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Contents

Agriculture, Forestry, and Aquaculture

FORMATION OF CHAR-LIKE, FUSED-RING AROMATIC STRUCTURES FROM A NON-PYROGENIC PATHWAY DURING DECOMPOSITION OF WHEAT STRAW. Xi Chen[1], Wenying Chu[2], Jingdong Mao[2] & Hongjian Gao[1], [1]Dept. of Resour. & Environ., AHAU. [2]Dept. of Chem. & Biochem., ODU. Fused-ring aromatics, important skeletal components of black carbon (BC), contribute to long-term carbon (C) sequestration in nature. They have previously been thought to be primarily formed by incomplete combustion of organic materials, and some methods for quantifying pyrogenic C are based on the estimation of fused-ring aromatic C, assuming non-pyrogenic origins are negligible. Using advanced solid-state ^{13}C nuclear magnetic

resonance (NMR), we for the first time identify fused-ring aromatics that formed during the decomposition of wheat (*Triticum* sp.) straw in soil under aerobic, but not anaerobic conditions. The observed formation of polyaromatic units as plant litter decomposes provides direct evidence for humification. Moreover, common methods for estimating pyrogenic BC only by quantifying nonprotonated or fused-ring aromatic C could lead to an overestimation of the contribution of pyrogenic BC to soils. The annual flux of such non-pyrogenic BC could be equivalent to 3-12% of pyrogenic BC added to soils from all other sources. Author contact: x1chen@odu.edu.

THE IMPACT OF FISH HEALTH REGULATIONS ON THE AQUACULTURE INDUSTRY IN VIRGINIA. M. David Crosby, Cooperative Extension. Virginia State University. Many states in the Mid-Atlantic region have fish health regulations requiring fish producers to have fish health paperwork for specific pathogens to ship live fish. Some states, like Virginia, have no regulations and others have strict regulations concerning pathogens like viruses (IPN), parasites (Whirling Disease) and bacterial diseases (Furunculosis). Virginia fish farmers shipping live fish out of state should have fish health inspections. The burden of cost is on fish producers. Most of these regulations are aimed at preventing the introduction of specific pathogens, mostly associated with salmonids, into the state. Private testing can cost about $4000 per farm, and many trout farmers have several farms. To obtain the paperwork needed for shipping fish, a trout producer with four farms would pay $16,000 in testing. This can be the equivalent sales of live fish for one state requiring testing. Koi producers test their fish for spring viremia of carp and herpes carp virus to obtain the fish health paperwork for shipping fish and to maintain a clean facility. Testing trout for gill lice (Salmincola), a recent problem, requires $300-$350 for each shipment into particular states like Pennsylvania. The net result is that fish health regulation is burdensome for small scale trout producers. Larger trout farms are more capable of absorbing this cost. The VSU Fish Health Diagnostic lab has assisted trout and koi producers by testing fish for pathogens required by importing states. The choice for trout farmers is to pass on higher production costs to consumers or go out of business. Author contact: dcrosby@vsu.edu

FUNCTIONAL, STRUCTURAL, AND ANTIOXIDANT PROPERTIES OF CHICKPEA PROTEIN HYDROLYSATES AFFECTED BY ENZYMATIC HYDROLYSIS. Magdalini Galanopoulos, Edward Sismour, Patricia Lynch, Abeer Almutaimi, & Yixiang Xu. Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Chickpea protein isolate (CPI) was hydrolyzed batchwise using Alcalase or Flavourzyme individually or by sequential treatment using Alacase followed by Flavourzyme. Functional, structural and antioxidant properties as well as SDS-PAGE profiles of the hydrolysates were investigated. Alcalase was more effective than Flavourzyme at cleaving peptide bonds, and extensive hydrolysis occurred during sequential treatment. Hydrolysates had a significant (P<0.05) increase in the solubility and emulsifying capacity. Fourier-transform infrared spectroscopy showed that ordered secondary structures in original CPI were lost during hydrolysis and new random coil structures were formed. Compared to CPI, all hydrolysates presented significantly (P<0.05) higher DPPH• scavenging capacity, especially sequentially-treated hydrolysates. SDS-PAGE banding patterns of the hydrolysates were markedly changed,

especially for hydrolysates treated using Alcalase in which protein bands were not visible. The results reveal that hydrolysis enhanced the functional properties and antioxidant activity of chickpea protein which may be beneficial for potential functional food ingredient application. Funding was provided through the USDA Evans-Allen program. Author contact: Yixiang Xu, yixu@vsu.edu.

DEVELOPMENT OF EUDRAGIT EPO/HPMC/CELLULOSE NANOCRYSTAL-BASED NANOCOMPOSITE TASTE MASKING FILMS. Alexiss McKinney, Shakeyla Willis & Yixiang Xu, Agricultural Research Station, Virginia State University, Petersburg, VA 23806. Taste-masking techniques have been widely utilized to conceal unpleasant tastes of medicines. Film coating has been found to be the most effective and commonly used approach for this purpose. Eudragit EPO, a cationic polymer with a low solubility at neutral pH and high solubility at low pH, is a desirable candidate as a film matrix. The objectives of this study were to (1) prepare Eudragit EPO nanocomposite films by incorporating hydroxypropylmethylcellulose (a co-matrix material), cellulose nanocrystals (CNC, a strengthening agent), and glycerol (a plasticizer) using a solvent cast method, and (2) evaluate disintegration rate, chemical structure, and thermal properties of the produced films. A faster disintegration rate was observed for the films immersed in an acidic environment than those in a neutral condition. Further, increasing Eudragit EPO concentration made disintegration of the films easier in both neutral and acidic conditions. Fourier-transform infrared spectroscopy results indicated that incorporation of CNC did not cause any structural changes because of its solubility, while differential scanning calorimetry results indicated that the glass transition temperature of the films decreased with increasing concentration of Eudragit EPO, which facilitated their disintegration. Our study results support the potential use of Eudragit EPO-based films for taste masking applications. Funding was provided through USDA Capacity Building Grant No. 2013-38821-21124 and Pfizer Consumer Healthcare. Author contact: Yixiang Xu, yixu@vsu.edu.

OVEREXPRESSION OF PODRM2, AN EPIGENETIC REGULATOR FROM PURSALNE, ENHANCES STARCH ACCUMULATION IN *ARABIDOPSIS THALIANA*. David Joseph & Shuxin Ren, Agriculture Research Station, Virginia State University. Starch, a major nutrient in the human diet, is considered key for bio-ethanol production. Starch is produced during photosynthesis by plants. Increasing starch production will help to provide foods for human consumption and animal feedstock, as well as for potential bioenergy production. Previously, we successfully cloned a homolog gene, DRM2, from Purslane and overexpressed PoDRM2 in *Arabidopsis*. Comparing the growth of wild-type Columbia and homozygous PoDRM2 transgenic lines, we observed that the plant size of PoDRM2 lines was significantly larger than that of Columbia, suggesting a potential high efficiency in photosynthesis. To confirm this observation, we investigated starch synthesis/accumulation in leaves using iodine staining. At the end of light period, PoDRM2-carrying *Arabidopsis* lines accumulated significantly more starch than did the control. More strikingly, at the end of dark period, as predicted, the wild-type control did not accumulate starch, whereas PoDRM2 lines accumulated starch as much as during light period. Furthermore, PoDRM2 lines contained more chlorophyll than the control. These results indicate that PoDRM2 functions as a key regulator of starch

accumulation. PoDRM2 encodes a methyltransferase, and genome-wide bisulfite sequencing identified >2,500 genes with altered methylation status. 55 out of 61 genes on the photosynthesis pathway were altered. Our results suggest that DNA methylation plays important role in plants regulating photosynthesis. Author contact: Shuxin Ren, sren@vsu.edu.

Posters

EVALUATION OF CHESAPEAKE BAY BLUE CATFISH (*ICTALURUS FURCATUS*) FOR VALUE-ADDED APPLICATION. Jayjuan Robinson, Mzuna Aldossari, Edward Sismour & Yixiang Xu. Agriculture Research Station, Virginia State University. Blue catfish (*Ictalurus furcatus*, BC), introduced to Chesapeake Bay to enhance sports fishing, and is now consider invasive. BC are estimated to comprise over 70% of fish biomass in the James River and similar conditions likely exist in other Virginia tributaries. Given its high fecundity and abundance, eradication is impossible. Control efforts have focused on increasing consumer awareness and consumption have met limited success. Development of value-added uses for BC meat and processing waste has not been investigated to our knowledge. As an initial step, we are evaluating protein isolated from BC fillets (FPI). Fresh fillets (n=14) were obtained from a local processor. White muscle was composited and divided into 12 portions. Half were extracted fresh and half were extracted after 1 month frozen (-20 °C) storage. For each storage condition, half were extracted using H_2O and half using 0.5M NaCl. The FPI was freeze-dried and used to characterize protein yield, color, emulsification, protein structural composition (amide I). Yield was higher for frozen fillet ($p=0.008$) and did not differ between extraction methods. Color did not differ among dry samples. FPI showed no emulsification capacity. Amide I peak area differed significantly ($p<0.000$) and was highest for fresh, H_2O-extracted FPI and lowest for frozen, NaCl-extracted FPI. This project has been supported by funding from the USDA Evans-Allen program. Author contact: Yixiang Xu, yixu@vsu.edu.

Archeology

MAPPING LANDSCAPES OF RESISTANCE AND FINDING A WAY FORWARD FOR AN ARCHAEOLOGY OF MARRONAGE IN THE GREAT DISMAL SWAMP. Becca Peixotto, American University and Perot Museum of Nature and Science. The Great Dismal Swamp Landscape Study (GDSLS) began in 2001 to investigate archaeologically the resistance communities that thrived in the wooded wetlands in southern Virginia and northern North Carolina between 1610 and 1860. Led by Daniel O. Sayers, the GDSLS focused its efforts in North Carolina on a mesic island miles into the swamp on land now managed by the U.S. Fish and Wildlife Service. Excavations there and elsewhere demonstrated that marginalized peoples, including indigenous Americans and African and African American Maroons, maintained a continuous presence in the swamp, operating both within the bounds of colonialist expansion and enslavement and beyond their control. A 2013 LiDAR survey revealed dozens of potential islands scattered throughout the swamp and revitalized exploration

and site-discovery efforts. One of these offshoots, the Swampscapes project led by the author, identified a viable method for surveying large swaths of the swamp and discovered two new Maroon-associated sites and several high-potential locations. This presentation summarizes the findings of nearly 20 years of fieldwork by the GDSLS team, and suggests avenues for future research aimed at a more thorough understanding of the landscapes, lifeways, and lives of the Dismal Swamp Maroons. (Swampscapes research supported by the Archeological Society of Virginia, The Explorers Club Washington Group, WINGS WorldQuest, and American University). Author contact: Becca Peixotto, becca.peixotto@american.edu.

A SURVEY OF VIRGINIA'S DUGOUT CANOES. H. Robert Hayes, Maritime Heritage Chapter, Archeological Society of Virginia. The practical and economic importance of single-log dugout and multi-log built canoes for Native Americans and European settlers is well established. In Virginia, the Mid-Atlantic Dugout Canoe/Logboat Registry currently has documented 27 of these vessels from 14 counties and two independent cities (Poquoson and Suffolk). Of these, 20 are single dugouts and seven are of multi-log construction. Twelve are recorded in the Virginia Department of Historic Resources' Virginia Cultural Resources Information System (VCRIS). For all vessels, significant data gaps exist, such as: physical measurements, wood type, tools used, methods of construction, and time-period dating. All 27 vessels show signs of post-contact-period construction. For some single-dugout canoes only written records remain, with the final disposition of the canoe unknown. Where determined, pine (yellow and loblolly), cypress, and chestnut logs were used for construction. Single-dugout canoes range in length from 11 to 26 feet (avg.16 feet). Multi-log boats range from 15 to 51 feet, and these appear to be correlated to time period, use, and the number of logs used for construction. The Registry team believes that there are several more canoes and logboats to be found and documented in Virginia; active field efforts to find them in creeks, rivers, and lakes, as well as continued investigation of private and museum collections and archives, will continue. (Supported by: Institute of Nautical Archaeology, and Archeological Society of Virginia). Author contact: Robert Hayes, asvcanoe@gmail.com.

THE EVOLUTION OF GLOUCESTER'S PLANTATION LANDSCAPES. Thane Harpole, The Fairfield Foundation. Major plantations such as Fairfield, Rosewell, and Warner Hall dominated Gloucester County during the Colonial and Antebellum periods. The families who owned these properties were prominently placed politically, socially, and economically within Virginia's governing class, and they controlled large numbers of enslaved Africans whose labor dramatically transformed the natural landscape. However, little survives in the documentary record to chart the creation and alteration of a complex cultural landscape from the mid-17th to mid-19th centuries. The use of both large-scale archaeological survey and focused test excavation at several prominent properties across the county is beginning to detail the scope and scale of these plantation landscapes and reveal in-depth information about the lives and interactions of the people who lived in these spaces. Author contact: Thane Harpole, thane@fairfieldfoundation.org.

