higher those of the fresh samples. The results show that 3 of the 5 plants: Carica papaya (Papaya), Cymbopogon (Lemon Grass), and Plectranthus amboinicus (French Thyme) had a higher dry HAA than fresh HAA. Carica papaya (Papaya) had the highest dry HAA (1727.95±745.44) and Moringa oleifera (Moringa) had the lowest dry HAA (133.93±14.39).

Laurus nobilis (Bay Leaf) had the highest fresh HAA (477.47±23.83) and Plectranthus amboinicus (French Thyme) had the lowest fresh HAA (17.18±4.54).

Acknowledgements: NSF HBCU-UP Grant # 1137472

Do Inhibitory Synapses Change Throughout The Day

Lewis Bennett

Mentor(s): Dr. Michelle C. D. Bridi and Dr. Alfredo Kirkwood

The Johns Hopkins University

An excitatory postsynaptic potential (EPSP) is a postsynaptic potential that makes the postsynaptic neuron more likely to fire an action potential. The flow of ions that causes an EPSP is an excitatory miniature postsynaptic current (mEPSC). Previous studies have shown that frequency and amplitude of mEPSC's increased after wake and decreased after sleep. Since mEPSC's are related to synaptic connections, this means that synaptic connection strength increases in the wake experience and decreases in the sleep experience. However, preliminary data from our laboratory indicates that the frequency of miniature inhibitory postsynaptic currents (mIPSC's) decreased after wake and increased after sleep. Since cortical plasticity and function are not shaped by excitation alone, but rather by the excitation/inhibition balance, we studied how the circadian rhythm may influence the brain's inhibitory synapses. Our first hypothesis stated that the change in frequency of mIPSC's might be due to a change in the number of synapses. Since each mIPSC result for the spontaneous activation of a single synaptic release site, we also hypothesized that the daily fluctuations may be due to a change in the activity of synaptic release sites. To test these hypotheses, we entrained mice in normal and reverse light cycles and sacrificed them just before lights on (T0) and lights off (T12) respectively. Immunohistochemistry was used to quantify the number of Synaptotagmin-2, (a known marker for paravalbumin positive inhibitory boutons) present in the visual cortex of mice. We found that the mice entrained in the T12 light cycle showed a significant high number of Synaptotagmin – 2 puncta present while the mice entrained in the T0 light cycle did not. The results obtained can be used to help scientist studying cortical plasticity to set up experiments to obtain optimum results.

Acknowledgements: National Science Foundation grant DBI-1262985.

The Role of CDK4/6 in Colon Cancer Cells

Annalyn Brown and Adrienne D. Cox

Mentor(s): Sehrish Javaid

UNC at Chapel Hill

CDK4 and CDK6 (cyclin dependent kinase) proteins are responsible for causing transcription of genes that lead to progression through the cell cycle's G1 phase. Constant activation of these proteins aids in the maintenance of cancer. Currently, there are CDK4/6 inhibitors in clinical trials, especially for colorectal cancers (CRC), that target the catalytic activity of both CDK4 and CDK6 proteins simultaneously. An inhibitor that selectively targets either CDK4 or CDK6 could increase efficacy while decreasing unwanted off-target effects. Therefore, we first aimed to determine whether CDK4 or CDK6 is more important for cell cycle progression in CRC cells. We hypothesized that individual inhibition of either CDK4 or CDK6 would cause cell cycle arrest and decrease cell proliferation. Because there are no pharmacological inhibitors that selectively affect individual CDK protein kinase activity, we performed genetic knockdowns in order to deplete expression of each gene product. To do this, we performed siRNA transfections on CRC cell lines (HCT116, LoVo, DLD-1). MTT assays were used to measure cell viability and soft agar colony formation assays were used to measure anchorage independent growth. Through genetic knockdowns of either CDK4 or CDK6, or both, we determined that loss of CDK4 resulted in strong compensatory upregulation of CDK6, and that reduction in either protein unexpectedly caused an increase in cell proliferation and metabolic activity. We speculate that these increases may be due to upregulation or higher dependence on the CDK protein that was not knocked down. Also, other pathways influencing G1 progression may be activated or upregulated as a result of the loss of CDK4/6. Unfortunately, an inhibitor selective for only one protein may be a further reach than first expected. Future studies include determining what pathways these cells are exploiting that allow them to proliferate despite lacking the full complement of CDK4/6/cyclin D complexes.

Acknowledgements: NIH

Size of Coral Colonies determine the mean and variability of growth rate

Lennon Bruney

Mentor(s): Dr. Stuart Sandin

Scripps Institute of Oceanography UCSD

Scleractinian (stony) corals are principal reef building organisms that maintain structural complexity in coral reef systems. Determining the rate of change and mortality of these colonial animals quantifies one aspect of benthic spatial pattern evolution. We predict that the size of coral colonies can play an important role in the growth rate and survivorship. Importantly, we predict that the morphology of corals can influence the strength of size dependent growth. For example, fragmented corals and smaller colonies may experience greater risk to stress factors, especially in response to exposure to algae. In order to determine the rate of growth and variability overtime of coral colonies an analysis was done with a photographic bi-annual time series taken in the Caribbean island of curacao between 2009 and 2013. A change in growth, shrinkage, fission and fusion was observed within the colonies. Colonies of Madracis mirabilis, Agaricia agaricites and Porites astereoides were the most abundant species found. Growth models through Matlab and R were used to help determine the growth rate and variability of these corals. With an increase in colony size showed an increase growth rate complemented by increase in variability for A.agaricites and P.porites. There was a different trend for M. mirabilis compared to the others, with no change in average growth with size despite comparable increase in variability.

Acknowledgements: University of California- Historically Black Colleges and Universities Initiative

Doping of 2D nanomaterials: Investigation of chemical environment and electronic structure effect.

Nakeshma Cassel

Mentor(s): Dr. Wayne Archibald

Brookhaven National Laboratory

Graphene has a potential to serve as a universal contact in next generation electronic devices based on graphene-metal interaction and hetero-stack of 2D materials. The work presented here explores the electronic structure of transition metal oxide, sulfides with graphene as these composites have numerous applications as a super capacitor due to its high power density and porosity. In addition, graphene has been incorporated with insulators such as MoS2 and boron nitride in unique assembly called Vanderwaal materials which has a potential to serve as optoelectronic device due to its tunable conductivity and mechanical flexibility. Researchers have struggled to build graphene-based devices because the material possesses no band gap which enables the material to behave as a conductor. A sizable band gap in graphene is a very important consideration for its incorporation in devices such as transistors because of the presence of charge carriers and the control of their type and concentration are required. In an effort to combat this problem, a band gap was engineered via chemical doping making graphene either p-type or n-type. Single layer chemical vapor deposition (CVD) graphene samples were doped with 1Å of gold, 1Å of chromium and 1Å of titanium via thermal/e-beam evaporation. Raman Spectroscopy of single layer CVD graphene doped with chromium indicated that it is n-type due to the peak at 1350cm-1 which is characteristic charge transfer peak. Additionally, titanium and gold doped Raman samples indicated that they are both p-type. Future analysis via Photoluminescence Spectroscopy (PL) can then be used to determine if a band gap was created and the size of the engineered bandgap.

Acknowledgements: NSF DMR -1420634

Identification of Aryl Hydrocarbon Receptor Antagonists with Biological Activity In Vitro

Nirisha Commodore

Mentor(s): Alejandra Ramirez-Cardenas and David Sherr, PhD

Boston University School of Public Health, Boston University School of Medicine

There are 85,000 anthropogenic chemicals registered by the Environmental Protection Agency, of which relatively few have been evaluated for their effects on human health. The Aryl Hydrocarbon Receptor (AHR) is a ligand-activated transcription factor that is notorious for its role in mediating the effects of environmental pollutants in several physiological and pathophysiological processes, for example, cancer. Many pollutants have been identified as AHR agonists. However, few antagonists have been detected. Therefore, a library of compounds was virtually screened to identify new compounds that displayed similar binding to the AHR as the known AHR antagonist, 2-((2-(5-bromofuran-2-yl)-4-oxo-4H-chromen-3-yl) oxy) acetamide (CB7993113). Five compounds, denoted as NEU1-5, were recognized as potential antagonists based on their similarity to CB7993113 and their predicted ability to bind the AHR. To test the functional characteristics of these compounds, AHR-driven reporter assays using a murine hepatoma cell line (H1G1) and an immortalized human epithelial breast cell line (MCF10F) were employed to assess the NEU compounds' ability to inhibit AHR activation. Titrations of a non-toxic AHR agonist, Beta-naphthoflavone (BNF), were performed to determine a concentration at which the activation of the AHR would be optimal for detecting any inhibition caused by the NEU compounds. Toxicity of compounds was determined by quantification of cell metabolic activity at various time points following cell treatments (MTT assay). Of the five compounds tested for AHR inhibition, NEU4 showed the most promising results. At concentrations of 10 and 50 uM, percent inhibition of AHR activation in NEU4-treated cells was significantly higher than the cells treated with 2.5 uM BNF (p-values, 0.00231, 0.00435 respectively). Toxicity quantification confirmed that there was no significant change in percent viability of cells following treatments. These experiments suggest that NEU4 may be a potent antagonist of the AHR and may represent a novel targeted cancer therapeutic.