DEVELOPING AN INTERACTIVE MODEL OF ARCHAEOLOGY AT FAIRFIELD PLANTATION WITH PHOTOGRAMMETRY AND 3D PRINTING. Ashley McCuistion, The Fairfield Foundation. Fairfield Foundation archaeologists initiated the Fairfield Model project in 2017. The goal of the project is to create an interactive three-dimensional (3D) model of archaeology at Fairfield Plantation, a 17th-century archaeological site in Gloucester County, Virginia. To create the model, we use a Phantom 4 Pro drone to photograph the base of each layer of soil we excavate, then process the images through Agisoft Metashape photogrammetry software to produce 3D models. The models are transformed into solid objects in Autodesk 3ds Max and printed at a 1:30 scale using a MakerBot Replicator+ 3D printer. Each printed component is an exact representation of a five-foot-square test unit layer, and each layer fits seamlessly on top of the layer below. The interactive model simulates the process of archaeology by allowing users to "excavate" the site and discover its history using archaeological methods. It has proven to be an effective teaching tool in classrooms and at the Fairfield Foundation's Center for Archaeology, Preservation and Education. Author contact: Ashley McCuistion, ashley@fairfieldfoundation.org.

ARCHAEOLOGY WITHOUT (GOOD) STRATIGRAPHY: WHAT WE CAN LEARN FROM COMPRESSED MOUNTAIN SITES. Carole L. Nash, School of Integrated Science, James Madison Univ. Multi-component archaeological sites in mountain settings are subjected to processes of extensive weathering and erosion, resulting in net deflation over time and a concentration of weather-resistant artifacts and natural rocks within near-surface contexts. In addition, the shallow profiles of compressed O/A and E/B soil horizons are subjected to various biogenic and cultural disturbances over millennia (tree roots, frost heave, burrowing, plowing, etc.). Together, these processes can contribute to an apparent lack of easily discernable vertical cultural stratigraphy, which removes the temporal framework necessary for evaluating findings. A recent excavation of Virginia Blue Ridge sites with cultural components dating from the Early Archaic through Late Woodland periods demonstrates that, despite the presence of lagged, mixed surfaces, it is possible to identify spatially discrete activity areas through the horizontal distribution of artifacts. The patterning of diagnostic artifacts in these areas allows for general statements regarding re-occupation across millennia. Archaeologists working in mountainous settings are encouraged to consider the possibility that compressed site conditions may require new approaches to data analysis and a shift in the kinds of research questions asked of the archaeological record. (Supported by the National Park Service and the Shenandoah National Park Trust). Author contact: Carole Nash, nashcl@jmu.edu.

DISCOVERY THROUGH REHABILITATION: THE BETTY VEATCH POTOMAC CREEK COLLECTION. Erin M. Cagney, New South Associates, Veterans Curation Program. In 2017, archaeologists at American University rediscovered the Betty Veatch collection sitting forgotten on the lab shelves—boxes upon boxes of prehistoric and historic artifacts alongside Veatch's personal journals, field logs, and photographs. After undertaking an emergency rehousing of the at-risk collection, it became apparent that the Betty Veatch collection was rich with recoverable and significant data from more than 54 sites in the Potomac Creek estuary in Virginia. The

estuary has been occupied for thousands of years and most famously was the location of the Patawomeke village, a contact-period, palisaded settlement known to archaeologists as the Indian Point site or 44ST01. Though several notable early archaeologists visited and collected artifacts from Indian Point, the location of those artifacts is unknown, and no systematic archaeological excavation ever has been conducted. Now the site has eroded into the Potomac River and the little that was left was graded away by the property owner in the 1980s. Veatch's collection contains hundreds of artifacts from 44ST01, enabling the first-ever cataloging and analysis of artifacts from the site. The artifacts reveal a long period of occupation in the Potomac Creek estuary and a diverse array of highly specialized tools and vessels. This analysis of Indian Point sheds new light on the village of Patawomeke and clearly illustrates the importance of maintaining and curating orphaned archaeological collections, particularly those from sites threatened by erosion and sea level rise. (Supported by: Council of Virginia Archaeologists, Virginia Department of Historic Resources, and Archeological Society of Virginia Northern Virginia Chapter). Author contact: Erin Cagney, erincagney@gmail.com.

DENDROCHRONOLOGY OF ATLANTIC WHITE CEDAR (*CHAMAECYPARIS THYOIDES* (L.) BRITTON, STERNS & POGGENB): IMPLICATIONS FOR COLONIAL WOODCRAFT. James M. Doyle & Robert B. Atkinson, Dept. of Organismal and Environmental Biol., Christopher Newport Univ. Atlantic white cedar (*Chamaecyparis thyoides*), AWC, occurs on coastal peat swamps from Mississippi to Maine. Commercial uses of the wood contributed to early over-harvest, which was said to have made the species endangered in New England by 1748. Wood from the species is lightweight and resists decay, traits valued for shingles, siding, buckets, and boatbuilding. Narrow tree ring widths, termed "tight grain" by wood crafters, makes the species easy to work and further enhances its rot resistance. Our results suggest that seasonally flooded saturated hydrologic regimes of natural peatlands were pervasive during the colonial era and favored narrow rings. However, the advent of ditching and draining of peatlands caused faster growth rates. Moreover, drained peat no longer favored AWC over competitors such as red maple (*Acer rubrum*), drained peat was more combustible, and post-drainage peat fires prevented natural regeneration and exacerbated shortages. Initial surveys of Colonial Williamsburg roofing materials seem to suggest that a decline in AWC caused people to favor bald cypress (*Taxodium distichum*) for shingles. Author contact: James Doyle, james.doyle.15@cnu.edu.

SEA LEVEL RISE AND THE LOSS OF ARCHAEOLOGICAL RESOURCES: TIME AND TIDE WAIT FOR NO MAN. Michael B. Barber, Archeological Society of Virginia. Archaeological resources along Virginia's Chesapeake Bay and Atlantic Coast shorelines are being threatened more than ever by sea level rise, catastrophic storm surge, and tidal erosion. As climate change is taking its toll, archaeologists can no longer afford to stand idly by and watch the devastating loss of significant data. Nor can we continue to adhere to the time-honored concept of "preservation in place" as the place will soon be the bottom of the sea or bay. Archaeologists also are faced with the disturbing reality of excavating without writing reports as time spent in report documentation will result in the loss of data. Examples of preservation efforts will be

presented along with a proposed action plan. Author contact: Michael Barber, archaeova@gmail.com.

ANALYSIS OF EUROPEAN AND DOMESTIC TOBACCO PIPES RECOVERED FROM EYREVILLE, SITE 44NH0507, IN NORTHAMPTON COUNTY, VIRGINIA. Michael Clem & Michael Barber, Virginia Department of Historic Resources. Following five excavation sessions, each lasting approximately ten days, we have recovered some 1,878 tobacco pipe stems, bowls, and fragments. Of those, 1,047 were made of white ball clay manufactured in both England and Holland. Also recovered were 831 red clay pipe fragments of local manufacture. Of the European pipe stems that were dated using bore diameter size as the methodology, slightly more than 50% date to the decades prior to 1650 and only 8% date to after the end of the 17th century. Of the white stems, only 64 were decorated with a floral or "fleur-de-lis" design, indicating Dutch origins. Of the 331 red clay bowls and bowl fragments, 261 were decorated with various zoomorphic and geomorphic designs, with the "running deer" motif dominating. The running deer pipe bowls display a great variety of artistic styles, which may indicate multiple artisans. The dominance of 17th century pipes raises questions concerning the known 18th century occupation of the site. In addition, questions arise regarding trade networks with both European and local markets. It appears as though trade with Dutch merchants may have dwindled following the Navigation Acts (1651, 1660) and that smoking among the occupants of the site starts to diminish in the last decades of the 17th century. It also appears, as with many other Chesapeake region sites, that local pipe manufacture and usage terminate by the end of the 1600s. Author contact: Michael Clem, mike.clem@dhr.virginia.gov.

RITUALIZED PRACTICES OF THE PRECOLONIAL CHESAPEAKE: AN EXAMINATION OF THE HATCH SITE (44PG51). Michael Makin, Virginia Department of Historic Resources. Excavated in the 1970s and 80s by Lefty Gregory, the Hatch site in Prince George County is arguably among the most significant precolonial archaeology sites in the Commonwealth of Virginia. Though the collection sat in storage for decades, it was recently donated to the Virginia Department of Historic Resources, making it accessible to researchers. The thorough excavation combined with abundant radiocarbon data allow the historical narrative of this magnificent site to come into focus. An unusual place, hidden in a remote location, the Hatch site witnessed frequently occurring ritualized gatherings from 900 to 1400 CE. These gatherings involved the sacrifice and internment of dogs as well as elaborate feasts on both estuarine and terrestrial resources. The ceremonies appear to have concluded with termination rites in which materials associated with the ritual were left in place where the event occurred. This presentation provides an overview of my interpretation of the Hatch site and explores the site's place within the broader precolonial context. Author contact: Michael Makin, dmmakin@email.wm.edu.

FINDING RICHMOND'S FIRST AFRICAN BURIAL GROUND: A HISTORICAL AND ARCHAEOLOGICAL ANALYSIS. Bryan Clark Green, Commonwealth Architects & Matthew R. Laird, The James River Institute for Archaeology, Inc. Until the City of Richmond established a new public cemetery for both enslaved and free

African Americans in 1816, its black residents were interred in the "Burial Ground for Negroes," a cramped and flood-prone cemetery in the Shockoe Bottom district. Despite its importance in the history of Richmond's African American community, virtually no documentary or cartographic evidence of the cemetery has survived. This absence of information has led to considerable speculation about when it was established, how large it was, and exactly where it was located. However, a painstaking analysis of newly uncovered sources has revealed how and when the cemetery came to be, and it is now possible to situate it within today's vastly altered urban landscape. This fuller understanding of the African Burial Ground has important implications for archaeologists, historians, preservationists, and the community at large. Neglected and disturbed since the early nineteenth century, the cemetery embodies how the city's distinctly African American spaces have been consistently devalued. In recent years, the African Burial Ground has become a touchstone in the debate between advocates of development and preservation in Shockoe Bottom. A clearer understanding of the cemetery, as well as its historical and physical contexts, can help Richmond to acknowledge and memorialize the lives and deaths of its earliest African American residents in an informed, meaningful, and lasting way. Author contact: Bryan Green, bryancgreen@gmail.com.

WHEN THE WATERS RISE: BURIALS AND FUNERARY OBJECTS FROM THE UPPARDS CEMETERY (44AC0571), TANGIER ISLAND, ACCOMACK COUNTY, VIRGINIA. Joanna Wilson Green, Virginia Department of Historic Resources. Over several days in December 2012 and April 2013, archaeologists from the Virginia Department of Historic Resources recovered a series of late-19th- and early-20th-century burials from the long-abandoned Tangier Island community of Canaan, located at the tip of the island in an area known as the Uppards. This northernmost portion of the island was heavily damaged by storm surge-related erosion, resulting in the exposure of human remains and coffin hardware along the beach. Storm and tidal action also displaced headstones from their intended graves, rendering identification of the interred individuals difficult if not impossible. In the absence of this information, we turned to analysis of the remains themselves as well as the items with (and within which) they were buried, using this information to build a context for the burials. This presentation focuses upon the results of both anthropological and material culture analysis, presenting these results as well as the inferences that may be made about these individuals and the now-lost community of Canaan. Author contact: Joanna Green, joanna.wilson@dhr.virginia.gov.

Astronomy, Mathematics and Physics with Material Sciences

GUESSTIMATION: SOLVING THE WORLD'S PROBLEMS ON THE BACK OF A COCKTAIL NAPKIN. Lawrence Weinstein, Old Dominion University. Why don't we all drive electric cars? Does it really matter if you don't recycle that plastic water bottle? If the Sun were made of gerbils, would the Earth be incinerated? How can we answer these questions without relying on experts? This talk will cover the principles of estimating, introduce the "Goldilocks" categories of answers, and then look at some of

the big (and small) questions of our time, including: Should we ban plastic straws? Gasoline or electric cars? Should we pee before flying? Author contact: Lawrence Weinstein, weinstein@odu.edu

THE EFFECTS OF RADIO WAVES WITH THE NERVOUS SYSTEM. Alexandria E Federick & Giovanna Scarel, Physics Dept., James Madison Univ. The interaction of electromagnetic waves with matter, and the sensitivity of capacitors to electromagnetic waves, is the fundamental reason for our research [1]. In this research, we wanted to understand how radio waves effect the Nervous System, through various parts of the human and animal body. Indeed, the Nervous System is a complex electric system made of capacitors. We observed that conservation of energy describes the interaction with the Nervous System of electromagnetic waves down to radio waves. For this part of the work we have used literature data.[1] Boone,D.E., Jackson, C.H., Swecker, A.T., Hergenrater, J.S., Wenger, K.S., Kokhan, O., Terzić, B., Melnikov,I., Ivanov, I.N., Stevens, E.C., and Scarel, G. (2018) Probing the Wave Nature of Light-Matter Interaction. *World Journal of Condensed Matter Physics*, 8, 62-89. Author contact: federiae@dukes.jmu.edu**.**