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Investigations Into The Feasibility Of Herbal Extracts As A Treatment Method For Sickle Cell Disease

Clilia Davis

Mentor(s): Dr Sandy Wyllie-Echeverria

University of the Virgin Islands

Sickle Cell Disease (SCD) is the basis of this literature review paper. More specifically vascular-occlusive (vaso-occlusive) events. SCD describes a collection of disorders that alters hemoglobin, the oxygen carrying molecule in red blood cells. “Persons possessing this disorder have abnormal hemoglobin molecules called hemoglobin S- contrary to the normal hemoglobin A; which can modify red blood cells into a sickle, or crescent, shape.” [9]. Moreover, due to this physiological alteration of hemoglobin, a host of clinical implications arise. “Definitively, as it relates to vaso-occlusive events, which is introduced and perpetuated by interactions among sickled cells, endothelial cells and plasma constituents; a plethora of clinical complications comprise of pain syndromes, stroke, leg ulcers, spontaneous abortions and renal deficiency just to name a few.” [8] As such, since there is no known cure besides hematopoietic stem cell transplantation, which is risky and expensive, other avenues have to be explored. My primary focus seeks to verify if the sickling phenomena can be reversed. I am proposing that the specified plant metabolites might act as an inhibitor in the gelation process that sickle cells undergo during hypoxia. If successful, this should reduce the prevalence of sickling and alleviate the impediments that are caused. I identified plant species with anti-sickling properties, and compared similarities of the chemical constituents in these plants. In addition, I highlighted the issues of hydroxyurea, in an effort to validate why herbal extracts could be a feasible option for treatment. I segregated ten plants, growing in the US. Virgin Islands and around the Eastern Caribbean, then tabulated those species that are suspected to have anti-sickling properties. Also, I created several bar graphs highlighting the following: a sample of the number of people from different locations that utilize the plants in my study for treatment in SCD. In addition, a graph outlining the period from 1971-2013; depicting the increase of published articles associated with this type of research. I found the publication of herbal treatments for SCD increased the latter quarter of the period. These results suggest that people are aware of the possibility of this type of remedy as an option and also indicates that more scientists may be open to further investigation of herbal treatment of SCD. In conjunction, in an effort to denote and apply real numbers to the prevalence of the disease within Caribbean territories, the number of people admitted to the local hospitals with SCD in St. Thomas USVI and St. Kitts were tabulated. This provided a framework of how widespread this genetic disease is. I conclude that my proposed investigation idea is an avenue for further study and experimentation to develop a treatment for the holistic clinical care of people with SCD.

Automated Covert Network Timing Channel

Eliakin del Rosario

Mentor(s): Kevin S. Griffin

Lawrence Livermore National Laboratory

A Covert Network Timing Channel is a mechanism used to transmit data by the inter-transmission timing of consecutive packets. The timing of these packets is read and decoded accordingly based on the encoding scheme of the data into the inter-transmission timing of the packets. To properly encode data into the inter-transmission timing of the packets, we have to account for the possible fluctuation of network activity that can cause a delay in the arrival of the packets. For this reason, a covert network timing channel needs some parameters that once generated can characterize the network in a way such that the timing of each packet arrival time does not conflict with one another thus decreasing decoding error. This poster presents a method used calculate the parameters needed to properly encode data into a covert network timing channel and effectively decreasing the potential error rate when decoding the extracted data from the inter-transmission timing of consecutive packets.

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Automated Covert NetTotal Antioxidant Activity in Virgin Islands Plants

Torhera Durand, Narome Belus and Anayah Ferris

Mentor(s): Dr. Bernard Castillo

University of the Virgin Islands

Antioxidants have been portrayed as substances that are greatly beneficial to human health and are widely used in a number of cosmetic and nutritional products. Antioxidants work to quench the formation of free radicals, thus, preventing cellular oxidation and the formation of certain illnesses like cancers, degenerative and cognitive illnesses, and the effects of aging. In nature, antioxidants can be found in a number of products, including, but not limited to, fruits, vegetables, and herbs. The purpose of our research was to determine the Total Antioxidant Activity in locally grown Virgin Islands plants (St. Croix, USVI) and to determine which plant had the highest Total Antioxidant Activity. Total Antioxidant Activity can be obtained from the Hydrophilic Antioxidant Activity (HAA) and the Lipophilic Antioxidant Activity (LAA). We hypothesized that for each of the plants tested the HAA would be greater than that of the LAA. Six locally grown plants were tested, Laurus nobilis (Bayleaf), Moringa oleifera (Moringa), Carica papaya (Papaya), Cymbopogon citratus (Lemon Grass), Capsicum anuum (Bell Pepper) and Plectranthus amboinicus (French Thyme). The antioxidant compounds for all six plants were extracted in aqueous and organic solutions for the HAA and the LAA, respectively. The antioxidant activities were measured using the ABTS/H2O2/HRP decoloration method using a UV-Visible Spectrophotometer at a wavelength of 730 nm for 5 minutes. The resulting antioxidant activities were expressed as (µmole Trolox Equivalent per gram dry weight). For all of the plants tested the HAA was generally higher than the LAA. Laurus nobilis (Bayleaf) had the highest Total Antioxidant activity (504.02 ± 36.17 µmole Trolox Equivalent per gram dry weight) while Plectranthus amboinicus (French Thyme) had the lowest Total Antioxidant Activity (31.86 ± 5.34 µmole Trolox Equivalent per gram dry weight). This lead to the acceptance of our hypothesis that the HAA would be greater than that of the LAA, and our findings promoted the consumption of Laurus nobilis or Moringa oleifera for the greatest intake of antioxidants among the six plants tested.

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Chemical Modifications to Tailor Electronic Structure of 2-Dimensional Nano-materials

Shanece Esdaille and Theanne Schiros

Mentor(s): Dr.Wayne Archibald

Columbia University

Two-Dimensional materials are a class of nanomaterials that are approximately one or two atoms thick. Graphene is most commonly associated with 2-D materials. It is our first contact in next generation electronic devices based on hetero-stacks of 2-D material. In particular, exploring contact doping as an interface to modify the work function of the interface. In addition to Graphene, Molybdenum disulfide was also looked at as another 2-D material to replace silicon in electronic devices. These 2-D materials were doped with other materials or impurities to determine the chemical properties of their structure. X-ray photo election spectroscopy (XPS) was used to analyze these samples and Igor procedures was used as the software to analyze the data. X-ray photoelectron spectroscopy is a surface-sensitive quantitative spectroscopic technique that measures the elemental composition at the parts per thousand range, empirical formula, chemical state and electronic state of the elements that exist within a material. The project involved the tuning of electronic structures of 2-Dimnesional sheets of Nano-materials by the exploration of chemical doping of both graphene as an electrode and a single layer transition metal dichalcogenide (TMDC) such as MoS2. In particular, focus was placed on chlorine doped graphene and chlorine doped MoS2 in the monolayer limit and in Van der Waal's hetero-stacks with an eye on next generation post silicon electronic devices. The calculated atomic concentrations and work function shifts agrees with theory in relation to chemical compositions and bond type. For chemical doping which is our chlorinated samples, it was observed that there is strong p-type bonding of almost 1ev; whereas in contact doping such as in Chlorinated Graphene layered on top of MoS2, these are strongly n-type bonding. From this we deduce that n-type doping occurred because the samples required a lot of charge and this suggests that contact doping really changes the game as it relates to the new age of electronics. As a result, we are now able to connect atomistic bond environment with electronic structure effects in 2-D materials.

Acknowledgements: NSF

Using Innovative Technologies to Measure the Development of Undergraduate Chemistry Students' Problem Solving Abilities

Angie Estien and Kaila Mitchell

Mentor(s): Dr. Bernard Castillo, Angelicque Tucker Blackmon

University of the Virgin Islands, Innovative Learning Concepts

Chemistry courses are generally taught using traditional lecture with a formulated method that does little to encourage critical thinking and problem solving skills. Research shows that students participating in blended learning environments experience increased engagement and ability to apply knowledge to solve real-world problems. However, little is understood about the development of students' problem solving skills while inside blended learning environments. Studies have not been conducted to specifically investigate increases in students' cognitive development and engagement in real time. This research study uses innovative technologies, more specifically, Tobii Eyeglasses, to assess the development of students' problem solving skills in an undergraduate chemistry course. In this study, researchers collected data with an eye-tracking system to quantitatively determine how students used the periodic table to solve nomenclature problems. Data were collected from students enrolled in a 100 level chemistry course offered during the summer 2016 semester. Students in the course were randomly assigned to a control (traditional lecture section) or experimental (a blended learning session) group. Researchers administered pre- and post- tests to obtain data on how students in each group responded to chemistry nomenclature multiple-choice problems. The eye-tracking glasses were worn by all students during each test to collect real time fixation and area of interest data. Fixation and area of interest data reveal the amount of cognitive effort (or lack thereof) that students exert as they attempt to solve chemistry problems. Data show that on average, students in the experimental group scored higher on the post-test than those in the control group. Furthermore, data indicate that students in the experimental group had higher fixation counts and durations while solving problems compared to those in the control group. At the same time, students in the experimental group visited appropriate areas of interest more often, but on average spent less time looking at the entire periodic table. Data from this research study suggests that higher fixation in appropriate areas of interest increases students' performance on chemistry nomenclature problem solving tasks. These findings are useful to informing the design of future distance learning chemistry courses and can aide chemistry faculty in directing students' attention to certain areas of the periodic table while solving chemistry nomenclature multiple-choice problems.

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Single-Atom Catalysis in the Gas Phase

Sojourna Ferguson

Mentor(s): Dr. Antonio Brathwaite and Dr. Michael Duncan

University of Georgia and University of the Virgin Islands

Transition metal nanoclusters have found widespread application as catalysts in numerous industrial-scale chemical reactions. However, the rational design of these heterogeneous catalysts, with tailored activity and selectivity, is still elusive. Recently, surface-supported single-atom catalysts have been shown to have higher activity, selectivity and stability than their nano-sized analogues. While these early results are exciting, further studies on the metal-support and metal-substrate interactions are needed to fully understand these systems. Gas-phase experiments are particularly convenient for investigating the vibrational behavior, and thus identity, of metal-substrate complexes. These experiments provide a well-defined environment that is free from the perturbing effects of surface supports, solvents, counter ions and matrices. In addition, ions can be size-selected, facilitating the systematic investigation of their structures and reactivity directly and via comparison with theory. Moreover, these experiments can provide benchmark data for comparison to computational chemistry calculations. In this study, we investigate the interactions of a single vanadium cation with acetylene molecules using infrared laser photodissociation spectroscopy and Density Functional Theory. This combined experimental and theoretical study provides evidence for the metal-catalyzed trimerization of acetylene to form benzene, as well as the formation of exotic metallacycles. Single-atom catalysts are the new frontier in heterogeneous catalysis and these studies provide a unique lens through which insight into their reaction mechanisms and pathways can be obtained.