CUBIC NONLINEARITY OF TUNGSTEN DISULFIDE NANOFLAKES THROUGH RESONANT EXCITATION. Tikaram Neupane, Dulitha Jayakodige, Sheng Yu, Bagher Tabibi, and Felix Jaetae Seo, Advanced Center for Laser Science and Spectroscopy, and Center for Atmospheric Research and Education, Department of Physics, Hampton University, Hampton, VA 23668. The cubic nonlinearity of optical materials has been articulated for the optoelectronic applications of Q-switch, mode-locking, optical power limiting, and optical modulator. Tungsten disulfide atomic (WS_2) layer is an intriguing nonlinear optical material due to the exotic materials and optoelectronic properties in atomic-scale flatland with the intralayer covalent bonding and interlayer van der Waals interactions. The cubic nonlinearities of WS_2 includes ~1-4 atomic layers in aqueous solution were characterized using a Z-scan techniques with the nanosecond pulse excitation source of ~ 532 nm. The WS_2 nanoflakes were resonantly excited at the absorption spectral region between A and B exciton peaks. The probability rate of direct transition in monolayer is relatively higher than that of indirect transition in bi/multi atomic layers. In addition, the higher laser intensity could excite the charge carriers into the deeper conduction band through a two-step transition. The open and closed Z-scan revealed the positive nonlinear absorption (~ 6.2 $x10^{-8}$ m/W) with reverse saturation, and the negative nonlinear refraction (~ -3.8 x 10^{-15} m^2/W) with peak-valley nonlinear transmittance respectively. The reverse saturation absorption indicates that the ground state absorption is larger than the excited state absorption, and the peak-valley trace indicates the defocusing characteristics. Acknowledgment: This work is supported by ARO W911NF-15-1-0535, NSF HRD-1137747, and NASA NNX15AQ03A. Corresponding Author: jaetae.seo@hampton.edu

IS THE GRASS REALLY GREENER ON THE OTHER SIDE? (IS THE FISHING REALLY BETTER IN THE OTHER RIVER?) Tom Mosca III, Rappahannock Community College. Fishery independent data collected by the Virginia Institute of Marine Science Trawl Survey from 1955 until 1995 were analyzed using one-

way ANOVA and Tukey *post hoc* analysis. The variable under consideration was catch per unit effort (number of each species per minute of trawl), and the three levels of analysis were James, York and Rappahannock Rivers. Analyses were performed for 14 species of finfish and blue crab, in order to identify relative abundance of each species in each river, as compared to the other two rivers. The idea was spawned by the widely held but anecdotal belief that large "yellow bellied" spot are more prevalent in the Rappahannock River than in the other two. Spot are in fact more abundant in the Rappahannock River, as are white perch, while there are significantly fewer hogchoker and blackcheek toungefish (both inedible) than in the other rivers. More Atlantic croaker, weakfish, silver perch, and white catfish were found in the York River. The James held more hogchoker and bay anchovy (both inedible), and channel catfish. Results for other species were mixed. Author contact: Tom Mosca III, tmosca@rappahannock.edu

FINDING MINOR PLANET PLUTO USING "BLINKING" SEVERAL IMAGES TAKEN TWO DAYS APART. Abraham J. Goldstein, Information Technology Department, Tidewater Community College. The author used software from a remote telescope located in the Canary Islands to image the minor planet Pluto. The site is known as the SLOOH Telescope site. Currently, the site has several telescopes positioned in Chile and the Canary Islands. The SLOOH images were all taken from the same telescope (alternatively, on odd and even days, two days apart). One could not distinguish the minor planet Pluto from these images by viewing only one image. However, by using the technique of "blinking" (superimposing common star patterns found in each image), one quickly finds that one image seems to "jump" when compared to hundreds of stars in the other image. This jumping image is the minor planet Pluto. Without using this technique, it would not be possible to differentiate Pluto from the neighboring stars in the same field. This blinking technique has also been used by astronomers to find asteroids, comets, and other minor planets in our solar system. Therefore, this well-known system has been used successfully both manually (as presented) and electronically in software applications to find previously undiscovered bodies. Author contact: JGoldstein@tcc.edu.

Posters

FABRICATION OF A COSMIC RAY VETO SYSTEM FOR THE MU2E EXPERIMENT. Kyle R. Fielman, Dept of Phys., University of Virginia. The Mu2e experiment will search for unambiguous evidence of charged lepton flavor violation through observation of the decay $N\,\mu^- \rightarrow N\,e^-$. In a three-year run, a single-event sensitivity of 2.9×10^{-17} is expected, 10,000 times better than the current limit. In order to keep the background below 0.25 events over the course of the run, an overall veto efficiency of 99.99% must be achieved. The Cosmic Ray Veto (CRV) is designed to meet these requirements with a dead time of approximately 5%. The CRV consists of extruded planks of polystyrene coated with titanium dioxide. The two extrusions house wavelength shifting fibers that transport photons to the end of the counters. Two counters are glued together to form the fundamental component of the CRV, the di-counter. Fiber guide bars are attached to the end of these di-counters to ensure alignment with the Silicon

photomultipliers used to detect the signal. Each of these di-counters is put through image testing, transmission testing, and testing with a radioactive source. The proficient di-counters are used to make modules which consist of four layers of di-counters interspersed with aluminum sheets. Currently, 1007 of the 2736 di-counters have been produced, along with the first five modules. Results from a test beam used on a pre-production batch indicates that the counters yield 42 PE/cm, far above the necessary 25 PE/cm. Author contact: krf4fe@virginia.edu.

Biology with Microbiology and Molecular Biology

CHARACTERIZATION OF PH-RESPONSIVE GENES IN *CRYPTOCOCCUS NEOFORMANS*. Kristen I. John[1], J. Andrew Alspaugh[2] & Michael S. Price[1,2], [1]Dept. of Biology & Chemistry, Liberty University and [2]Dept. of Medicine, Duke University. Compared to other fungal pathogens, *Cryptococcus neoformans* is particularly skilled at adapting to the human host environment in order to avoid detection by the immune response. One of the primary ways in which it does this is through its pH regulation system of the Rim pathway. Four genes were recently shown to be related to pH regulation within C. neoformans – CNAG_01580, CNAG_02291, CNAG_05866, and CNAG_06473. In order to characterize the function of these genes, we created knockout mutations by PCR and biolistics transformation. Through phenotypic screening, we identified mutant strains that were defective at growth at an alkaline pH. If these genes display a significant role in virulence, they may be potential targets for therapy in the future. (Supported by: Undergraduate Research Grant, The Virginia Academy of Science, and Provost Research Initiative Grant, Liberty University). Author contact: Kristen John, kjohn1@liberty.edu.

MONITORING THE STABILITY OF TRANSGENES IN *THERMOSYNECHOCCUS ELONGATUS* BP1. Cherrelle L. Barnes, James W. Lee & Lesley H. Greene. Dept. of Chemistry and Biochemistry, Old Dominion University. Genetically engineered (GE) cyanobacteria have become a platform for renewable energy production, in that biofuels can be produced from CO_2, water and sunlight by introducing a set of genes. Although the synthetic biology approach seems advantageous, it is important to understand the bio-risk of these organisms if they were to be used for commercial application. One of these possible bio-risk concerns is the stability of transgenes within such GE organisms if they were to escape into the environment. In this study, genes of interest were inserted into the chromosome of *Thermosynechococcus elongatus* BP1 via of homologous recombination. Once the transformation and insertion of genes were verified by PCR, sets of cultures were prepared with and without antibiotic pressure for an extended period-of-time. Over a 6-month period, the presence of the transgenes was tested every two weeks by PCR. The expression of the transgene was also tested by reverse-transcription PCR. The results of this study will be presented. Understanding how long transgenes remain in the chromosome of the host can be valuable to the biotechnology community that are considering using the GE cyanobacteria approach for biofuel production and policy makers that want to safely

regulate many GE organisms for commercial production. Author contact: clbarnes@odu.edu.

DETERMINING THE ROLE OF A *SACCHAROMYCES CEREVISIAE* GENE, YDL199C, IN DNA REPAIR. Mariam Tekle & Deborah Zies, Dept. of Biol., University of Mary Washington. Genomic DNA carries the genetic information in all organisms, therefore it is essential to preserve its integrity. If the genetic information is compromised then mutations can arise, leading to many potential problems, including cancer. All organisms must constantly monitor their DNA for damage and have mechanisms by which they can repair damage. While the main DNA repair genes have been well characterized, there are still likely to be many genes that contribute to successful DNA repair. Our goal is to use budding yeast as a model organism for the identification of novel genes involved in DNA repair. We chose a gene of interest, YDL199C, from a large-scale study conducted by Jaehnig et al (1). The researchers treated wild-type yeast cells with a mutagen, methyl methanesulfonate (MMS) and identified genes that changed in expression. To confirm the result for our gene of interest, we treated wild type strains with MMS over-time and measured target gene expression using qPCR. Results to date show that there is high variability in both our gene of interest, YDL199C and our positive control, MAG1. Due to the high variability, we cannot refute or approve the original findings. To further investigate the function of our gene, we compared a strain deleted for YDL199C to the wild type strain in budding index, drug sensitivity and mutation rate assays. The budding index results suggest that the deletion strain does not have a cell cycle phenotype. The drug sensitivity assay showed that there is no difference between the two strains and the mutation rate assay showed that there is no significant difference between the wild-type and the strain deleted for, YDL199C. (Supported by: Irene Piscopo Rodgers '59 and James D. Rodgers Student Fellowship II and UMW Undergraduate Research). Author contact: mtekle@mail.umw.edu

DEGRADATION OF POLYETHYLENE TEREPHTHALATE PLASTIC BY IDEONELLA SAKAIENSIS - PART I. Todd D. Gruber, Caroline Tsui & Andrew C. Chafin, Department of Molecular Biology and Chemistry, Christopher Newport University. PETase is an enzyme that degrades the plastic found in plastic water bottles (polyethylene terephthalate – PET). We have cloned the PETase enzyme into an expression plasmid under an inducible promoter for use in *E. coli*, and developed assays to measure rates of plastic degradation by this enzyme. We can detect enzymatic activity via a colorimetric assay using p-nitrophenyl acetate (PNPA), a small molecule substrate analog. This assay is straightforward, easy, and fast. Additionally, we have found that *Ideonella sakaiensis*, the bacterium from which PETase was cloned, can only be grown on certain types of PET. Specifically, the degree of plastic crystallinity has a significant impact on growth. We demonstrate that by changing the crystallinity of a particular plastic sample, we can change a sample that does not support growth into one which robustly supports growth. Finally, we have developed an assay in which plastic degradation can be monitored spectroscopically, allowing us to begin to select for improved mutants of the parent organism. Supported by a Small Project Research Grant from VAS 2018. Author contact: todd.gruber@cnu.edu.

INVESTIGATING PHENOTYPIC DIFFERENCES BETWEEN THE STP1 K/O AND WT *ARABIDOPSIS THALIANA* IN RESPONSE TO VARIOUS ENVIRONMENTAL STRESSES. Aya Andos, Ani Clem, Alexis Foor, Catherine Shola, & Janet Daniel, James Madison University. Sugar transport protein-1 (STP-1) is an H+/monosaccharide co-transporter in model organism *Arabidopsis thaliana*. We are investigating this protein because its impacts on the growth and function of the plant are not well known. For a better understanding of how STP-1 contributes to this plant, we are growing wild type (WT) and STP-1 knock-out (k/o) plants on agar plates to measure their responses to different environmental stressors. Previous work in the lab show that STP-1k/o seedlings grown on agar plates containing 50 -100mM NaCl have increased root length, stalk length and more leaves at 4 weeks. These results suggest that STP1 k/o influences plant osmoregulation. Over the last year, we have been characterizing the halotropic response of WT and STP-1 k/o plants by plating seeds on 0mM/300mM split plates to determine genotype specific response to salt exposure. In addition to characterizing the halotropic response we are also measuring root length and the angle of displacement from gravitropic response. Because the hypersaline environment decreases plant growth, we have decreased the salinity to 0mM/200mM split plates to allow roots to grow long enough to observe phenotypic differences. We are also developing methods to increase the harvest of roots, shoots and leaf tissue for tissue-specific gene expression studies. These studies will enable us to better understand the role of STP-1 in the plant. We also plan to extend these studies to compare the gene expression patterns of both genotypes in high saline environment. We were grant winners from the 2018 VAS meeting. Author contact: foorat@dukes.jmu.edu

CIRCADIAN REGULATION OF THE p53 RESPONSE IN CANCER THERAPEUTICS. Esther L. Wisdom, Xianlin Zou, Sarah K. Jachim, Philip Stauffer, Anne M. Brown, Liang Jiang, & Carla V. Finkielstein, Dept. Biol., Virginia Tech. The p53 tumor suppressor transcriptionally regulates cell cycle progression and death processes in response to genotoxic stress and thus prevents the accumulation of mutations and cancer development. Mutants of p53 that are transcriptionally inactive as result of structural rearrangements can be rescued by drug treatment. One mutant that shows promise for this approach contains a Tyr to Cys mutation (named p53YC hereafter) causing a destabilizing crevice. Due this crevice, p53YC is largely unfolded at body temperature and doesn't trigger cell cycle arrest or apoptotic pathways. Aminobenzothiazole derivatives can bind to the destabilizing crevice. The crevice sits at the interface of binding with PER2 a circadian protein that regulates p53 stability, activity, and shuttling between cellular compartments. This led us to hypothesize that treatment with aminobenzothiazole derivatives would be more effective if delivered at a time-of-day when PER2 expression in the tumor is low. First, we looked at the effect of different mutations in p53 and PER2 on their binding. The YC mutant showed increased binding to PER2 and mutants near the YC crevice showed a variety of binding affinities. We monitored the effect of drugs on p53 and PER2 binding using immunoprecipitation and docking modeling. Higher concentrations of aminobenzothiazole reduced PER2 and p53 binding. We also monitored the circadian expression and stability of PER2 and p53 in the presence of aminobenzothiazole. Our findings place PER2 as a direct regulator of

p53 and provide insights on PER2's relevance in cancer therapeutics. Author contact: elwisdom@vt.edu

PATTERNS OF WHEEL RUNNING IN BULBECTOMIZED MICE. Anna M. Rinko. & Robert P. Waters, Dept. of Biol., University of Mary Washington. This work aims to better characterize the hyperlocomotor phenotype of olfactory bulbectomized (OBX) mice, a premiere model of depression. Characteristics of OBX mice mimic symptoms of human depression and include anhedonia, anxiety, hyperactivity, and hormonal changes. We previously examined anhedonia in this model by providing OBX mice with a reinforcing stimulus in the form of a running wheel, anticipating that these mice would have decreased wheel interaction due to a documented attenuated interest in rewards. Instead, the OBX mice ran significantly more than controls. We concluded that this likely resulted from OBX hyperactivity. To better characterize these findings, we utilized a sorter system that required an operant task to gain access to an external running wheel for a period of three weeks. We also evaluated social dominance and corticosterone levels. We found that OBX mice spent significantly less time interacting with the running wheel, showed disruptions to their circadian pattern of activity, and had higher fecal corticosterone levels at day 21 of the experiment. However, we observed no differences between running speed or entries into the wheel cage. Cage entries increased slightly ($p = 0.182$) among OBX mice. We interpret these changes in wheel engagement as anhedonia, while the increased cage entries reflect hyperactivity in OBX mice. We also provide supporting evidence for circadian disruptions and the presence of higher corticosterone in OBX mice. (Supported by an undergraduate research grant from the University of Mary Washington). Author contact: arinko@mail.umw.edu.

SUCCINATE DEHYDROGENASE ACTIVITY ASSAY DEVELOPMENT AND POTENTIAL EFFECTS FROM A POST-TRANSLATIONAL MODIFICATION. Abigail Vickers, Nhat Truong & Pei Zhang, Department of Biology & Chemistry, Liberty University. O-GlcNAcylation is a post-translational modification that regulates the function of many different proteins. The modification is performed by O-GlcNAc transferase (OGT), which transfers a N-acetylglucosamine onto a serine or threonine residue of the protein. O-GlcNAcylation acts as both a nutrient and stress sensor, increasing in response to elevated glucose levels, nutrient starvation, heat shock, and other stress conditions. Increased O-GlcNAcylation has been linked to cancer and metabolic diseases such as diabetes and obesity, as well as decreased mitochondrial function. Preliminary studies have shown that succinate dehydrogenase (SDH), which acts as both complex II in the mitochondrial electron transport chain and an enzyme in the TCA cycle, is O-GlcNAcylated. SDHA was mutated at predicted key O-GlcNAcylation sites to prevent post-translational modification and was then transfected into Hela cells. Cell lysate was then used to perform an enzymatic assay to determine the effects of O-GlcNAcylation on the activity of SDH. The activity of the mutated SDH was decreased compared to the wildtype, suggesting that O-GlcNAcylation is important to the activity of SDH. Author contact: Abigail Vickers, ahvickers@liberty.edu

Posters

DOES RELB CONTRIBUTE TO TUMOR PROGRESSION IN GLIOBLASTOMA MULTIFORME? H. F. Angel[1], L. N. Brown[2], D. D. Biswas[2], K. A. Mockenhaupt[2], M. G. Marone[2] & T. K. Kordula[2], Thomas Nelson Community College and Department of Biochemistry & Molecular Biology, Virginia Commonwealth University. Glioblastoma Multiforme (GBM) is a vastly aggressive grade IV cancer. Even with the best treatments, the survival of patients with GBM ranges between 12-15 months. GBM is characterized by increased neuroinflammation, with extensive infiltration by residential microglia and high numbers of glioblastoma associated macrophages (GAMs). RelB, a transcription factor and member of the NF-κB pathway, is a marker of mesenchymal GBM and correlates with poor prognosis in GBM patients. Interestingly, we found that RelB induces the activation of GAMs in GBM. Thus, we hypothesize that RelB contributes to the aggressiveness and increased inflammation associated with GBM. To investigate the role of RelB in GBM, we generated spontaneous tumors using an oncogenic lentivirus in wild-type and astrocyte-specific RelB conditional knockout ($RelB^{\Delta AST}$) mice. Histological assessment revealed that tumors were significantly smaller in $RelB^{\Delta AST}$ mice. Additionally, immunofluorescence staining suggested that tumors in $RelB^{\Delta AST}$ mice contain less endothelial cells and decreased vascularization. Further, fluorescence-activated flow cytometry revealed that the number of microglia and macrophages were significantly lower in RelB-deficient tumors, suggesting that RelB plays an important role in GBM-associated neuroinflammation. Together, these data demonstrate that astrocyte-specific RelB plays a crucial role in tumor progression, tumor vascularization, and GBM-associated GAM infiltration. Our results indicate that RelB could be a contributor to the aggressiveness of GBM, suggesting that targeting RelB may lead to novel therapeutics for the treatment of GBM. (Supported by NIH, VCU Bridges to the Baccalaureate R25GM102795). Author contact: tomasz.kordula@vcuhealth.org.

COMBINED EFFECTS OF STATINS AND CHEMOTHERAPY ON HEAD AND NECK SQUAMOUS CELL CARCINOMA. Sara Fioretti & Rosemary Barra, Dept. of Biological Sciences, University of Mary Washington, Fredericksburg, VA. Worldwide, head and neck squamous cell carcinoma (HNSCC) is the sixth most common cause of cancer with a five-year survival rate of 40-50%. Common treatments include various chemotherapeutic agents and radiation, however only 50% of patients respond to conventional treatments. The high morbidity and mortality rates come from the malignant nature of HNSCC. The overexpression of RhoC GTPase, involved in cell signaling, gene expression, cytoskeleton organization, and cell proliferation, mediates HNSCC metastasis. For RhoC GTPase to function, it must be prenylated to form an association with the cell membrane by HMG-CoA reductase. This enzyme is also involved in the synthesis of cholesterol and is inhibited with the commonly prescribed high cholesterol drug Atorvastatin. Previous studies have shown that inhibiting RhoC GTPase prenylation with Atorvastatin limits HNSCC cells metastatic capability. The purpose of this study is to analyze the effect of statins on the effectiveness of the chemotherapeutic agent cisplatin. SCC15 cells were treated with various concentrations of cisplatin and Atorvastatin and cell viability was determined using the MTT assay. Preliminary results indicate a significant dose dependent decrease in cell viability with Cisplatin and Atorvastatin treatment. 40 mM Cisplatin decreased cell viability 72% and treatment with 10 mM Atorvastatin caused a 35% decrease in viability. Combination treatments

appeared to act synergistically, showing a further decrease in SCC15 cell viability. Author contact: rbarra@umw.edu.

HUMAN TUMOR XENOGRAFTS IN *XENOPUS* FROGS. Estefanie M. Marshall[1], Santiago Lima[2] & Amanda J. Dickinson[2], Thomas Nelson Community College and Department of Biology, Virginia Commonwealth University. *Xenograft models* are an important tool to study the development and progress of cancers. They allow us to test new drugs and examine mechanisms underlying the growth or death of cancer cells. In particular, aquatic models such as zebrafish larvae are being explored as a *xenograft model* due to their large brood size, transparency, ex utero development, easily amenable to gene knockout, lack of a mature immune system, and very low cost. Frogs share all of these advantages, but in addition, frogs have an extended larval period with only basic immune function and are larger in size, which could facilitate a broader range of experiments. Therefore, in this study, we have begun to develop a frog *xenograft* cancer model. We explored the creation of *xenografts* in two different life stages; juvenile and larval. The objective of this study is to examine conditions that allow a human cancer cells to grow in frogs. Our study preliminary results indicate that juvenile stages do not form noticeable tumors after 3 weeks. However, we note that at least one live larvae has a suspicious growth at the injection site, and another larvae that died had an abnormal growth. Future experiments are planned to examine the pathology of these growths and optimize the implantation technique using fluorescently labeled cells so that success rates and tumor size can be easily quantified. (Supported by NIH, VCU Bridges to the Baccalaureate R25GM102795). Author contact: ajdickinson@vcu.edu.

FINE-SCALE PATTERNS OF GENETIC STRUCTURE IN HOST PLANTS AND THEIR RHIZOBIA SYMBIONTS. Mahboubeh H. Nobarinezhad, Department of Biological Sciences, Mississippi state University & Lisa Wallace, Department of Biological Sciences, Old Dominion University. In this study, we tested fine scale genetic structure (FSGS) in the host plant *Chamaecrista fasciculata* and its rhizobia partner. Genetic structure of the plants was tested using 14 microsatellite markers and the identity of the rhizobia was determined using truA gene sequences. The results showed significant FSGS for both partners. We acknowledge Biology Faculty Fund of Mississippi State University for funding for this project and Old Dominion University for assistantship funding. Author contact: Mahboubeh H. Nobarinezhad, mh2329@msstate.edu.

NUCLEAR TRAFFICKING OF *ORIENTIA TSUTSUGAMUSHI* EFFECTOR ANK13 UTILIZES RADAR. N. B. Otto[1], H. E. Adcox[2], & J. A. Carlyon[2], [1]Thomas Nelson Community College and [2]Department of Microbiology & Immunology, Virginia Commonwealth University. *Orientia tsutsugamushi* is a mite-borne, pathogenic, obligate intercellular pathogen responsible for scrub typhus; a febrile and potentially fatal disease endemic to Asia and the western Pacific region. During infection, *O. tsutsugamushi* secretes multiple ankyrin-repeat containing proteins (Anks). When ectopically expressed in HeLa cells, one Ank in particular, Ank13, localizes to the host cell nucleus. It is known that some obligate intercellular pathogens secrete nucleomodulins; proteins that localize to host nuclei and modulate host genetic expression to create conditions favorable for the

pathogen. *O. tsutsugamushi* dysregulates gene transcription during infection, and it may be doing so through the use of Ank13 as a nucleomodulin. However, exactly how Ank13 localizes to the nucleus is unknown. When testing the most common pathway of nuclear import, recognition of a nuclear localization signal (NLS) by importin, it was shown that Ank13 enters the nucleus in an importin-independent manner. Ank13 appears to be utilizing the RanGDP-Ankyrin Repeats (RaDAR) pathway. In order to interact with RanGDP, a protein must have hydrophobic residues at the 13th position on two concurrent ankyrin repeats (ARs). We created mutants to test this hypothesis by observing their localization in transfected HeLa cells. These mutants had their 13th hydrophobic residues on AR4 and/or AR5 replaced with hydrophilic residues. SDS-PAGE gels and Western blots were performed on cytosolic and nuclear fractions of these cell lysates. To visualize the localization of Ank13 mutants in individual cells, we also performed immunofluorescence assays (IFAs). The results of these experiments suggest that Ank13 utilizes the RaDAR pathway for nuclear import. (Supported by NIH, VCU Bridges to the Baccalaureate R25GM102795). Author contact: jason.carlyon@vcuhealth.org.

INVESTIGATION INTO THE FUNCTION OF SACCHAROMYCES CEREVISIAE YLR149C AND SIR2 GENES IN THE PRESENCE OF HYDROGEN PEROXIDE AND NICOTINAMIDE MONONUCLEOTIDE. Leonid Smorodintsev-Schiller and Deborah Zies. University of Mary Washington. Genetic stability is crucial for well-being of an organism. Most of the de novo occurring mutations are detrimental, resulting is serious conditions such as type 1 diabetes and sickle cell anemia. Chemicals can affect genetic stability of an organism by altering either one of the intricate biological pathways or directly the DNA structure itself. Hydrogen Peroxide (H2O2) is well known chemical involved in formation of reactive oxygen species that are capable of damaging DNA. Another chemical, nicotinamide mononucleotide (NMN) can be used to generate NADH and NAD+, that can beneficially influence the stability of genetic material. The purpose of this study is to determine if the deletion of two Saccharomyces cerevisiae genes, YLR149C and SIR2, have an effect on genomic stability in the presence of hydrogen peroxide alone, or in the presence of both hydrogen peroxide and NMN. YLR149C was chosen because it is an ORF an gene with an unknown function, but has been shown to increase in expression during DNA damage. SIR2 was chosen because of its known role in NAD+ metabolism. Both genes, therefore may be involved in repair of genetic material. Mutation Rate Assay are being used to determine the frequency of novel mutations associated with the presence of the two chemicals in YLR149C deletion, SIR2 deletion, and wild type yeast strains. The results of these assays will be presented. This investigation will help to determine if SIR2 and YLR149C play in biological pathways active when organisms are exposed to the elevated level of H2O2 and nicotinamide mononucleotide. lschiller@mail.umw.edu

COMMON GENE VARIANTS IN G6PC GENE MAY CONTRIBUTE To FATTY LIVER DISEASE/HYPERLIPIDEMIA IN GENERAL POPULATION. Shan, Zaidi & Ancha, Baranova. George Mason University. Mutations in the *G6PC* gene, which encodes the catalytic subunit of Glucose-6-phosphatase, are found in patients with Glycogen storage disease 1a (von Gierke disease) and are associated with the

accumulation of glycogen and fat in the liver and kidneys. We hypothesized that heterozygous carriership of *G6PC* mutations may contribute to non-alcoholic fatty liver disease (NAFLD). To find support for this hypothesis, analysis of NAFLD-associated genetic networks was performed using Pathway Studio software; IGFB1 (Insulin Like Growth Factor Binding Protein 1) was identified as a connector between the NAFLD phenotype and *G6PC* expression and function. Moreover, PI3K/PKB pathway was highlighted as involved both in NAFLD and in von Gierke disease, with the activation of *G6PC* being a suppressor of NAFLD. Glucose carriers SLC2A2 and FBP1 were two other connectors between "weakened" *G6PC* and NAFLD. We also detected involvement of fatty acid synthase, TORC1 and the metabolic pathways of pyruvate and lactate. In hyperlipidemia, G6Pase is commonly overexpressed. The main outcome of the study is that new molecular targets for NAFLD are introduced through the Pathway Studio analysis for possible development of novel therapeutics. Author contact: szaidi14@masonlive.gmu.edu