Acknowledgements: National Science Foundation

Hydrophilic Antioxidant Activity in Parent and Hybrid strains of Sorrel (Hibiscus sabdariffa)

Anayah Ferris, Narome Belus, and Torhera Durand

Mentor(s): Bernard Castillo II, Ph.D.

University of the Virgin Islands

Antioxidants are substances that protect cells against damage from oxidizing molecules, known as free radicals. Antioxidant activity also appears to be important to disease prevention. Sorrel (*Hibiscus sabdariffa*) is grown in tropical regions, and known widely for its nutritional value and being a source of antioxidants. The University of the Virgin Islands (UVI) Biotechnology and Agroforestry Program grows and crosses sorrel lines in an attempt to study various functional properties, but there is no information on how the antioxidant activity of sorrel differs among parent and hybrid varieties. The objectives of this study were to determine and compare the Hydrophilic Antioxidant Activity (HAA) in parent and hybrid daughter strains of sorrel. We hypothesized that (1) the hybrid strains will have a higher HAA than the parent strains and (2) the hybrid strains will have a higher HAA in both the fresh and dried sorrel samples. Fresh and oven-dried samples of three different sorrel varieties were used in this study: TTB (parent), KDN (parent), [(KDN x TTB) x TTB)] F5 (hybrid). All strains were grown at the UVI, Albert Sheen Campus. Hydrophilic antioxidants from these samples were extracted in an aqueous ph = 7 phosphate buffer solution. The ABTS/H_2O_2/HRP decoloration method was used to measure the antioxidant activity. The samples were monitored at 730 nm in a UV-VIS Spectrophotometer over a course of 5 minutes. HAA was expressed as µmol of Trolox equivalent per grams of dry weight (µmol TE/ g DW). It was observed that the dried samples of all sorrel varieties had significantly higher antioxidant activity than the fresh samples. Furthermore, the HAA for the fresh [(KDN x TTB) x TTB)] F5 was in between that of the fresh parent samples. TTB had the highest HAA for the fresh samples (1487.12 µmol TE/ g DW) and KDN had the lowest (355.09 µmol TE/ g DW). [(KDN x TTB) x TTB)] F5 had the highest HAA for the dry samples (32162.67 µmol TE/ g DW) and KDN had the lowest (999.28 µmol TE/ g DW).

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Clustering Malware: Towards Extracting Features Using Hashes

Rhonda Forbes and Jhara Irish

Mentor(s): Marc Boumedine

University of the Virgin Islands

Malicious Software better known as malware produce ongoing dangerous security and privacy problems for users and industries. Antivirus and antimalware programs are inefficient for identifying the most recent attacks. Due to the large volume of malware created, it is important to create malware analysis tools in order to defend against these threats. The data mining technique known as clustering is one of the tools that is used to study malware. In order to perform our experiment, we needed a safe environment, so we installed a virtual environment called VMware, two programs called QuickHash and GTKHash, and a lot malware samples. In addition, we used WEKA package to perform the data mining analysis. Malware samples data after extracted the MD5, SHA1, and SHA256 hashes in the VMware Kali Linux virtual machine using QuickHash and GTKHash. This was completed by identifying the type of malware and by generating the hashes using a website called VirusTotal. Since the simpleKmeans algorithm requires to define numerical features in order to determine the distance between malware, the next step will be to extract numerical features from malware hashes so clustering algorithm could group the malware in meaningful category.

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Comparing Data from Telescopic X-Ray Instruments: Can We Trust All Satellites?

Alexander Fortenberry and Quianah T. Joyce

Mentor(s): Dr. Bruce Gendre

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In astronomy and astrophysics, x-ray emissions from cosmic entities aid in revealing what type of sources they emanate from. Swift, NASA's latest x-ray satellite, has not been operating at its intended configurations. The satellite is experiencing difficulties maintaining a stable temperature in its charge capture device. This research intends to determine if this complication causes discrepancies in Swift's collected data by using gamma-ray burst data. Gamma-ray bursts are excellent comparison candidates due to their brightness and fluctuations. We compared archived data of GRB 130427A and GRB 090423A from Swift and the European Space Agency's XMM-Newton observatory. Next, we reduced the data and produced the respective spectra. We then analyzed and compared the spectra to one another to find any discrepancies. We have determined, based on data analysis of the spectra, that Swift is working properly despite the cooling malfunction.

Acknowledgements: HBCU-UP 1137472 and NASA-MIRO

Comparison of Fluorescence Spectra of Toxic and Non-toxic Fish

Jamisha Francis

Mentor(s): Paul Jobsis Ph. D.

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Ciguatera fish poisoning (CFP) is the most common marine non-bacterial food poisoning in the world. CFP is the most common food poison in the Virgin Islands, with about 3 of every 1,000 people poisoned. CFP in the Virgin Islands is caused by the consumption of local reef fish that have consumed other fishes with the toxin present. Small fish consume the micro algae dinoflagellate Gambeirdiscus toxicus species that is the known to produce the ciguatoxin (CTX) in its cells. CTX is known to bio-accumulate, the concentration increases as it continues up the food chain; top predator fishes have the highest concentrations. However, sharks are the exception, apparently sharks have enzymes that can break down the CTX. Prior studies showed that CTX is composed of a long chain of cyclic molecules. Cyclic molecules usually fluoresce; this led us to attempt to measure the fluorescence spectrometer of fish to look at differences between toxic and non-toxic fish spectra. Fish samples were mashed with water at a 2:1 ratio with a mortar and pestle. 3 mL of in situ fish samples were placed in Cary fluorescence spectrometer for analysis. Emission spectra were scanned using a 5 nm slit width from 400 to 620 wavelength range. Files were saved using comma separated values (CSV) and exported to excel to analyze and compare data. We found there is a possibility that fluorescence spectrometers could be used to identify CTX poison. This was not a definitive study. Future work has to be done. Collaboration with other ciguatera researchers and additional fish samples could be used to further study if our findings correlate with the lab test.

Acknowledgements: VI-EPSCoR

Parrot fish Herbivory Towards Invasive Sea Grass Halophila stipulacea

Cequoyah A. George

Mentor(s): Dr. Theresa Turner

University of the Virgin Islands

Invasive species can many times become a threat to its new environment and with *Halophila stipulacea* being a new invasive species to the Caribbean Sea, the possibility of its threats to the native marine life and ways to control its rapid growth are in question. Being that *Scarus iserti* parrot fish are common herbivores in the Caribbean, I tested the hypothesis that this species could be used as a biocontrol for this invasive sea grass. In a multi-choice feeding experiment juvenile parrotfish were collected then separated into ten individual containers where they were exposed to two previously weighed amounts of the native sea grasses, *Syringodium filiforme* and *Thalassia testudinum,* and a previously weighed amount of the invasive sea grass, *Halophilia stipulacea* for a 24 h time period in order to determine the parrotfish food preferences. This experiment resulted in the native sea grass, *Syringodium filiforme* being the preferred by the parrotfish in comparison to *Halophilia stipulacea* and *Thalassia testudinum.* In a no-choice experiment the fish were fed either the invasive sea grass or the most preferred native sea grass from the first experiment (*Syringodium filiforme*). Results from this experiment showed significantly that the native sea grass, *Syringodium filiforme* was eaten at a higher rate although the fish that were exposed to the invasive sea grass, *Halophilia stipulacea,* did eat a some of it. Thus, the parrotfish, *Scarus iserti,* could control *Halophilia stipulacea* only without the presence of the *Syringodium filiforme.* In future studies habitat preferences for this fish should also be studied in addition to the difference in feeding preferences for that of juvenile fish in comparison to full grown adults.

Acknowledgements: Emerging Caribbean Scientists and HBCU-UP grant 1137472

Estimating the Risk of Alcohol Onset Soon After Cannabis Onset: A Triggering Process?

Villisha Gregoire, Karl Alcover, and Hui Cheng

Mentor(s): James C. Anthony

Michigan State University

In the world and in the United States, alcohol is one of the most commonly used legal drugs and cannabis is the most commonly used internationally regulated drug (NIAAA, 2016; NIDA, 2015). Recently, in the United States (US), epidemiological estimates for prevalence of use of most internationally regulated drugs have stabilized, but this has not been the case for prevalence of cannabis use, which is increasing somewhat (NIDA, 2015). Both alcohol and cannabis are psychoactive drugs. As such when they are taken prematurely primarily during early teens (12-17 year olds), there are concerns about toxic effects on the developing central nervous system and associated impairments in cognitive functions. At present, early teen cannabis use raises the possibility that cannabis use now starts first, and then triggers onset of drinking alcoholic beverages. In this study we aim to determine whether cannabis onset changes alcohol use using the epidemiologic case-crossover design in which cases serve as their own controls. Estimates are from newly incident alcohol and cannabis users (combined n= 51,122), whose month and year of first use are known from the US National Surveys on Drug Use and Health (NSDUH), 2002-2014. NSDUH annually assesses non-institutionalized US residents aged 12 years and older. For the case-crossover analysis, we used the month prior to the month of alcohol onset as the 'hazard' interval, while two months prior to the month of alcohol onset served as the 'control' interval. The association is measured by the epidemiologic "case-crossover" (CCO) method, obtained using the McNemar's test of matched data. Relative risk (RR) estimates were statistically robust for individuals 12 years and older as well as for both 12-17 year olds and 18-21 year olds. RR 95% CI for each age group does not entrap the null value (RR=1.0). We found evidence that cannabis onset now may be a trigger for onset of drinking alcohol.

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Seasonal Variation in Zooplankton Community Structure

Travis Hamlin and Josh Howsmon

Mentor(s): Sennai Habtes

University of the Virgin Islands

Zooplankton community structure is highly susceptible to seasonal change of oceanographic variables (Keister and Peterson, 2003; Beaugrand et al., 2002). The changes of oceanographic variables can cause an restructuring of the zooplankton in an area (Keister and Peterson, 2003). Seasonal trends of zooplankton communities in the Virgin Islands are not well known. As part of the Virgin Islands Experimental Program to Stimulate Competitive Research (VI EPSCoR) Mare Nostrum Ecosystem Analysis Project, we will be examining the seasonal shifts in zooplankton community structure across a gradient from nearshore to coastal pelagic waters within Brewers Bay. In order to examine this, we will be conducting monthly and quarterly zooplankton tows across four predetermined transects. During quarterly tows we will be using nets of various mesh sizes to catch zooplankton of differing sizes. CTD (Conductivity, Temperature, Depth) casts are being used to profile water columns at thirty-three predetermined sites in order to gather environmental data that may affect the zooplankton species assemblages. This data collection has been ongoing since august 2015 this provides us with approximately one year of samples to process and explore seasonal variation of zooplankton community structure within Brewer's bay. The oceanographic conditions present in Brewers Bay will be used to determine if there is any correlation between environmental factors with the community structure of zooplankton at each habitat. A primary goal of my research as part of this project is to develop a database of digital images of zooplankton and identify them to the lowest possible taxonomic. This will aid in the identification of zooplankton in the waters surrounding the Virgin Islands, and allow a digital record for future analysis. This research project is ongoing and data collection will continue until one year of Mare Nostrum water quality sampling is completed.

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Relation between Marijuana Use and ADHD Symptoms among High School Sophomores

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Mentor(s): Dr. Stewart Ehly

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During the period of adolescence, individuals are in the process of developing an identity for themselves, which involves taking risks and exploring the world for new perspectives. Substance use among adolescents stems from peer pressure, the need for an outlet from stressors related to family, school, or personal problems, and yearning to experience new things. Commonly, marijuana is the most prevalent illicit drug used in America according to the National Institute on Drug Abuse. In addition, attention deficit hyperactivity disorder (ADHD) affects approximately nine percent of children between the ages of 13 to 19 according to National Institute on Mental Health. Characteristics of ADHD involve a consistent pattern of hyperactivity, impulsivity, and inattention that affects an individual's ability to function in at least two settings (e.g., home & school). This study aims to explore the relationship between ADHD hyperactivity and inattention symptoms with the amount of marijuana use among high school sophomores. A sample (N=29) of high school sophomore students ages 15 to 17 years from rural and urban Iowa high schools were selected to participate in this study. We hypothesize that there is a statistical significant relationship between marijuana use and ADHD inattention symptoms among high school sophomores. Students were tasked with the completion of a semi-structured interview conducted within their households or private space. Results indicated that marijuana use and ADHD inattention symptoms were not related in a statistically significant manner. However, as students increase their marijuana usage, the more likely they were to display symptoms of ADHD hyperactivity. Therefore, the relation between ADHD hyperactivity symptoms and marijuana use was statistically significant.

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Exploratory Study of Gene Regulation by Rbf1 in Drosophila with Focus on the Apoptotic Pathway

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Mentor(s): Rima Mouawad and Dr David Arnosti

Michigan State University

Retinoblastoma (Rb) is a tumor suppressor that plays an important role in major cellular processes such as cell cycle, differentiation and apoptosis. Rb regulates cell cycle progression by binding to E2F/DP and inhibits their activity; even so its deregulation of an Rb/E2F pathway is present in many human cancers. Many studies have focused on RB role in cell cycle control, but less is known about its function in other processes such as apoptosis. Previous work in the Arnosti's lab has documented the phenotypic effects of different overexpressed Rbf1 (fly RB homolog) isoforms in the wing imaginal discs. Overexpression of Rbf1-WT proteins resulted in notches on the wing and an increase in apoptotic activity. Expression of a mutant form, lacking the "instability element" resulted in larger adult wings and anti-apoptotic activity. By contrast, expression of a mutant form of Rbf1 containing a point mutation within the instability element for the Rbf1-K77A resulted in a very reduced wing and high level of apoptosis activity. We hypothesize that mRNA transcriptional levels, specifically for apoptotic genes would be defective. Using the Drosophila system and the transcriptional gene expression data obtained through RNA-seq, our aim is to conduct bioinformatics analysis to identify direct Rbf1 target genes that are involved in apoptosis. The basic procedural steps included visualization, sub cluster analysis, gene ontology and gene ontology interpretation. We found apoptotic genes that displayed either pro-apoptotic behavior or anti-apoptotic behavior. The mechanism behind is unknown. We analyzed the mRNA level for the following seven-apoptotic genes, which all displayed defective expression in the microarray analysis. As far as this exploratory study is concerned, future work is recommended. We will be conducting both biological and computational analysis of promoters of differentially regulated genes, comprehensive analysis of all the molecular pathways, alternative/ supplementary results with fold change data, and analysis of indirect Rbf1 genes.

Acknowledgements: NIH

The Effects of the Invasive Seagrass Halophila stipulacea on The West Indian Sea Egg (Tripneustes ventricosus)

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Mentor(s): Teresa Turner

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The West Indian Sea Egg (Tripneustes ventricosus) is one of the most prominent grazers on Caribbean seagrass beds. On some Caribbean islands such Martinique and St. Lucia, there is a commercial fishery for it. Because Caribbean seagrass beds are being invaded by the Indian Ocean seagrass Halophila stipulacea, T. ventricosus is a prime candidate to control it. This study conducted on St. Thomas United States Virgin Islands, aimed to determine whether Tripneustes can act as a biological control for Halophila as well as what effects this seagrass might have on the urchin. To test this hypothesis a multi-choice feeding experiment was conducted to determine preference among the seagrass species found on the island. The experiment showed that T. ventricosus preferred Thalassia testudinum over the other seagrasses but did not eat significantly more of the other native seagrass Syringodium filiforme. A no choice experiment was also conducted to determine feeding rate. The urchins ate more T. testudinum than the invasive seagrass even with no choice. To further determine if the West Indian Sea egg would be a suitable biocontrol for H. stipulacea, urchins were fed either Halophila or Thalassia for four weeks.

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A Novel Solution for Powering Our Planet Comparative study of a Novel Titania Sol and a Titania Powder for the Improved Efficiency of Dye-sensitized Solar Cells

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Mentor(s): Lisa C. Klein, Ph.D.

Rutgers, The State University of New Jersey, Materials Science and Engineering

Over the next 50 years, the world's energy needs are set to double and it is estimated that photovoltaics or solar cells can provide over 90 % of the world's electricity. Photovoltaics based on dye-sensitization of titania (TiO2) electrodes are a renewable, low-cost alternative to conventional solid-state photovoltaic devices. TiO2 is an ideal semiconductor for photocatalysis in dye-sensitized solar cells (DSSCs). It lends itself to being an important catalyst due to its nanoparticle size, high photocatalytic activity, low cost and its safe use in the environment. The application method and properties of the photocatalyst considerably contribute to its efficiency. Currently, titania dye-sensitized solar cells have a reported efficiency of 10 % and an increased efficiency would have a profound impact on the contribution of renewable technologies in electricity production. A comparison study of a new titanium dioxide sol (i.e., colloidal solution) and a titanium dioxide powder was performed to determine the difference in efficiency of titania DSSCs. We aimed to determine whether the sol, with its easier handling properties, is an efficient alternative semiconductor in dye-sensitized solar cells compared to the titanium dioxide powder. The dye sensitized TiO2 solar cells were examined using scanning electron microscopy (SEM). Additionally, titania dye-sensitized cells were assembled on fluorine-doped tin oxide (FTO) coated glass, Copper/Gold stained FTO coated glass and the open circuit voltage was measured in various lighting conditions. The open circuit voltage measurements indicate that the output of the DSSCs made from the titania sol is higher than that of the DSSCs made with the powder over time; additionally, the Copper/Gold FTO substrates have an influence on the performance of both the sol and the powder. The sol on a FTO substrate and with the addition of this Copper/Gold coated FTO substrate could potentially contribute to TiO2 DSSCs efficiency.

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Evaluation of Hot Iron Branding on Cortisol Concentration and Behavior in Senepol Cattle

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Mentor(s): Dr. Robert W. Godfrey

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The objective of the study was to evaluate the impact of hot iron branding on cortisol concentrations and behavior of Senepol heifers and bulls (n = 15/sex; ~14 mo of age). During week 1 calves were evaluated for pen temperament using a subjective scoring system (1 = calm up to 5 = aggressive). Pen scores were evaluated in same sex groups of 5 calves at a time. Calves were then put in the chute, without catching their heads, with no squeeze applied. The chute score (1 = calm up to 5 = extremely agitated) was determined and after applying squeeze an initial blood sample was collected from the tail vein. Calves were kept in the chute for ~1 min to mimic the time it takes to brand and then a second blood sample was collected. The calf was released from the chute and Exit Velocity was measured using a pair of electric eyes and timer. A second pen temperament score was collected on all calves after they had all been through the chute. During week 2 the process was repeated with the addition of the branding using a hot iron between the two blood sample collections.

During week 2 the data was collected just as it had been during week 1. Plasma was harvested from blood samples and stored at -20 °C until being assayed for cortisol and cortisol binding globulin. Preliminary analysis of the behavior data shows that Senepol cattle have calm temperaments and slow exit velocities, regardless of time relative to the stress of branding. This is in agreement with previous data collected in our lab where Senepol cattle had low chute scores and slow exit velocities. The analyses of the plasma samples for cortisol concentrations.