Biomedical and General Engineering

ENHANCED EXCIPIENT GROWTH SURFACTANT REPLACEMENT THERAPY IN AN IN VIVO RAT LUNG INJURY MODEL. Franck J. Kamga Gninzeko[1], Michael S. Valentine[1], Sahil R. Chindal[1], Susan Boc[2], Sneha Dhapare[2], Michael Hindle[2], Dale Farkas[3], P. Worth Longest[3], & Rebecca L. Heise[1], [1]Dept. of Biomed. Engineering, [2]Dept. of Pharmacy, [3]Dept. of Mech. Engineering., Virginia Commonwealth Univ. IRDS, Infant respiratory distress syndrome is a form of respiratory distress syndrome that affects premature infant and the solutions that exist to remedy to the disease are breathing support and other therapies to keep the airway open and to prevent those airways from collapsing. A variety of drugs exist on the market to tame IRDS. These include, Alveofact®, Curosurf® and Survanta®. The common method of delivery for this drug is liquid deposition; however, it is not effective as the drug does not reach the small airways. We have developed an enhanced excipient growth (EEG) powder of Survanta that we delivered via an aerosolizer to Sprague Dawley rats. The rats were anesthetized, and surfactant depleted using 2 saline lavages. Then, the EEG powder was administered followed by a 10-minute mechanical ventilation (MV) at 8ml/kg. Ventilation mechanics were taken before depletion, after depletion, after the MV, bronchoalveolar lavage was performed and the cells were cytospun onto a microscope slide. We hypothesized that rats that receive EEG Survanta powder will have improved lung mechanics compared to the ones that received liquid Survanta. The results showed a significant improvement in compliance and elastance of EEG powder group compared to the liquid survanta. Finally, there was no significant difference in neutrophil count of the lavage obtained from the EEG powder group compared to the liquid survanta. Author contact: Franck Kamga Gninzeko kamgagninzefj@vcu.edu

VOLUNTARY DRIVE AMPLIFIES EFFECTS OF PAIRED-PULSE TMS AND ARM POSTURE ON BICEPS CORTICOMOTOR EXCITABILITY. Thibault Roumengous, Paul A. Howell & Carrie L. Peterson, Dept. of Biomedical Engineering, Virginia Commonwealth Univ. Non-invasive brain stimulation techniques are typically

applied at rest, but may be more effective or representative of neural changes when applied during a range of voluntary effort. We investigated the effect of voluntary drive on intracortical facilitation (ICF), short-interval intracortical inhibition (SICI) and static arm posture (AP) in the non-impaired biceps. Ten healthy participants (age 19 to 27; 7 males, 3 females) were seated in a chair with electromyographic (EMG) sensors placed on their dominant arm supinated in a cast attached to a force transducer. Baseline TMS trials consisted of single-pulse stimuli (120% resting motor threshold) delivered to the biceps cortical hotspot via a 110mm double cone coil (Magstim) during 0, 50, 75 or 100% MVC at 90° elbow flexion (AP90). Condition modifications involved modulating the elbow angle to 120° (AP120) and 45° (AP45), and addition of a conditioning TMS pulse of 90% RMT at an interstimulus interval of 1.5 ms for SICI (PP1.5) and 30 ms for ICF (PP30). A two-way ANOVA was performed to compare baseline (i.e., AP90 condition) measures of MEPs to all other conditions across voluntary effort levels. We found that high voluntary effort (≥ 50% MVC) increased ICF, SICI, and static elbow angle mediated changes in biceps corticomotor excitability. Thus, changes in corticomotor excitability may be more detectable at high voluntary effort. (Supported by VCU's CTSA -UL1TR000058- and the CCTR Endowment Fund). Author contact: Thibault Roumengous, roumengoust@vcu.edu

THE EFFECT OF INTERMITTENT THETA BURST STIMULATION ON CORTICOMOTOR EXCITABILITY OF THE BICEPS AND TRANSFERRED MUSCLES. Blaize C. Majdic, N Mittal & CL Peterson, Dept. of Biomedical Engineering, VCU. Motor re-education of the muscles is critical for attaining optimal outcomes in individuals with spinal cord injury (SCI) who have had an upper limb reconstruction (ULR) surgery. Neuromodulation of the primary motor cortex (M1) in pair with physical therapy may be a promising method for improving motor re-education after a ULR surgery. Increases in the excitability of the corticospinal motor pathway projecting to upper limb muscles have shown to be associated with motor learning and skill acquisition. The purpose of this study was to determine the effect of intermittent theta burst stimulation (iTBS) on the corticomotor excitability of the biceps and transferred muscles, as measured by motor evoked potential (MEP) amplitudes, in non-impaired (NI) individuals, individuals with tetraplegia, and individuals who have had an ULR surgery. It was found that change in MEP amplitude after iTBS was not different between sham and active coils in the NI group, while MEP amplitude was increased after active iTBS to a greater degree than sham in the SCI and ULR groups. This suggests that iTBS may be a promising method for improving motor outcomes for those with spinal cord injury and ULR. (Supported by the NIH National Center of Neuromodulation for Rehabilitation awarded to the Medical University of South Carolina). Author contact: Blaize Majdic, majdicbc@vcu.edu

GUIDED DEVELOPMENT OF NATIVE-LIKE LIGAMENT TO BONE JUNCTIONS. M. Ethan Brown & JL Puetzer, Dept. of Biomedical Engineering, VCU. Fibrocartilaginous osteoligamentous junctions are structurally complex tissues < 1 mm wide which connect elastic ligaments to stiff bone. They are composed of 4 zones with gradual transitions in collagen organization and biochemical composition to allow for functional mechanical load distribution between tissues. Engineered replacements have

failed to drive the formation of these unique zones necessary for long-term mechanical function. Previously we developed a culture system which guides ligament fibroblasts to develop aligned native sized and hierarchically organized 30 µm collagen fibers using high density collagen gels and mechanical boundary conditions. These constructs hold great promise as ligament replacements; however, development of an organized junction would aid their function *in vivo*. Compressive boundary conditions and the addition of beta tricalcium phosphate (βTCP) were used in conjunction with our previously developed system to drive the organization and development of zonal ligament-to-bone junctions. Statistical analysis was performed by 2-way ANOVA with SNK post-hoc analysis ($p<0.05$ significant). Glycosaminoglycan (GAG)/DNA remained constant for mid and transition zones but trended toward significantly increasing for βTCP clamped sections by 6 weeks, matching native junction development where GAG is elevated in neonatal interfacial regions and decreases with age ($p<0.056$). By 6 weeks, confocal imaging displayed βTCP samples resemble immature bovine junctions with zones of highly aligned parallel fibers in middle, perpendicularly aligned transition, and βTCP incorporated random, porous collagen network under boundary. Author contact: brownme9@vcu.edu

AGE-SPECIFIC ALTERATIONS IN LUNG MECHANICS AND MACROPHAGE POLARIZATION INDUCED BY HIGH PRESSURE-CONTROLLED MECHANICAL VENTILATION. Michael S Valentine[1], Franck Kamga Gninzeko[1], Sahil Chindal[1], Cynthia Weigel[2], Sarah Spiegel[2], Angela Reynolds[3], & Rebecca Heise[1].[1]Biomedical Engineering, [2]Biochemistry and Molecular Biology, [3]Mathematics and Applied Mathematics, Virginia Commonwealth University. The largest population of patients requiring MV is the elderly, and age is a known predictor for the severity of VILI. Lung macrophages, which can be polarized into pro-inflammatory (M1) or anti-inflammatory (M2) phenotypes, greatly contribute to barrier integrity and local inflammation as mediators of injury and inflammatory signaling. Young (2-3mo) and old (20-25mo) mice were subjected to pressure-controlled MV (PIP: 35-45 cmH20, RR: 90 breaths/min, PEEP:0 cmH20) for 2 hours using a Scireq FlexiVent. This study suggests that aging results in significant alterations in lung structure/function and macrophage polarization, which are further impaired or exacerbated by PCMV. Furthermore, we provide evidence that these age-dependent negative outcomes correlate with decreased S1P signaling. Age-related differences in macrophage polarization mechanisms, such as those regulated by S1P, could be viable therapeutic targets for patients requiring MV by preventing or modulating the exaggerated inflammatory response, subsequent tissue injury, and impaired repair that often leads to sepsis and mortality. (Supported by: National Institute of Health 1R01AG041823-01A1, VCU Massey Cancer Center Lipidomics Shared Resource: NIH-NCI Cancer Center Support Grant P30 CA016059). Author contact: Michael Valentine, msvalentine@vcu.edu

COMPUTATIONAL ANALYSIS OF LISFRANC REPAIRS. M. Tyler Perez & Jennifer S. Wayne, Dept. of Biomedical Eng., Virginia Commonwealth University. While Lisfranc injuries in the midfoot are less common than other ankle and midfoot injuries, the outcomes of surgical repairs of these injuries remain poor. Existing literature has compared the different surgical procedures but has not concluded with a

recommended procedure. This study uses a computational biomechanical model to evaluate the ability of different surgical repairs to return the stability of the Lisfranc joint after an injury. Using SolidWorks™, a healthy human foot model was created whereby biomechanical function was dictated by accurate 3D articular anatomy, ligament restraints, and muscle loading. This model was validated on the experimental results for a cadaver study of a healthy and injured Lisfranc joint. Four surgical procedures that are used to repair Lisfranc joints were modeled. These were three open reduction and internal fixation (ORIF) procedures (endobuttons, screws, and dorsal plate hardware used) and arthrodesis with screws. A combination of rigid body modeling and finite element analysis was used to determine the mechanical stability in the joint (ie ability of the procedure to prevent separation in the joint) when the foot is loaded in a plantar flexed position. The von Mises stresses experienced by the different hardware were evaluated to determine where there was a risk of implant failure. Lastly, the contact forces with the ground and for joints adjacent to the Lisfranc joint were collected to compare the kinetics after surgery. Results showed ORIF with screws and arthrodesis had joint mechanics similar to a healthy foot. However, these fixation techniques with rigid hardware such as screws and plates showed areas of high stress that are at risk of fatigue failure. Author contact: Tyler Perez, perezmt@vcu.edu

DEVELOPMENT OF A DEVICE FOR THE QUANTIFICATION OF ARM RIGIDITY IN PATIENTS WITH PARKINSON'S DISEASE. Gina O. Miller & Paul A. Wetzel, Dept. of Biomed. Engineering, VCU. Parkinson's Disease (PD) is comprised of many symptoms which progress at different rates based on the patient, one of the most common being joint rigidity. This symptom, caused by the inability of the muscles to relax and extend properly, due to reduced dopamine levels, often begins in one arm and spreads through the leg on the same side of the body, then through the torso and the remainder of the body over time. The current standard for determining joint rigidity in a clinical setting is a subjective test completed by the clinician based on the feel of the relaxed wrist and elbow joints as they are flexed and extended. In some cases, an ordinal rating, determined through the use of the MDS-UPDRS, is used to scale the severity of the patient's rigidity, but there is no objectivity in these measurements either. We present a torque-based device to objectively quantify rigidity in a PD patient's arm. The device employs a servo motor-shaft assembly, connected to a rigid forearm sling and controlled by a computer to flex and extend the elbow joint in two possible orientations, pitch and yaw. A torque transducer and potentiometer will measure the torque necessary to rotate the shaft and the position of the shaft with respect to time, which can then be used to objectively determine joint rigidity. Angle of rotation, acceleration, and velocity of the shaft will be constantly monitored internally to ensure safety. By quantifying joint rigidity, clinicians will be able to more accurately track the progression of this symptom and the disease as a whole and administer appropriate medical care specific to an individual patient's PD progression. Author contact: Gina O. Miller, millergo@vcu.edu

SEGREGATED ANATOMICAL AND FUNCTIONAL SUB-CIRCUITS OF THE BASAL GANGLIA-THALAMOCORTICAL NETWORK DIFFERENTIALLY CONTRIBUTE TO DISTINCT MOTOR PATHOLOGIES INCLUDING DYSTONIA AND PARKINSON'S DISEASE. George R. Weistroffer[1,4], D

Kumbhare[2,4], PA Wetzel[1], & MS Baron[3,5], [1]BME, [2]Neurosurgery, [3]Neurology, VCU, [4]McGuire Research Institute, [5]SE PADRECC, VAMC, Richmond. The basal ganglia-thalamocortical (BGTC) motor network is organized into segregated re-entrant subcircuits originating from distinct premotor and primary motor territories. We previously reported that a precise neurotoxic ibotenate lesion in the ventral globus pallidus (GP) induces dystonia, while a discrete dorsal lesion induces parkinsonism. To delineate these individual subcircuits, we injected multi-synaptic anterograde neuronal viral tracers into these two GP hotspots and reconstructed the fluorescent labeling to the level of the motor cortex (MC). Florescent tagged vesicular stomatitis virus (rVSV) was locally administered into the above hotspot in GP (n=18 rats). After 2-4 days, the rats were perfused, and the brains were processed. Dense, circumscribed anterograde labeling of neurons was observed in the thalamus and MC. Initial higher-dose VSV injections maintained for 4 days (n= 5) produced identical dystonic symptoms as observed with neurotoxic lesions, validating the accuracy of the injection targets. Histological observations revealed the GP dystonia hotspot projecting to primary MC (L2.2, A2.1, D2.5) and the parkinsonian hotspot to secondary MC (L1.5, A2.4, D2). This study provides compelling evidence that dystonia and parkinsonism originate along separate motor BGTC subcircuits. This study is funded by VA BLR&D Merit Review award (M. Baron, PI). Contact author: George Weistroffer, weistroffegr@vcu.edu