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Spatial patterns in parasite prevalence and load on a coral host suggests parasitism is driven by anthropogenic stress in Mo'orea, French Polynesia

Richard Laplace, Ashlyn Ford, J David Muñoz, Caitlin Fong, and Sennai Habtes

Mentor(s): Dr. Paul Barber and Dr. Peggy Fong

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Parasites are important but understudied, particularly in marine systems, and their relationship to anthropogenic stress remains relatively unknown. In July 2016, we observed high prevalence and dense aggregations of a parasitic trematode on the host coral, Porites spp. in Mo'orea, French Polynesia. This parasite infects individual coral polyps and is characterized by a raised, pink polyp; to complete its lifecycle, the coral polyp is consumed by butterflyfish. Based on preliminary observations, we hypothesized that, if anthropogenic stress was positively related to parasitism, parasite prevalence (proportion of hosts infected) and load (measured here as density per area of coral) would be highest within the more developed bays. We conducted surveys of parasite prevalence completing over 200 transects within the two bays and along the north shore and back reef. We found prevalence was highest in the bays and lowest in the back reef. We quantified parasite load (# of infected polyps per 100 cm² of coral) with visual observations and photographs on randomly-selected colonies at low, medium, and high prevalence sites. In the low and medium sites, the majority of colonies (80-95%) had no parasites; maximum loads were 1800/100 cm2 in the low prevalence site and 4533/100 cm2 in the medium prevalence site. In contrast, almost all colonies in the high prevalence site had values over an order of magnitude higher. This study provides a baseline for future investigations into the relationship between anthropogenic stress and parasite prevalence and load that will help increase our understanding of these understudied associations

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Extracting DNA from Halophila stipulacea Plants Around the Virgin Islands

Shantae Lewis and Erlin Ravariere

Mentor(s): Dr. Alice Stanford

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Invasive species pose a threat to ecosystems by outcompeting native species for resources. One of such invasive species is the seagrass Halophila stipulacea. This seagrass has invaded the waters of the Virgin Islands, and if not stopped, could cause detriment to the native species. One example of the problems it can cause is the extinction of the native species. The goal of this research is to find the genetic variability of the sea grass and to use that information to create an invasion history map. To do this, leaf samples of the seagrass, H. stipulacea, were collected from eight different sites around the Virgin Islands. The collected samples were cleaned of debris and epiphytes and stored in silica gel for drying. Over the summer, DNA was extracted from the plants from each site. When one leaf was used, varying DNA yields were collected from those extractions. Results were inconclusive with minimal trends being seen. After further testing it was found that the DNA quantity for our extractions were too low and as a result all samples had to be re-extracted. The new extractions are completed using plants that have about 15 to 25 leaves or that weigh at least .1 gram when dried. Ten of the twenty samples that were re-extracted were made into libraries in order to sequence there DNA. At the moment the larger samples are being re-extracted, protocols are being revised, and new buffers are being made in order to receive more visible DNA. As a result, we have not tested our hypothesis as yet which states that, the genetic variability of the seagrass, Halophila stipulacea, will be lower than that of its place of origin.

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A Bioinformatics Approach to Classify Viruses Using a Classification Decision Tree Model

Samuel Liburd Jr.

Mentor(s): Dr. Marc Boumedine

University of the Virgin Islands

Viruses serve as one of the most efficient vectors for death and disease, killing millions worldwide. Because of this, my research has been targeted at the ability to automatically classify viruses based mainly on their genetic characteristics. To do so, I downloaded and analysed 511 (+) ssRNA virus genomes for unique genetic characteristics that identify them. The seven virus families used were Flaviviridae, Potyviridae, Betaflexaviridae, Virgaviridae, Cornaviridae, Picornaviridae, and Tombusviridae. Among these virus families, 12 different features were manually chosen to classify the viruses; genome length, adenine, guanine, cytosine, and thymine count, the number of start codons, G-C and A-T percentages, host organisms, the number of protein coded for, and the number, if any, of segmentations in the genome. These attributes were tested by the Correlation-based Feature Subset Eval and Best First algorithms in WEKA's (a data mining package) Attribute Selector. The chosen attributes, genome length, A, C, and G counts, G-C percentage, host organism, and number of proteins formed were then run through the J48 classification algorithm. This algorithm used 66% of the genomic datasets to create a decision tree model. After creating the model, the program then classified the remaining datasets based on the created decision tree. Using this decision tree, 99.4% of the remaining viruses were accurately classified. This classifier works to expedite the virus classification process with a new, mainly genetic, analysis method.

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Determining the Transmission Route of the Dusky Damselfish Apicomplexan Parasite

Shakilah Liburd

Mentor(s): Dr. Jennilee Robinson

University of the Virgin Islands

The Apicomplexa is a phylum of eukaryotic parasites that infect species ranging from fish to mammals. Examples include the causative agents of human diseases toxoplasmosis and malaria. Intracellular Apicomplexa have been observed in blood cells of Caribbean fish, including Stegastes adustus, dusky damselfish. Our goal is to determine how dusky damselfish are infected, whether through the fecal to oral route or by blood-feeding creatures such as gnathiids. We hypothesize that fish are infected through the fecal to oral route. We collected 10 dusky damselfish from Brewer's Bay, St. Thomas. Fish were held overnight in individual buckets. The bucket water was filtered to collect fecal matter. Fish were anesthetized to draw a blood sample, and then returned to the reef. Giemsa-stained fish blood was examined and five of the ten fish were infected. Percoll density gradients were used to fractionate the fecal matter and fractions from infected and uninfected fish were compared by microscopy. We have observed objects that resemble apicomplexan oocysts in fecal fractions of infected fish, suggesting that the parasite is transmitted by the fecal to oral route. We also sought to isolate infected blood cells for further study. Percoll density gradients were used to fractionate the fish blood, hopefully separating infected from uninfected cells. Each blood fraction was examined by microscopy and DAPI staining was used to visualize host and parasite nucleic acid in infected blood cells. Future studies will include transmission experiments exposing uninfected juvenile fish to infected adults with or without the presence of hematophagous gnathiids.

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Modeling the Spread of Coral Disease by a Graph-Theoretic Approach

Star Matthew

Mentor(s): Dr. Robert Stolz

University of the Virgin Islands

Coral reefs provide habitats to many marine organisms, protect coastlines from negative effects of cyclones and storms, and overall are significantly important for many reasons. They are often destroyed by various effects that include coral disease. The objective of this project is to model how the rapid tissue loss disease (White Plague Disease) might spread throughout a community of coral reefs in the Virgin Islands through the methods of dispersion and ocean currents. The approach we took in addressing this problem was using a partial differential equation: the advection diffusion equation: $N_t=-uNx-vN_y+D(N_{xx}+N_{yy})+\mu N$, where N is the concentration of a substance, t is the time, D is the diffusion, μ is the growth or decay coefficient and x and y are spatial coordinates. This study will develop the model and apply it to the waters surrounding the Virgin Islands.

We started out by splitting the equation into two separate parts: advection, the first part of the equation and diffusion, the second part. Taking this approach allowed us to solve the two conditions separately, using several difference methods. The first of the finite difference methods used was the Forward Difference Method. The forward difference is an expression which calculates a new amount by taking the old amount and adding the change in time. We started by solving the two equations using this method. Information was gathered and coded in a program, Matlab. This program resulted in a moving image that displayed the concentration of the particles. However, we were unable to significantly increase the resolution because the model was numerically unstable. This resulted in moving onto using the Crank-Nicolson Method, which is a combination of the forward difference and backward difference approximations and is unconditionally stable. The same steps used in the previous example were repeated and we got a program running for this method as well, which resulted in our desired image. The working model was then applied to the local Virgin Islands waters.

This program eventually resulted in a connectivity graph that shows the connections of each of the coral sites in relation to each other. We suppose a site is connected to another based on if any of the particles in the initial concentration dropped at one site happen to pass or roll over any of the other sites. The graph stemmed from an adjacency matrix that give values of the strength and direction of the connectivity between the 13 coral monitoring sites. We developed connectivity graphs for 15 and 30 day periods.

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Wireless Security: Simulation of Network Jamming

Leroy Matthias Jr. and Kelvin Dover Jr.

Mentor(s): Marc Boumedine and Michel Kinsy

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Jamming attacks block normal communication by generated interference in networks. Jamming is classified as a subset of denial of service (DoS) attacks. In order to study and understand this problem, we survey jamming techniques used fin wireless networks. Jamming devices are simple to make but illegal for civilian use. Only authorized government agencies can deploy them. Since the aim of the research project is to investigate how they work and how we can combat against them, we will design our experiments using the OMNET++ simulator. OMNET++ offers a set of C++ libraries that allow programmers to deploy a wide range of communication devices as well as their functionality.

Jammers operate by sending large packets of information in a way that floods the communicating devices and make them inoperable. To simulate a jamming process, we design three experiments and implement the first two under this research activity. The first experiment shows how two devices communicate without interference. The second experiment demonstrates how the jammer blocks packets. The last experiment combines the first two experiments to illustrate the inability of two devices to effectively communicate once the jammer is activated. Based on these experiments, we are able to characterize out how real jammers work, the components that carry out different tasks, and how to defend against a jammer.

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Leaf Variation in the Invasive Species Halophila stipulacea

Calwyn Morton

Mentor(s): Dr. Avram Primack and Dr. Sandy Wyllie Echeverria

University of the Virgin Islands and VI-EPSCOR

This research seeks to determine if there is morphological variation in leaf length, width and area of *Halophila stipulacea* in the US Virgin Islands. *Halophila stipulacea* is an invasive seagrass species originally native to the Indian Ocean. It invaded the Mediterranean Sea shortly after the opening of the Suez Canal, and has recently been found in the Caribbean. Variation in seagrass leaf metrics can be a signal of genetic variability, the influence of the submarine environment, the increase or decrease in nutrient availability, the amount of organic content in the sediment and generally as a predictor of the effect of human caused disturbance in coastal habitats (May-Ku 2010). Samples of *H. stipulacea* leaves were collected from eight sites in the US Virgin Islands.These samples were scanned and leaf metrics were analyzed using the image processing program: ImageJ for their length, width and area. These data were then compared to that of other sites where *H.stipulacea* was found and will be used to compliment data from genetic, sediment and water column environmental analyses and be used to construct an invasion model of *H.stipulacea* in the US Virgin Islands.

Acknowledgements: VI-Epscor

How are rural residency related to alcohol involvement among adolescents?

Shanaliz Natta

Mentor(s): Dr. Wendy Slutske

University of Missouri

In this study we examined two ways that rural residency may be related to alcohol involvement among adolescents: (1) whether rural residency is associated with alcohol involvement, and (2) whether genetic influences on alcohol involvement are moderated by rural versus urban residency. Participants were monozygotic (MZ=509) and dizygotic (DZ=330) 17-year old same-sex twin pairs from the 1962 National Merit Twin Study who completed questionnaires that included 10 items about alcohol involvement. These items were combined into an alcohol composite variable (Cronbach's α=0.79). Participants were categorized based on whether they lived in a rural (33%) or urban area. Men had significantly higher scores on the alcohol composite than did women ($d=0.24$, $p<.001$) and individuals living in rural areas had significantly lower scores on the alcohol composite than those living in urban neighborhoods ($d=-.27$, $p<.001$). Overall, the MZ twin correlations were larger than the DZ correlations among both males and females suggesting that there is a genetic influence on alcohol use. We used structural equation modeling to estimate the influence of heritability (A), shared environment (C), or unique environment (E) on alcohol involvement. The overall estimates for men were A=0.33, C=0.38, E=0.29 and for women were A=0.32, C=0.40, E=0.28. However, these estimates were moderated by rural versus urban residency. Among males there was a greater genetic influence on alcohol consumption in rural than urban settings. Conversely, among females, there was less of a genetic influence on alcohol consumption in rural versus urban settings. The results for females are consistent with previous studies conducted in Finland and Minnesota that also found higher heritabilites for alcohol involvement in urban than in rural settings. Possible explanations for the different findings in men and women will be discussed.

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Bioavailability of Methylmercury in Rice Cereal and Fish

Genique Nicholas and Wenbin Cui

Mentor(s): Dr. Yong Cai

Florida International University and University of the Virgin Islands

Methylmercury (MeHg) is known as a contaminant worldwide and a potent neurotoxin that is harmful to the neurodevelopment in infants. MeHg is formed from inorganic mercury by the action of microbes that live in aquatic systems and then bioaccumulated through the food chain. Traditionally, consumption of fish or fish based food was considered as the major pathway of MeHg exposure to human. A lot of effort has been made to study the concentration, bioaccessibility, and bioavailability of MeHg in fish. However, the recent finding that rice could also accumulate MeHg in its grain prompted our interest in studying the MeHg level and bioavailability in rice and rice product due to the high consumption of rice product around the world, especially for human infants. Infants do not directly consume fish or rice, however, could still be exposed to MeHg due to the consumption of breast milk and rice or fish based baby food such as rice cereal. There is a very limited information available regarding MeHg in rice cereal and the potential exposure of infants to MeHg. Therefore, the main objectives for this research are to: 1) determine the amount of MeHg in rice cereals, 2) estimate the bioaccesibility of MeHg in rice cereals, and 3) compare the bioaccesibility of MeHg in rice cereal and fish. To achieve these goals, experiments have been designed and conducted. Twelve commercially available rice samples were purchased from a market and tested. Preliminary experiments have shown that rice cereals do contain considerable level of MeHg. To evaluate the bioaccesibility of MeHg in rice cereals, in vitro gastrointestinal digestion procedure was used to simulate the digestion process followed by acidic KBr extraction and analysis using cold-vapor atomic florescence spectrometry. The MeHg concentrations were recorded in ng/g. The results showed that the MeHg concentrations were lower than that of recorded concentrations for fish (ranging from 14.3±13.9 ng/g to 527.4±84.1 ng/g in sea food samples). The results show that out of the samples we tested the average MeHg concentration was 5.6±4.19 ng/g, and the average bioaccessibility was approximately 50%. Considering the great amounts of rice cereal consumed by infants, the MeHg intake through rice cereal may post potential health risk to infants. MeHg bioavailability in the rice cereal samples and also fish samples will be conducted in order to compare the bioavailability between MeHg in rice and in fish.

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Behavioral Patterns of the Index of Non-Repetitive Sequences

Chanae Ottley

Mentor(s): Dr. Chris Plyley

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The study of sequences of (not necessarily distinct) group elements which sum to zero has numerous applications in game theory, cryptography, Ramsey theory and graph theory. For example, the determination of Davenport's Constant (the smallest integer k such that any sequence of k-elements has a subsequence with sum 0) is considered one of the most important unsolved problems in finite group theory. If a sequence contains no repetition, then Olson's Constant (denoted Ol(G)) is the analog of the Davenport Constant, and is defined as the minimal integer k such that every sequence of distinct elements of length k in G has a zero-sum subsequence. Even for Zn (the integers under addition modulo n), the precise values of the Ol(Zn) are only known for $n<65$.

Kleitman and Lemke formulated the concept of index in 1988 while resolving a conjecture of Paul Erdos. If S is a zero-sum sequence in Zn, then the index of S is the minimal integer multiple of n that S may be made to sum to after multiplication by an integer relatively prime to n. In 2011, the question was posed to determine the minimal integer k such that every sequence of length k has a zero-sum subsequence with index 1. In this project, we determine this value (denoted by T(n)) for all $n<25$. To accomplish this, we check every sequence of a given length in Zn for zero-subsequences of index 1. We formulate several results to reduce the number of sequences that must be checked, and use a computer program to generate a list of remaining sequences, which are then checked by hand. To establish upper and lower bounds on the value of T(n), we categorize all sequences of length T(n)-1 which have index greater than 1. Our data suggests that the value of T(n) is likely closely linked to the value of Ol(Zn).

Acknowledgements: HBCU-UP grant 1137472 and SURE program

Wake-induced oscillations of a flexible cylinder in tandem orientation with a rigid cylinder

Jakobi Peets

Mentor(s): Yahya Modarres-Sadeghi and Banafsheh Seyed-Aghazadeh

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The research project performed in the Fluid-Structure Interactions lab focuses on conducting preliminary scale experiments that will eventually help improve the design and maintenance of mooring lines, such as those used to stabilize offshore wind turbines. The experiments are carried out in a re-circulating water tunnel at Fluid-Structure Interactions laboratory, with a test section of 1.27 m×0.5 m×0.38 m and maximum flow velocity of U=0.3 m/s. These experiments consist of a rigid cylinder, placed in the test-section of the water tunnel, held fixed at both ends. A flexible cylinder is also placed in the wake of the rigid cylinder. The flexible cylinder is marked with uniformly-distributed black dots along its length. The oscillations of these dots will be captured in the streamwise (inline) and transverse (crossflow) directions using two synchronised high speed cameras (a Phantom Miro 110 and a Panasonic Lumix DMC-FZ200). The captured videos will be the inputs to a tracking software (Tracker) which creates synchronised displacement time histories in the inline and crossflow directions at these discrete points. Previous research has been done on a flexibly mounted rigid cylinder, as well as flexible cylinder placed in flow, which result in large amplitude oscillations of the cylinder, referred to as vortex induced vibrations (VIV). The main focus of this research project is to analyze the behavior of the flexible cylinder when placed in the wake of a rigid cylinder. The effect of the distance between the rigid and the flexible cylinder on the dynamic response of the system will be investigated through these experiments. Depending on the distance between the two cylinders, the flexible cylinder, due to the wake of the rigid cylinder, might experience oscillation from a trail of disturbed water from the preceding rigid cylinder, called wake-induced oscillations. Understanding the physics of the wake-induced oscillations plays an important role in the design schematics, fatigue life, and maintenance of mooring lines.

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Identifying Parrotfish Spawning Habitat in the USVI

DeWein Pelle

Mentor(s): Sennai Habtes, PhD and Daniel Holstein, PhD

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The mesopelagic reef system surrounding the United States Virgin Islands (USVI) contains a series of banks which provide spawning aggregations for a vast array of species that are economically important, including snapper and grouper. To prevent overfishing, the U.S. Caribbean Fishery Management Council (CFMC) instituted seasonal fishery closures along the Grammanik Bank, located South of St. Thomas, USVI. Additionally, parrotfish in the Scaridae and Sparisoma genera inhabit similar aggregations neighboring the USVI and are larger herbivorous reef fish whose diet consist of algae from coral reefs. Unfortunately, there is insufficient information on the spawning sites inhabited by parrotfish in the USVI, in addition to supplementary data such as their behavioral and biological processes amongst these locations. In response, scientists from the National Oceanic and Atmospheric Administration (NOAA), Southeast Fisheries Science Center (SEFSC), Atmospheric and Oceanographic Laboratory (AOML), the University of the Virgin Islands (UVI), and the Virgin Islands Department of Planning and Natural Resources (VIDPNR) are utilizing the NOAA Research Vessel (R/V) Nancy Foster as part of a multi-year interdisciplinary study to investigate these processes and collect data on abundance and distributions of these species. More specifically, the researchers participating in the 2016 cruise collected larvae, early development stages of less than ten days old, of these species near coastal reefs through sampling with a variety of net systems along 100 stations in the Coastal Waters surrounding the USVI, British Virgin Islands, and Puerto Rico. The locations where larval parrotfish in the Scaridae and Sparisoma genera were found were evaluated using a Connectivity Modeling System (CMS), which observes motion for a single or group of particles using a stochastic Lagrangian framework. Additionally, this biophysical modeling system uses and array of modules to accurately delineate the pathway of any particle in respect to how it travels throughout currents or even complex topography. For this research, the CMS was modified to backtrace the movement of the collected larvae. Thereafter, it will be used to identify possible parrotfish spawning habitat in the waters surrounding the USVI.