Botany

STUDYING INTRASPECIFIC DIVERSITY CAN REVEAL NOVEL ASPECTS OF PLANT ECOLOGICAL INTERACTIONS AND EVOLUTIONARY DIVERGENCE. Lisa E. Wallace, Dept. of Biological Sciences, Old Dominion University. The study of intraspecific variation has long been considered important to the field of evolutionary biology because natural selection acts upon this variation to generate novel forms. More recently, intraspecific variation is recognized to influence ecological properties of ecosystems as well, often having equal or greater effects compared to interspecies diversity. Studies at the intraspecific level are necessary to link patterns with the processes that generate and shape the biodiversity that we see in Earth's present and past. In this presentation I provide examples of how intraspecific variation has contributed to eco-evolutionary diversification in two systems: endemic plants of the California Channel Islands and a widely distributed orchid species with a remarkable amount of floral diversity. These studies demonstrate that the degree of intraspecific variation varies immensely across space and species and that patterns of genotypic and phenotypic variation are often discordant. Intraspecific data sets have direct application in how we characterize and manage biodiversity, and species should be studied for both genotypic and phenotypic variation. Given the selection pressures experienced by organisms around the world due to climate change, studies of intraspecific variation are a critical piece in predicting how species and communities will respond to these changes. Author contact: Lisa E. Wallace, lewallac@odu.edu.

THE FLORA OF VIRGINIA PROJECT: A 2018-2019 PROGRESS UPDATE. Marion B. Lobstein, Professor Emeritus, Northern Virginia Community College. The

Foundation of the Flora of Virginia Project (FFVP) released the mobile version of *Flora of Virginia* App for Android and iOS systems in September 2017. This App contains an easy-to-use graphic key for use by the general public as well as inclusion of the dichotomous keys and descriptions at family, genus, and species level. The background chapters from the *Flora of Virginia*, a glossary, botanical illustrations, photographs, and county range maps from the Digital Atlas of the Virginia Flora are also features included in the App. Additional information on conservation ranks for rare or threatened species and scores for level of invasiveness for invasive species are also provided in the App. Additional photographs for the current species included in this mobile App have been added over this last year. Work is now underway on updating the *Flora of Virginia* App in an initiative called "Keeping the Science Current". This is part of Flora II to update the *Flora of Virginia* information since the 2012 publishing date. This effort will add approximately 150 new species to the App as well as current taxonomic changes. The descriptions at the species, genus, and family levels will need to be reflected in updated the dichotomous and graphic keys. Gary Fleming, recently retired chief ecologist for the Natural Heritage Program, has agreed to serve as the fourth author of the *Flora of Virginia* and he will be updating and expanding the ecological information of the species included in the App. Virginia Academy of Science support has been essential to the Flora of Virginia Project in the past and in the future. Author contact: Marion B. Lobstein, mblobstein@earthlink.net.

NOTES FROM NATURE - PLANTS OF VIRGINIA: AN UPDATE ON THE ONGOING DIGITIZATION OF VIRGINIA'S HERBARIA. Andrea Weeks, Dept. of Biology, George Mason Univ., Fairfax, VA 22030. In 2014, 11 Virginian herbaria (GMUF, FARM, VPI, LYN, VMIL, URV, LFCC, JMUH, VCU, BDWR, AVCH) began creating publicly-accessible online databases of their specimens, including high-resolution digital images (www.sernecportal.org). To date, 220,938 records have been digitized from the original eleven herbaria. Five herbaria have concluded NSF-sponsored digitization activities, four are in process, and the two remaining herbaria are slated to begin in 2019. Since 2014, Virginian herbaria have been added (PGC, LGBG) and lost (WYCO) from Index Herbariorum. In 2018, three additional Virginia herbaria (WILLI, ODU, MWCF) joined the SERNEC TCN initiative as an NSF PEN award, which will increase the number of digitized specimens from Virginia's Coastal Plain. LFCC will be permanently transferred to GMUF in 2019 and will be digitized, with grant support from the Virginia Native Plant Society. Lastly, research advances about the Virginia flora garnered from the digitized records from the are beginning to appear in the literature. Notably, the next edition of Flora of Virginia is referencing species records liberated by this effort and the known flora will expand as a consequence (Supported by Virginia Native Plant Society and National Science Foundation, EF-1410086 "The Key to the Cabinets: Building and sustaining a research database for a global biodiversity hotspot."). Author contact: Andrea Weeks, aweeks3@gmu.edu.

THE UNIVERSITY OF RICHMOND HERBARIUM FUNGI COLLECTION. W. John Hayden, Dept. of Biol., Univ. of Richmond, Richmond, VA 23173. The University of Richmond Herbarium (URV) includes 2750 specimens of lichenized and non-lichenized fungi most of which were assembled by R. F. Smart, his students, and his

colleagues in the 1930s and 1940s. Prominent collectors among the non-lichenized fungi include A. B. Seymour and F. S. Earle (177 Economic Fungi exsiccatae), F. A. Wolf (specimens from North Carolina), D. H. Linder (mostly Virginia collections); and J. L. Lowe (*Poria* from eastern North America). Included among the URV "fungi" are specimens of Oomycetes and Plasmodiophoromycetes, now considered to be non-fungal protists. E. S. Luttrell collected all groups of organisms while a student, but his most noteworthy contribution to URV consists of 1200 specimens of Virginia Cladoniaceae (lichenized fungi), assembled a few years after his graduation, while working for the Virginia Soil Conservation Service. Two other former students K. L. Poff and M. Ferrell collected ca 25% of the lichenized fungi at URV. Non-lichenized fungal specimens have been upgraded recently and are now enclosed in packets of acid-free paper affixed to standard herbarium sheets. Lichenized fungi are stored in packets held vertically in new acid-free trays. Label data for non-lichenized fungi at URV can be located on the Consortium of North American Lichen Herbaria web site. Author contact: W. John Hayden, jhayden@richmond.edu.

THE YEAR OF THE TREES: JMU CELEBRATES 30 YEARS OF OUTDOOR ENGAGEMENT IN A WOODLAND SANCTUARY. Conley K. McMullen, Dept. of Biology, James Madison Univ. & Jan Sievers Mahon, E.J. Carrier Arboretum, James Madison Univ. The year 2019 marks the 30th anniversary of an arboretum on the campus of James Madison University. The initial idea of converting part of the college woods into an arboretum began in the 1960s when Norlyn Bodkin arrived on campus. Over the years, this idea gained momentum, and in 1977 President Ronald Carrier approved the plans for an arboretum, and 26 acres were set aside for the project. Work began, slowly but surely, and in 1989 the arboretum opened to the public. In 1993, the arboretum expanded to 125 acres, with much of the added property comprising a forest of hardwoods that in 1998 was named The Norlyn L. Bodkin Oak-Hickory Forest. Also in 1998, the arboretum was officially named the Edith J. Carrier Arboretum in honor of JMU's 4th first lady. Other major projects over the years included creating a pond, erecting a pavilion for outdoor classes, and building an education center. The Edith J. Carrier Arboretum has developed into a woodland sanctuary on the JMU campus, and is a public urban garden and forested greenspace that preserves native plant species, provides opportunities for research, and promotes knowledge of the botanical and natural world for people of all ages. It is, a living laboratory that supports communal growth and involvement by presenting a place where flora and fauna can be appreciated, studied, and conserved; and its vision for the future continues to be to inspire outdoor engagement in a woodland sanctuary. Author contact: Conley K. McMullen, mcmullck@jmu.edu.

EVALUATING ATLANTIC WHITE CEDAR (*CHAMAECYPARIS THYOIDES*) TREE RINGS BETWEEN NON-TIDAL AND STORM-DRIVEN TIDAL WETLANDS. Jane F. Oswalt, J. Mitchell Doyle, & Robert B. Atkinson, Christopher Newport University. Atlantic White Cedar (*Chamaecyparis thyoides*, AWC) grows in a narrow range along the East Coast of the United States from Maine to Mississippi. Soils are acidic (~ 5.5 pH) and almost continuously saturated with freshwater. Less than 2% of stands remain, most harmed by ditching, fire, and logging. Now some of the most pristine stands are threatened by sea level rise as the current population lies within 70 m (200

feet) of sea level. This study contrasts AWC tree ring growth patterns with regard to water levels, precipitation, temperature, and drought intensity between the Great Dismal Swamp National Wildlife Refuge in Southeastern Virginia (3-7.5 m above sea level, GDS) and Alligator River National Wildlife Refuge in Northeastern North Carolina (<1 m above sea level, AR). GDS is an inland freshwater, drained peatland and AR is a coastal freshwater, storm-driven tidal wetland. Basal area increments (BAI) show GDS to have larger growth compared to AR but the biomass equal. The tree ring growth patterns of this species can help characterize the historic hydrologic regime in order to restore ditched sites; BAI trends signify AR as a restoration model for GDS. The next goal of this research seeks to isolate and understand the effects of saltwater intrusion from sea level rise in coastal stands. Author contact: Jane Oswalt, janeoswalt19@gmail.com.

AN ECOLOGICAL COMMUNITY SURVEY OF GAYLORD MARSH, A CALCAREOUS FEN IN CLARKE COUNTY, VIRGINIA. Daisy M. Blakely[1], Woodward S. Bousquet[1], Gary P. Fleming[2], Paul D. Poston[1], Hayden Bauserman[1], James Falletta[1], Emilio Rengifo[1], Collin Smeltzer[1], Jennifer Crider[1], Environmental Studies Program, Shenandoah University[1] and Virginia Natural Heritage Program[2]. Gaylord Marsh is located on private property in Clarke County, Virginia. Ecological communities had initially been surveyed in a single plot at the site in 1993. To more fully characterize the site, researchers in 2018 examined two more plots using the relevé method. A supplementary reconnaissance located noteworthy plant species outside the survey plots. A total of 63 vascular plant taxa, 33 of which occurred in the relevé plots, were documented. Seven county records, and 6 state-rare plant species were recorded. The county records and state-rare plants were all native to Virginia. Of the plant species found in the relevé plots, by dominance 98.9% were native and only 1.1% were introduced. By species richness, 97.0% were native, and only 3.0% were introduced. Of even greater surprise is that the dominant species *Carex utriculata* (beaked sedge) occurs in Virginia only at Gaylord Marsh. This research provides a baseline for future surveys at the site and the documentation of any changes in the vegetation that may occur. Author contact: Daisy M. Blakely, dblakely17@su.edu.

TARGET ENRICHMENT AND HIGH THROUGHPUT SEQUENCING APPROACHES TO RESOLVE THE MOLECULAR PHYLOGENY OF *PLATANTHERA* SECTION *LIMNORCHIS* (ORCHIDACEAE). Eranga H. Wettewa[1,2] & Lisa E. Wallace[2], Department of Biological Sciences, [1]Mississippi State & [2]Old Dominion University. *Platanthera* (Orchidaceae) is one of the largest genera of temperate orchids, with more than 200 species occurring in north temperate areas. Previous phylogenetic analyses in this genus have identified major radiations of species and tested sectional boundaries with respect to closely related genera, but we still lack a clear understanding of relationships among species within these major clades. *Platanthera* section *Limnorchis* has been identified as monophyletic in these previous analyses, and this group has long been recognized to be morphologically distinct from other *Platanthera* in North America. However, the recognition of several new species recently and morphological similarity of U.S. species with congenerics in Mexico and Asia have hindered a thorough understanding of species diversity and phylogenetic relationships in *Limnorchis*. In this project, we utilized one of the "reduced-

representation" methods, targeted-enrichment of low-copy nuclear genes to developed novel markers to use in estimating the phylogeny of section *Limnorchis*. We sequenced 24 samples collected from a wide geographic distribution, representing 22 *Platanthera* species, outgroup taxa and intermediates. Preliminary phylogenetic results of sequence variation in these markers are presented to test two hypotheses: 1) Section *Limnorchis* is monophyletic relative to other *Platanthera* species, 2) Species diagnosed by morphological characters are genetically divergent and represent distinct evolutionary lineages. Author contact: Eranga Wettewa, ehw89@msstate.edu.