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Dromia erythropus sponge decoration preference

Cheryl Petsche

Mentor(s): Dr. Edwin Cruz-Rivera

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Many behaviors in nature are based on avoiding predation. One way for an animal to avoid predation is to use camouflage. Dromia erythropus is a decorator crab that is known for mainly using a large piece of sponge for its decoration. To determine the mechanisms of sponge selection by the crab, decoration choice was analyzed in relation to field use, active choice, and differences in handling time of different sponges. Crabs collected in Brewers Bay, St. Thomas (USVI), were most frequently decorated with the sponges Amphimedon compressa and an unidentified purple demosponge, but were found to use at least eight species of sponge. A multiple choice experiment using the sponges Amphimedon compressa, Aplysina fulva, Tedania klausi, Ircinia strobilina and an unidentified demosponge determined that crabs preferred the sponge T. klausi. Video analysis of individually-filmed crabs supported crab preference for T. klausi with a mean total handling time of 2.63 hours (n=3), in contrast to handling times of 4.34-11.06 hours for four other sponges. Curiously, handling time on the unidentified demosponge was higher than that on other low preference sponges, despite its high frequency of use in the field. Data suggest that multiple cues, including biomechanical and chemical, likely determine decoration choice in this crab species. More analyses, including quantification of specific behavioral sequences from videos and experiments on the roles of sponge chemistry, will follow to fully understand decoration preferences.

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Development of a Low Cost Telescope System for VHE Astronomy

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Mentor(s): Jeremy Perkins

NASA Goddard Space Flight Center

Ground based gamma-ray astronomy has progressed dramatically over the past 40 years. Currently there are 176 confirmed sources detected above 100 GeV ranging from Supernova Remnants (SNR) to Active Galaxies and other phenomena. The next generation of Imaging Air Cherenkov Telescopes (IACT) is currently being developed. The CTA, or Cherenkov Telescope Array, will be a ground-breaking facility made up of a few dozen telescopes of multiple sizes with a sensitivity an order of magnitude greater than the current generation.
We are investigating an alternative approach and developing an inexpensive array of ground based telescopes using COTS (Commercial Off The Shelf) products. This array would not be as sensitive as CTA but would be able to study supernova remnants and other galactic sources above 2 TeV which might not be a priority for the large CTA community. Currently we are developing a single prototype telescope which will be installed at the Goddard Geophysical and Astronomical Observatory. One of the challenges of this approach is to use products whose primary purpose is not astronomy. For example, the positioner for the prototype does not have adequate pointing accuracy. Thus, developing inexpensive absolute encoders is necessary. We developed absolute encoders using COTS accelerometers and photo-interrupters, read out by an Arduino Uno. These absolute encoders will provide the pointing knowledge needed for standard operations.

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Impacts of Sponges on Coral Recruitment and Recovery

Tia Rabsatt

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Corals play a major and important role in coral reef ecosystems. Corals provide a habitat and food to other organisms on the reef. However, studies show that coral cover has declined drastically due to natural disasters and anthropogenic activities over the past few decades. In contrast, sponge cover has been increasing. It is hypothesized that the increase in sponge cover is inhibiting coral recruitment and the regrowth of corals. The purpose of this experiment was to investigate whether sponges are inhibiting the recruitment of corals through space occupancy or allelopathy. The experiment consisted of scoring recruits (coral larvae) that landed on recruit plates at six shallow waters reef sites and identifying coral, sponge and macro-algae cover in the surrounding area of the plates. Coral recruit density found on plates was found to be positively related to the percent coral cover found around the plate. This study can help identify the impacts of sponges on coral resilience.

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What effect do summer science camps have on their participants? An assessment of the 2016 Youth Ocean Explorers Program

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Mentor(s): Howard Forbes Jr.

University of the Virgin Islands

African-Americans are underrepresented in marine sciences and there is a great need for Caribbean people who will be scientific leaders in the future management of marine resources. Youth Ocean Explorers (YOE) is a 4 week-long summer program held from to July 11th to August 5th 2016 for students in grades 7 through 12, aimed to foster environmental stewardship ethics within the selected 24 students. YOE was created to offer experiential learning opportunities in marine science during the summer and at an age when students are most likely to lose interest in science. This study serves to evaluate students' baseline marine science knowledge and compare it to knowledge learned during the camp via the use of Pre and Post test evaluations. I hypothesized that students' Post test responses will significantly improve compared to their Pre test responses due to them being engaged in the newly configured YOE curriculum. On day 1, students completed a survey that gauged their knowledge of marine science, environmental awareness, attitudes towards marine science and their actual commitment towards the environment. Over the course of the program, the students received daily lectures on scientific concepts that incorporated elements of Next Generation Science Standards (NGSS) which were followed by several hands-on field activities that helped to reinforce those concepts. At the conclusion of the program, students were administered the Post test; results were pooled in Microsoft Excel and analyzed using a Chi-Square Analysis, significance was taken at $p < 0.05$. For questions assessing attitudes, only three questions showed a statistically significant change between the Pre test and Post test. For questions assessing factual knowledge of the ocean, five questions showed a statistically significant gain between the Pre test and the Post test. The results based on student attitudes suggest that some of the students had a moderate degree of environmental stewardship ethics prior to the program. Conversely, the results from the knowledge based questions suggest that the YOE curriculum provided students with enough experimental learning opportunities to enhance their retention of material. Replication of this study in future years will help to increase the sample size and further validate the YOE curriculum.

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Cardiovascular Fitness is Positively Correlated with Left Entorhinal Cortical Thickness in Healthy Young Adults

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Structures in the medial temporal lobe (MTL) memory system show experience-dependent neuroplasticity. Within the MTL, this plasticity has been observed in the hippocampus (HC) in both humans and animal models. Specifically, rodent model studies have shown a positive correlation between voluntary wheel running and adult neurogenesis in the dentate gyrus subregion of the HC. These models have not examined neuroplasticity in the entorhinal cortex (EC), even though the EC serves as a primary input to the HC formation. Both are brain areas that are well-known to be critical for memory formation and show early pathology in Alzheimer's disease. In order to test whether these rodent models could translate to humans, our lab previously used a voxel-based volumetric analysis to assess a relation between EC volume, cardiovascular fitness (VO_2 max), and recognition memory in a cohort of healthy young adults. This previous analysis showed right EC volume, but not HC volume, positively correlated with VO_2 max. Here, using a surface-based analysis in a new young human cohort, we hypothesized that VO2 max would positively correlate with EC thickness and with performance on tests of spatial cognition, and that these tests would positively correlate with structures that are known to recruit spatial cognition. We used Freesurfer, a surface-based morphometric analysis method, to measure cortical thickness and brain volumes in a young adult cohort (n = 25, 20 to 33 years). Using multiple regression we first examined whether VO_2 predicted EC thickness. Second, we correlated VO_2 max and cortical thickness and brain volume data with performance on cognitive tasks thought to recruit MTL structures. Age, gender, and intracranial volume were used as covariates. We determined VO2 max using a modified-Balke protocol treadmill test. Results: A multiple regression significantly predicted left EC thickness using VO_2 max ($F(4, 20) = 4.58$, $p < .01$, $r^2 = .37$), holding age, gender, and intracranial volume constant. Greater VO_2 max and age were independently associated with greater left EC thickness ($r = .495$, $p < .01$, $r = .388$, $p < .05$, respectively). No significant relationships were identified for measures of spatial cognition with EC thickness or VO_2 max. Conclusions: Consistent with our predictions and our previous work VO_2 max was positively correlated with left EC thickness. These data further support that cardiovascular fitness may be implicated in the plasticity of structures in the MTL, even in healthy young adults. Our cross-sectional data suggest aerobic exercise should affect plasticity of MTL structures in the healthy human brain, which is the current research focus in the Brain Plasticity and Neuroimaging Lab.

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Sponges Under Temperature Stress

Juliet Ruggiero

Mentor(s): Andia Chaves-Fonnegra

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One threat to coral reefs is the increase of ocean temperatures, which can produce coral bleaching and mortality. While corals are dying, marine sponges (Phylum Porifera) have become abundant and are currently an important habitat-forming animal on Caribbean coral reefs. However, it is unknown if temperature stress has a negative effect on common species of reef sponges. This study evaluates if higher water temperature affects survival, pigmentation and “tissue” regeneration of three species of common reef sponges. Sponges were collected from the reef and placed at two experimental average temperatures (control: 28.0°C and stress: 31.5°C) for a period of 10 days. Our results showed that percentage of mortality and pigmentation did not vary with temperature. However, at species level, Aplysina cauliformis tend to lose pigmentation faster under temperature stress, whereas Desmapsama anchorata gained pigmentation in both control and stress. Cliona delitrix pigmentation was the same over time. Tissue regeneration occurred in both control and stress temperatures for all three species. This preliminary experimental study showed that sponges tolerate stress temperature over ten days. Future studies should focus on temperature stress effect on sponges over longer periods of time.

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Synthesis, characterization, and electrochemical studies of cobalt(III)-containing species

Brianna Scotland, Michael J. Celestine, and Jayden Eppley

Mentor(s): Alvin A. Holder Ph.D.

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As the human population rises, so does the demand for energy. Currently, energy is being supplied through fossil fuel which is no longer sustainable. Subsequently, research has provided a solution through hydrogen production by the reduction of water molecules. The overall goal of this research is to successfully coordinate various ligands to $[Co(phen)_2(H_2O)_2](NO_3)_3$ by substituting the aqua ligands to form $[Co(phen)_2(N\text{-}N)](NO_3)_3$ (where N-N represents 2-2'-bipyridine (dpa), di(pyridine-2-yl)amine (dpa), 1,10-phenanthroline (phen), 2,2'-Dipyridylketone (dpk), 1,10-phenanthroline-5,6-dione (phendione), and 2-(2'-pyridyl)benzothiazole) (pbt)). The main hypothesis of this study is as follows: **The chemical environment around the cobalt(III) metal center of each complex should be different for every cobalt(III)-containing complex synthesized and should be reflected in the ^{59}Co NMR spectra.** In addition to this, all complexes synthesized in this study was characterized via ^{1}H and ^{59}Co NMR spectroscopies as well as through the uses of electrochemistry. Characterization of the various complex displayed coordination of the N-N ligands such as phendione, dpk, and pbt successfully coordinated to the Co(III) complex, which was converted from a NO_{3-} salt to a PF_{6-} salt. Element analysis of the $[Co(phen)_2(dpa)](PF_6)_3$ complex further confirmed the coordination of the dpa ligand to the Co(III) metal center with a small PF_6 salt impurity. From the electrochemical studies with $[Co(phen)_2(dpa)](PF_6)_3$, $E_{1/2}$ values were observed at +0.28, -1.08, and -1.75 V which corresponds to the $Co^{III/II,}$ $Co^{II/I,}$ and the $Co^{I/0}$ redox couples, respectively. Additionally, through spectroelectrochemistry the spectral changes that were observed as $[Co(phen)_2(dpa)](PF_6)_3$ was reduced to the Co (I) species, as well as $[Co(phen)_2(H_2O)_2](PF_6)_3$ and $[Co(phen)_3](PF_6)_3$ showed major absorbance changes circa 420 nm and into the near-infrared region. In conclusion, a different chemical environment was observed when phendione, dpk, and pbt ligands were coordinated to the Co(III)metal center.