ENCAPSULATION OF AFRICAN VIOLET (*SAINTPAULIA RUPICOLA* B.L. BURTT) SHOOT PRIMORDIA FOR MASS PROPAGATION. T. Warner Lowry & Michael H. Renfroe, Dept. of Biol., James Madison Univ. The *in vitro* propagation of plants is a promising method for the production of plants in species that are endangered, commercially valuable, and/or otherwise difficult to propagate through traditional horticultural methods. Leaf explants from critically endangered *Saintpaulia rupicola* were cultured on chemically defined media supplemented with various concentrations of thidiazuron (TDZ). These concentrations were effective in the production of shoot primordia that could then be encapsulated in a sodium alginate matrix to create synthetic seeds (synseeds). Synseed technology has potential in planting *in vitro* generated plant material in greenhouses to assist in the mass production of usable plants. Experiments were performed to determine if 2% or 3% sodium alginate was better for the emergence of the isolated shoot primordia. The 2% treatment had significantly more plants emerge and was used for the production of synseeds in later experiments. Various concentration of plant preservative mixture^{TM} (PPM) were used to make synseeds to test the phytotoxicity of PPM. There were no significant differences seen between the concentrations. Finally, experiments were performed with 0.0 ml/L and 5.0 ml/L PPM in the synseeds on sterile vermiculite, non-sterile vermiculite, and non-sterile soil. Synseeds planted on non-sterile soil had significantly less plant growth than the other media treatments. All synseed experiments had some shoots emerge that then rooted and grew into full, new plants. The methods used are potentially useful in the mass production of new *S. rupicola* plants for the purposes of conservation both *ex situ* and *in situ*. Author Contact: T. Warner Lowry, lowrytw@dukes.jmu.edu.

Posters

THE STRUCTURES AND FUNCTIONS OF WOODY DEBRIS IN HEADWATER STREAMS OF THE NORTHERN SHENANDOAH VALLEY, VIRGINIA. Paul D. Poston, J.A. Kincaid, A.M. Rubano,Environmental Studies Program, Shenandoah University. Woody debris (WD) in headwater streams has been recognized to have direct impacts on channel morphology and sedimentation. The arrangements and characteristics of in-stream wood alters the velocity and direction of stream flow, which can facilitate increased bank erosion and sediment transport within the channel. This research documented the position and function of woody debris in headwater watersheds containing low to moderate human activity to determine if such activity influenced WD recruitment into streams and established sample sites to facilitate future research. Research sites were selected based on land use, located by GPS and surveyed. WD was

then measured and cataloged by station, position, function, and decay class. Sediment depth, stream bed composition, bankfull width, bankfull depth, and wetted width measurements were also cataloged and recorded before and after each wood structure. Results indicated that the volume of WD was unaffected by the change in human activities. Lower sediment measurements were recorded in areas having higher human activity which can be attributed to the increased runoff and water volumes released as a result of deforestation. Author contact: Paul D. Poston, Pposton17@su.edu.

Chemistry

EFFECT OF DIMERIZATION AND HALOGEN BONDING ON SUBSTRATE BINDING TO THE THYROID HORMONE DEACTIVATING DEIODINASE 3 PROTEIN. Eric S. Marsan & Craig A. Bayse, Department of Chemistry and Biochemistry, Old Dominion University. Iodothyronine deiodinases (Dio) are proteins which activate and deactivate thyroid hormones (THs) by regioselective removal of an iodine. Disruption of thyroid hormone homeostasis leads to detrimental side effects including hypothyroidism, cardiovascular disease, and structural abnormalities. Deiodination is induced by a selenium atom in the conserved selenocysteine (Sec) residue located in the active site of these proteins. Halogen bonding (XB) has been proposed as a possible means of deiodination of thyroid hormones. XB interactions occur between a nucleophile (usually a Lewis base) and a halogen, which serves as the lone-pair acceptor. The widely-accepted σ-hole model for XB emphasizes electrostatic interactions between the donor and acceptor. However, many computational docking studies fail to account for the σ-hole, often leading to inaccurate results. In addition, a crystal structure for the dimer of Dio3 has yet to be elucidated, which is the active form of this protein. In the present study, we perform Molecular Dynamics (MD) simulations on T_4-bound Dio3 by using the "dummy atom" method to account for the σ-holes on the ligand. In addition, we use the SymDock program to construct a dimer of Dio3 and optimize its structure using a symmetry-restraining method. RMS and H-bond analyses herein were used to characterize and identify important interactions and key residues within the protein. Author contact: emarsan@odu.edu.

PHOTO-RESPONSIVE METALLO-GELS. K. Ghebreyessus & A. M. Sallee, Dept. of Chemistry and Biochemistry, Hampton University. Metal-organic compounds that interact with external stimuli provide versatile materials for medicinal, biological, chemical, and electronic applications. A novel class of highly promising photo-switchable arylazopryazole (AAP) based molecular switches have been recently reported. The rate of photo-isomerization of these new systems can be easily modulated by the substitution pattern on the pyrazole ring. We present here a new type of photoresponsive low molecular weight metallo-gelators based on phenylalanine and 3,4,5-tridecoxybenzamide conjugated with AAP ligands that are able to respond to light and metal-complexation. The simple mixing of the gelators with different copper(II) and zinc(II) salts resulted in rapid formation of metallo-gels. We also screened different types of metal salts in search for an ideal gel forming condition. The results revealed that the gelation process is independent of the type of metal salts used. The photo-responsive

behavior of both the gelators and the matallo-gel was studied by UV-vis Spectroscopy. Upon Irradiation with UV light (l = 363 nm) the AAP molecular switches undergoes efficient reversible *trans*-to-*cis* photo-isomerization. However, the light-induced gel-to-sol transition of the metallo-gel was not observed. These results may suggest that the photo-isomerization of the AAP unit is blocked while in the gel state. (Supported by NSF PREM grant; award#:1827820). Kesete.Ghebreyessus@hamptonu.edu.

UNDERSTANDING THE EFFECT OF INTRAMOLECULAR AND INTERMOLECULAR INTERACTIONS ON ENERGETIC MATERIAL SENSITIVITY. Ashley L. Shoaf & Craig A. Bayse, Department of Chemistry and Biochemistry, Old Dominion University. High energy density materials (HEDMs) with improved properties are under investigation to replace hazardous materials currently used in military and aeronautics applications. However, experimental data is limited because detonation is practically instantaneous; thus, information from density functional theory (DFT) could be used to predict energetic properties from bond activation measures. Trigger bonds, activated bonds that break to initiate explosive decomposition, are proposed based on DFT calculations and the Wiberg bond index (WBI), a measure of interatomic electron density. WBIs of HEDM trigger bonds were compared to those in reference molecules (i.e. contain same bond type and hybridization) to determine a relative scale for bond activation (%ΔWBIs). Trigger bonds are expected to be longer, have a lower electron density and be activated by repulsion and steric effects relative to the corresponding bond in reference molecules. Since detonation is a unique solid-state process, gas-phase calculations guide condensed-phase calculations to understand the favorability of certain initiation pathways. Thus, molecular dynamics simulations show how intermolecular interactions change over time with increasing pressure. Correlating %ΔWBIs to experimental data could provide insight into the effect of intramolecular interactions on sensitivity while molecular dynamics can show how intermolecular interactions influence sensitivity.

TRANSFORMATION OF SILVER NANOPARTICLES IN ANIONS. Peter N. Njoki, Department of Chemistry and Biochemistry, Hampton University. A laboratory experiment was developed to demonstrate the transformation of silver nanoparticles (Ag NPs) in water containing phosphate and sulfate anions. The experiment, conducted by high school students, involved hands-on training on synthesis of Ag NPs and characterization of the NPs via ultraviolet−visible (UV−Vis) spectroscopy. This was followed by UV−Vis examination of the change in absorbance and wavelength during the interaction of NPs with phosphate or sulfate anions. This study helped the students appreciate the transformation of NPs in aquatic environment containing anions. (Supported by: National Science Foundation HBCU-UP ACE Implementation. HRD-1238838). Author contact: peter.njoki@hamptonu.edu

ANALYSIS OF THE LIGHT INDUCED DEGRADATION OF NITROCELLULOSE LACQUER COATINGS USING VARIABLE TEMPERATURE REFLECTION ABSORPTION SPECTROSCOPY. Taylor W. Pryor & H. Francis Webster, Department of Chemistry, Radford University. In this paper nitrocellulose was coated on silver on the order of < 100 nm thick. This was then run in

FTIR while heating to get the normal degradation temperature of an undamaged film, and in TGA to view the mass as a function of temperature. Then new coated samples were exposed to different wavelengths of light 254 nm (UVA), 310 nm (UVB), and 365 nm (UVC). As thought the lower the wavelength the shorter length of time it took to destroy the nitro peaks as measured by FTIR. With the 254 nm light the destruction time of the nitro peak was ~0.5 hours, the 310 nm was ~12 hours, and the 365 nm was still present after 500 hours. Because of this the 365 nm was selected as the wavelength of interest and run out to 500 hours of exposure. These were done in a photo reactor with 365 nm bulbs at a constant humidity and constant temperature. These were then heated and the shift in degradation were plotted as area ratios. What was found as a function of time was that as the film became damaged that it began to decay at a lower temperature, and the total loss of the 1670 cm-1 peak occurred at a lower temperature. The undamaged polymer degraded in TGA at 180 °C vs 173°C using the RASTA technique while the 500-hour trial began to degrade at 139°C using the RASTA method. Author contact: tpryor5@radford.edu

SYNTHESIS AND ANTIMICROBIAL ACTIVITY OF SPIRO-OXINDOLES. Vincent de Paul Nzuwah Nziko[1], B. Bennette[1] & S. M. N. Efange[2], [1]Department of Chemistry and Biochemistry, Hampton University, Hampton, VA 23668, [2]Dept. of Chemistry, University of Buea, Cameroon. Spiro [indole-3,3'-pyrrolidin]-2(1H)-one analogs were synthesized via an intramolecular Mannich reaction. These compounds were investigated for their ability to inhibit in vitro the growth of D10 Plasmodium faciparum, K1 Plasmodium faciparum, Trypanosoma cruzi, trypanosoma.b. rhode- siense and Leishmania donovani. Compounds 73b was the most promising as inhibitors of both D10 and K1 P. falciparum. However, the compounds are not as efficient as chloroquine. Structure-activity relationships (SAR) and quantitative structure-activity relationships studies were carried out on this series. Our results allowed us to determine the minimal structural requirements for antiplasmodial activity in this series of compounds.

INVESTIGATION INTO THE EFFECT OF HETEROATOM CONTENT ON KEROGEN STRUCTURE USING ADVANCED 13C SOLID-STATE NMR SPECTROSCOPY. Wenying Chu1, Xiaoyan Cao2, Klaus Schmidt-Rohr2, Justin E. Birdwell3 & Jingdong Mao1, 1Dept. of Chemistry & Biochemistry, ODU, 2Dept. of Chemistry, BU, 3Central Energy Resources Science Center, USGS. Three shale samples containing kerogen with extreme hereroatom contents were selected to study the effect of heteroatom concentrations on kerogen structures. Advanced 13C solid-state nuclear magnetic resonance (NMR) techniques, including multiple cross-polarization/magic angle spinning (multiCP/MAS), dipolar dephasing (multiCP/DD), and 2D 1H–13C heteronuclear correlation (2D HETCOR) were applied to the samples. The high oxygen content in Estonian kukersite corresponded with abundant aromatic C-O structures and that nonprotonated aromatic carbons bonded to oxygen and alkyl chains led to more diverse aromatic signal distributions and structures in the kukersite organic matter than were observed in the other shales. The low-heteroatom kerogen in Australiam Glen Davis torbanite had the simplest structural pattern and the lowest aromaticity. The organic sulfur-rich Ghareb marinite from Jordan contained the highest aromaticity and most diverse alkyl structures among the three shales. Consistent with previous studies of shales

and kerogens, NMR provides deeper insights into structural characteristics in organic matter than kerogen typing based solely on elemental ratios (H/C, O/C) or programmed pyrolysis parameters. Author contact: wchu@odu.edu

DEVELOPING SMALL MOLECULE INHIBITORS FOR CALPAIN DEPENDENT DEGRADATION OF DESMOPLAKIN. Kendahl L. Ott[1], Taylor L. Albertelli[1], Nathan T. Wright[1], Heather Manring[2], Maegen A. Ackermann[2] & Stuart Campbell[3], [1]Department of Chemistry and Biochemistry, James Madison University, [2]Department of Physiology and Cell Biology, Ohio State University, [3]Department of Biomedical Engineering, Yale University. Desmoplakin (DSP) is a large (260 kD) protein found in the desmosome, a subcellular structure that links the cytoskeleton of one myocyte to that of its neighbor. In cardiomyocytes, desmoplakin's main function is to maintain cell-to-cell adhesion and synchronization during heart contractions. A mutation hot-spot, centered around the SH3 domain of DSP, is associated with arrhythmogenic cardiomyopathy, but the underlying mechanism(s) of this association isn't well studied. Through various fluorescence techniques, it can be shown that many of these disease-causing mutations display increased calpain sensitivity. Additionally, structural and computational studies on DSP variants show that this cleavage event is driven not through a gross structural change, but instead through the discrete exposure of a normally-occluded calpain cleavage site. Initial *in silico* and *in vitro* screens of small molecules suggest the feasibility of developing a pharmaceutical solution to prevent calpain-mediated DSP cleavage. (Supported by: NSF REU (CHE-1757874), NSF RUI MCB-1607024, Henry Dreyfus Teacher-Scholar Award & VAS Undergraduate research minigrant). Author Contact: Kendahl L. Ott, ottkl@dukes.jmu.edu

MOLECULAR MODELING AND DRUG MAPPING HEMOLIN PROTEIN WITH DRAGOMABIN ANALOG. Michelle K. Waddell, Dept. of Chem. & Biochem., Hampton University. Malaria is a mosquito-borne disease carried primarily by the *plasmodium falciparum* parasite. Over time the parasite has developed resistance to several antimalarial drugs. Dragomabin, a bioactive isolate of marine cyanobacteria, *Lyngbya majuscule*, has shown activity against Chloroquine-resistant parasites although the mechanism is not fully understood. The objective of this research was to improve the activity rate of Dragomabin through computational modeling of a protein that binds to Chloroquine in a similar manner. The selected protein, Hemolin, is an insect immunoglobulin superfamily member and a lipopolysaccharide-binding immune protein induced during bacterial infection. The CheMagic.com Virtual Molecular Model Kit was utilized to construct the Dragomabin molecule, and was later used to import the Hemolin protein from ProteinDataBank.com. Protein Data Bank Extract was then later used to create Cartesian coordinates to be imported into Auto Dock in order to bind Hemolin with Dragomabin. A series of Dragomabin analogs were modeled using both CheMagic.com Virtual Molecular Model Kit and ChemDraw 3D 16.0. Dragmobin analog 5 was found to have the most effective binding affinity to the Hemolin protein. (Supported by: U.S. Department of Education Ronald McNair Post-Baccalaureate Program at Hampton University). Author contact: Michelle K. Waddell, michelle.waddell@hamptonu.edu.