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Identifying the role for *shp* in preventing cholestasis

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Mentor(s): Jannette Rodriguez-Otero

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Bile acids are amphipathic molecules that are components of bile that facilitate absorption, and the transport of biological molecules in mammals and vertebrates. Bile is synthesized in the liver and subsequently transported through the gastrointestinal system, before being excreted into the faeces. The delicate balance of bile acids is regulated by genes present in the liver and intestines. Alterations in these genes can cause disturbance in bile acid homeostasis and accumulation of bile acids in the liver leading to the development of cholestasis. Bile acid balance is kept in check by proteins called nuclear receptors. One particular nuclear receptor of interest is SHP (Small Heterodimer Partner), a transcriptional repressor expressed in the liver that lacks a DNA binding domain. SHP is known to inhibit the genes responsible for bile acid synthesis such as CYP7A1 and CYP8B1. Apart from synthesis, SHP can also modulate bile acid transport and excretion. Therefore, SHP seems to play a substantial role in maintaining bile acid homeostasis. In addition to the liver, SHP is expressed in multiple tissues including endocrine organs, metabolic organs, reproductive organs and cardio pulmonary organs. Global SHPKO (knock-out) animals have been characterized in depth but it is complex to extrapolate these findings to define a liver-specific role for SHP. Therefore, in this project we have utilized liver-specific SHPKO animals to perform our studies. By specifically deleting SHP in the hepatocyte, we were able to identify the crucial role of SHP in maintaining bile acid homeostasis in the liver cells. Wild type mice and SHPKO mice were fed either a normal chow diet or a 1% cholic acid to see how bile acid homeostasis was altered when excessive amounts of bile acids were present in the liver of SHPKO mice. The RNA from the livers of these mice were extracted to synthesize cDNA. The cDNA was then used to perform quantitative polymerase chain reactions (qPCR) in order to quantify the expression of bile acid synthesis, transport and excretion genes in the liver. In addition to multiple qPCRs, a colorimetric bile acid assay was performed in order to quantify the concentration of bile acids in the liver samples. The liver samples were also sectioned and stained for protein Ki-67 in order to evaluate the effect of SHP on proliferation of the liver cells. The goal of this project was to evaluate the role of SHP in regulating the accumulation of bile acids in the liver as well as SHP's ability to upregulate and downregulate the relative expression of bile acid synthesis, transport and excretion genes in the liver, and lastly evaluate SHP's effect on proliferation in the liver. We hypothesized that the liver specific knock-out of nuclear receptor SHP would result in the upregulation of bile acid synthesis genes and increase in the overall quantity of bile acid present in the liver.

Chemical and contact doping of graphene involving Chlorine (Cl) and Molybdenum disulfide (MoS2)

Cassia Smith, Shanece Esdaille, and Nakeshma Cassell

Mentor(s): Dr. Theanne Schiros and Dr. Wayne Archibald

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Though the advent of silicon semiconductors revolutionized computing and electronics, and silicon based electronic devices remain dominant today, the performance limits of silicon technology will be reached in the very near future. Two dimensional materials such as graphene – which is comprised of a single atomic layer of carbon – offer the most promising replacement for silicon based devices due to their flexibility, low power needs, high thermal conductivity, and other exceptional mechanical properties. The chemical doping of graphene by addition of foreign atoms (i.e Nitrogen, Boron) has been considerably explored through research since the work function, carrier concentration, and electronic structure of graphene can potentially be tuned at the atomic level through doping. However, chlorine doped graphene is still a relatively new frontier.

Our project entailed the analysis of data that was obtained from X-ray Photoelectron Spectroscopy (XPS). In particular, we focused on chlorine doped graphene and chlorine doped Molybdenum disulfide (MoS2) in the monolayer limit and in Van Der Waals heterostructures. Our analysis also explored the effects of contact doping as an interface to modify the work function of electrodes. The overarching goal of graphene based research is to provide a viable and highly efficient replacement for silicon in next generation electronic devices.

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Microclimate in the US Virgin Islands: Towards Real-Time Data Management Analytics

Kyrelle Thomas

Mentor(s): Dr. David Morris, Dr. Brice Orange, and Sandra Maina

Etelman Observatory, University of the Virgin Islands

Paramount in assessing the vulnerability of Small Island States to climate change threats are microclimate variability investigations and their near real-time monitoring. Particularly, that is, given these data products represent critical tools for improving our knowledge of the precursor signals to short and long-term climate modulations. Though the existing network of USVI remote sensing stations, deployed through successful previous WRRI projects, observables provide the ideal environment for work towards addressing these fundamental gaps in our understanding, they require a paradigm shift of current data handling and hardware management analytics. This study has developed and created the foundation documentation for implementing techniques required to maintain real-time accurate microclimate monitoring in the USVIs. During these tasks we have additionally performed and implemented 90% of the required systematic station calibrations to four of the islands' 14 stations, and identified preliminary protocols required for station longevity in data collection.

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Towards the Understanding of Extreme Crossover Interference in Model Species C. elegans, Sp. 29 and C. briggsae

Krislen Tison

Mentor(s): Mattew Rockman and Max Bernstein

New York University

Homologous recombination during meiosis I in eukaryotes is a fundamental process that allows for proper chromosome segregation and exchange of unique genetic material. It is a major mechanism by which diversity amongst organisms is driven. The formation of crossovers in most organisms is tightly regulated, whereby chromosomes experience few crossovers relative to the number of double-strand breaks created. However, in *Caenorhabditis elegans (C. elegans*) crossovers occur only once per chromosome pair. Such a low frequency points to what is called a nearly complete crossover interference meaning that interference extends across the entire length of the chromosome. This extreme occurrence has not been found in any other organism. The phenomenon of crossover interference is characterized as the development at which one crossover hinders the existence for other multiple proximal crossovers to occur. Our interest lies in examining whether the event is present in other nematodes within the *Caenorhabditis* genus. The objective of this study was to investigate the phenomenon of extreme crossover interference on Chromosome II for *Caenorhabditis*. *sp. 29 (sp. 29*) and *Caenorhabditis briggsae* (*C. briggsae)*, with the intention of comparing the findings to that of *C. elegans*. Here we test the hypothesis that C*. elegans, C. sp.29,* and *C. briggsae* will demonstrate similar patterns of extreme crossover interference, despite *C. sp. 29* being an outgroup. Experimentation for this study involved genetic crossings of worms from the same species and fertilization during the L4 stage, DNA extraction followed by polymerase chain reaction, and lastly identification of crossovers based on specific markers (genotyping). In total, 180 *C. briggsae* and 97 *C. elegans* strains were successfully genotyped where *C. briggsae* has 107 zero crossovers, 71 single crossovers and 2 double crossover while *C. elegans* has 47 zero crossovers 49 single crossovers, 1 double crossover. Data for sp. 29 were inconclusive as troubleshooting issues hindered the progression of data collection. A Fisher ‘s exact test was conducted to show how significantly different the number of non-recombinant and recombinant chromatids are compared to the 50-50 recombination expectation. The test showed that *C. briggsae* has a P-value of 0.0568 and *C. elegans* a P-value of 1.0000 which means both values are not significantly different in regards to 50-50 expectation. This result suggests that *C. briggsae* worms are experiencing similar crossover interference as *C. elegans*. Future direction of this study involves filling the gap for *sp.29* data as well as identifying the phenomenon of nearly complete crossover interference in other nematodes under the *C. elegans* super -group and the possible evolutionary aspects of the occurrence.

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Androgen Regulates tRNA Fragments (tRFs) in Prostate Epithelium

Elangeni Yabba

Mentor(s): Manjari Kiran Ph.D, Brian Reon, and Anindya Dutta MD/Ph.D

University of Virginia

Prostate cancer is very common cancer in men. Scientists are looking for effective biomarkers to determine the severity of prostate cancer. Previous work, done by the Dutta lab, reports that tRFs function similar to microRNAs in that they can regulate gene expression. tRFs are 14-32 bases, single-stranded RNA derived from mature or precursor tRNA, and are distinct from the stress-induced tRNA fragments created by cleavage in the anti-codon loop. tRFs have been shown to be important for cell-cycle progression and for regulating the dynamics of RISC. It is also known that androgens promote prostate cancer by regulating gene expression. We hypothesized that tRFs are regulated by androgens. If we find such androgen-regulated tRFs, we will propose that this is a novel way by which androgens regulate gene expression. In order to test our hypothesis, we first downloaded small RNA data for prostate cancer cell line from GEO, NCBI that contained sequences from androgen deprived and androgen enriched conditions. Using tools such as BLAST, bowtie, and fastx toolkit and in-house python scripts, we found tRFs and estimated their expression values by calculating reads per million-mapped reads (RPM). We found a total of twelve tRFs that seem to be regulated by androgen with expression values that ranged from 0.47 to 347.20 RPM. Two of the tRFs are induced by androgen and the others were repressed. The fold change of tRF expression ranged from two to four. Our results suggest that androgen may regulate the expression of tRFs, and, in the future, we plan to determine whether the androgen- regulated tRFs (a) regulate gene expression in cultured prostate cancer cell lines and (b) are altered in prostate cancers from different patients and whether these alterations lead to changes in expression of tRF-targeted genes in those cancer.

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