ENGAGING UNDERGRADUATES IN RESEARCH THROUGH DPAL (DISTRIBUTED PHARMACEUTICAL ANALYSIS LABORATORY): SCREENING FOR LOW QUALITY PHARMACEUTICALS USING ATOMIC ABSORPTION SPECTROSCOPY. Maria A. Puccio. Dept. of Natural Sci. and Math. Ferrum College. Method development, quality assurance, and calibration are concepts that can be difficult to convey to undergraduate students. Many undergraduate labs follow a "cook-book" recipe in which the method is already developed, quality assurance isn't required, and students struggle to understand what calibration is for. DPAL is a citizen scientist group which partners with pharmacists in low-income countries to obtain samples for potentially low quality or falsified medicines. These samples are then distributed to undergraduate institutions in the DPAL network for analysis. This offers a real-world problem for undergraduate students to tackle. Students at Ferrum College are currently developing a method for the analysis of magnesium from magnesium sulfate injection solutions (used in the treatment of preeclampsia). This work will present the results of the first phase of method development and the plans for incorporating DPAL into research and undergraduate courses next semester. Author contact: mpuccio@ferrum.edu.

THE REACTIVITY OF SELECTIVE ZINC FINGER PROTEINS WITH REDUCIBLE SULFUR AND SELENIUM COMPOUNDS – A QM/MM STUDY. Ana Dreab[1], Patricia B. Lutz[2] & Craig A. Bayse[1], [1]Dept. of Chemistry & Biochemistry, Old Dominion Univ. [2]Dept. of Science, Technology & Mathematics, Regent Univ. Zn-S centers are important to different biological processes such as DNA transcription and repair, biochemical recognition and protein regulation. Zinc finger (ZF) regions of transcription proteins, which are found as three classes (Cys_4, Cys_3His and Cys_2His_2), are an important subset of zinc-binding proteins. Reducible sulfur and selenium (r-S/Se) compounds eject Zn^{2+} from zinc-sulfur proteins. The Zn^{2+} ejection leads to the loss of the tertiary and quaternary structure of the protein and therefore the loss of its functions. The underlying mechanism is poorly understood and a fully characterization is required to design and use specific sulfur- and selenium-based inhibitors of the therapeutic potential. In the current work, the mechanism of Zn^{2+} release from Cys_4 – type ZFs by ebselen and dithiones are explored through a series of QM/MM studies that addresses both the energetics and the sterics of the interactions. Both the charge and the solvent accessibility of all ZF Cys S atoms are calculated to determine the most favorable site for the attack of the electrophilic r-S compound. The preliminary data is in agreement with our previous gas-phase calculations and the results are compared with the experimental data, when available. (Supported by: The Virginia Academy of Science). Author contact: cbayse@odu.edu

THEORETICAL STUDIES OF THE NON LINEAR OPTICAL PROPERTIES (NLO) OF A SERIES OF DITHIENOPYRROLE-BASED DONOR-PI-ACCEPTOR (D-P-A) DYES. Edmund Moses N. Ndip, Dept. of Chemistry and Biochemistry, Hampton University. The changes in the structure, linear and nonlinear optical (NLO) properties of several organic semiconductors as the donor / acceptor strengths and substituent groups on N of pyrrole moiety are changed have been investigated. These include geometrical parameters, dipole moments, HOMO-LUMO

energy gaps, absorption wavelengths, and total polarizabilities and hyperpolarizabilities. Semi-empirical calculations of the frequency-dependent linear polarizability, α, the second, β- and third, γ-order hyperpolarizabilities at the fundamental (1028 nm) and other wavelengths were achieved by applying the *ab initio* time-dependent coupled perturbed Hartree -Fock (TDCPHF) method at the Restricted Hartree- Fock (RHF) level using routines contained in MOPAC2016 program. Donor groups studied include $(C_6H_5)_2N$-, $(CH_3)_2N$-, and CH_3O-. Acceptor groups studied include –CHO (aldehyde), cyanoacrylic acid, $=C(CN)CO_2H$, cyanoacrylic amide, $=C(CN)CONH_2$ and rhodanine. The polarizability and hyperpolarizabilities exhibit discernible frequency dependence. Higher level calculations using first principles *ab initio* methods (DFT, TDDFT and others along with large basis sets including polarization functions are planned for the future to verify the observed trends. This work was supported in part by Hampton University – Brandeis University NSF DMR PREM grant. Author contact: edmund.ndip@hamptonu.edu

THERMAL DEHYDRATION OF METAL SALT HYDRATES. T.C. DeVore, Isatu Kanara & James Harness, Dept. of Chemistry and Biochemistry, James Madison Univ. The thermal hydration-dehydration cycles of metal salt hydrates are being investigated for use in devices that can be used to harvest water from the atmosphere. The dehydration pathways of $MgSO_4 \cdot 7\ H_2O$ has been investigated under several experimental conditions. The first water is lost by 300 K to form $MgSO_4 \cdot 6\ H_2O$. The next five waters of hydration are apparently lost in one step to form $MgSO_4 \cdot\ H_2O$ in uncapped cells in flowing nitrogen. However, as the rate of transport is slowed by putting a cap on the cell, intermediates of $MgSO_4 \cdot n\ H_2O$ with n = 3, 2, 1 are also observed. Model free and isothermal kinetics indicates that the dehydration also passes through these intermediates in uncapped cells. Isothermal kinetics data can be fit using the contracting volume mechanism. However, the apparent activation energy decreases slightly as the sample mass increases suggesting that even in uncapped cells, the dehydration is following a quasi-equilibrium mechanism. Author contact: devoretc@jmu.edu.

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DETERMINING THE CHEMICAL THERMOSTABILITY OF THE DIMERCAPROL COMPLEXES WITH MERCURY AND LEAD IN TREATING HEAVY METAL POISONING. Briana Roberts, Stephanie Chigbu & Insu Frank Hahn, Dept. of Chemistry and Biochemistry, Hampton University. Exposure to metals such as lead (Pb) and mercury (Hg) have been found to cause heavy metal poisoning. Chemical chelation therapies with chelating agents, including Dimercaprol (BAL) and Succimer (DMSA), have been applied to treating the heavy metal poisoning by capturing toxic heavy metals in the cardiovascular and lymphatic systems. There has been lack of understanding of the thermochemistry of the metal complex compounds with chelating agents used in chelate therapy for heavy metal poisoning. Here, theoretical semi-empirical AM1 (Austin Model 1), PM3 (Parameterized Model number 3), and MNDO (Modified Neglect of Diatomic Overlap) calculations for the newly constructed 3-D models of controlled dimercaprol with Pb^{+2} and Hg^{2+} were conducted in gas and water phases to investigate the intrinsic thermochemical coordination bond properties, ie.,

stability and reactivity of biological-inorganic chelates for chelation therapy in heavy metal poisoning, via MOPAC (Molecular Orbital Package) simulations. The newly obtained comparative thermochemical data in this study may contribute toward new chelate therapies, drug development and its applications. (Supported by NSF HBCU-UP ACE NANOHU PROGRAM, Hampton Univ.). Author contact: insu.hahn@hamptonu.edu.

INVESTIGATING THE STABILIZING EFFECT THAT PENICILLAMINE HAS ON HEAVY METAL POISONING. Mercedes Matlock, Arielle Patterson, Briana Roberts & Insu F. Hahn, Dept. of Chemistry and Biochemistry, Hampton University. It has been reported that exposure to metals such as lead (Pb), mercury (Hg), chromium (Cr), arsenic (As), iron (Fe), etc. can cause heavy metal poisoning. Chemical chelating agents such as Penicillamine, Dimercaprol, Ethylenediaminetetraacetic acid and Succimer have been used for inorganic chelation therapy to treat the heavy metal poisoning by capturing toxic heavy metals in the cardiovascular and lymphatic systems. These chelated metal complexes are then excreted through the urine. However, no thorough thermochemical stability investigations on the chelated metal complexes for chelation therapy have been reported. In this study, semi-empirical AM1 (Austin Model 1), PM3 (Parameterized Model number 3), and MNDO (Modified Neglect of Diatomic Overlap) quantum chemical approximations for the newly constructed 3-D models of controlled penicillamine complexes with Pb^{+2} and Hg^{2+} were conducted in gas and water phases to examine the intrinsic thermochemical stability and reactivity of the biological-inorganic chelates being used in chelation therapy for heavy metal poisoning. The newly obtained comparative thermochemical data via MOPAC (Molecular Orbital Package) simulations may contribute toward new chelate therapies and drug development. (Supported by NSF HBCU-UP ACE NANOHU PROGRAM, Hampton Univ.). Author contact: insu.hahn@hamptonu.edu.

THE EFFECT OF TRIGGER BONDS IN ORGANIC CAGE MATERIALS USING WILBERG BOND INDEX ANALYSIS. Mohamamd Jaffar & Craig A. Bayse, Dept. of Chemistry and Biochemistry, Old Dominion University. Energetic materials (chemical explosives) have a high amount of stored chemical energy that can be released when their bonds break under stimulus (stress, heat, shock). We have examined the trigger bonds in a series of cage molecules. The Wiberg bond index and bond lengths are calculated in order to estimate the compounds' sensitivity and to develop a "green" explosives. Organic-cage compounds based on prismane and cubane have large strain energies, high heat of formation, and compact structure and may be comparable to known energetic materials, like TNT. A classic example of cage-like energetic materials is CL-20.

$$\%\Delta\mathrm{WBI}_{\mathrm{AB}} = \frac{\mathrm{WBI}_{\mathrm{AB}}(\mathrm{HEDM}) - \mathrm{WBI}_{\mathrm{AB}}(\mathrm{reference})}{\mathrm{WBI}_{\mathrm{AB}}(\mathrm{reference})} \times 100$$

Wiberg Bond Indices (WBIs), a measure of electron density between two atoms in a bond. The trigger bond was assigned for a molecule based on the negative value of %ΔWBI relative to the reference. Examples of references we used, nitromethane ($C(sp^3)$-NO_2), dimethylnitroamine ($N(sp^3)$-NO_2), and nitroester ($O(sp^3)$-NO_2). Author contact: cbayse@odu.edu

EFFECT OF HYDROGEN BONDING ON THE CONFORMATION DYNAMICS OF AN Ω-LOOP OF IODOTHYRONINE DEIODINASE. Alexis Tran-Thompson, Jenna R. Garcia, Eric S. Marsan & Craig A. Bayse, Department of Chemistry and Biochemistry, Old Dominion University. Iodothyronine deiodinases (Dios) are selenocysteine-dependent enzymes that activate and deactivate thyroid hormones through elimination of iodide. Mutations at key residues can prevent deiodination to disrupt developmental and metabolic processes. Multiple μs molecular dynamics simulations using AMBER have been performed on the wild-type of Dio3 and its Ser167Ala, Thr169Ala, and Glu200Thr mutants to understand the structural effects of mutation on a critical omega-loop that is believed to contribute to substrate binding and activation. Hydrogen-bonding interactions between loop residues and the active site define the conformation of the loop and presumably substrate selectivity and the activity of the protein. Hydrogen bonding interactions between loop residues and the side chains of the Ser167/Thr169 residues at the active site pin the loop to the bulk of the protein. Mutations of these residues significantly increase loop flexibility, which likely results in diminished substrate binding and loss of activity. (Grant-in-aid of Research, The National Institute of Health). Author contact: Alexis Tran-Thompson, ttran014@odu.edu.

EXAMINING THE TEMPORAL DYNAMICS OF CASPASE-8 ACTIVATION IN THE EXTRINSIC PROCESS OF APOPTOSIS. Catherine H. Zwemer & Randall D. Reif, Dept. of Chem., Univ. of Mary Washington. Apoptosis is a process of cell death that occurs within the body. Caspases are a family of enzymes which activate each other to degrade cellular proteins leading to the death of the cell. The steps of apoptosis are well known, however the timing of caspase activity within the cell is not. The purpose of this research is to understand the temporal dynamics of the caspase-8 activation in the extrinsic pathway of apoptosis. Cells are examined by fluorescence microscopy using an affinity microfluidic device and a fluorogenic caspase probe derived from Rhodamine 110. Fluorescence is monitored over a period of 6 hours, indicating the level of caspase activity within the cell. This procedure is conducted for caspase-8 using a $IETD_2R$ probe. Caspase-8 activity was shown to start 1.6 hours post-induction lasting 180 minutes. Understanding the timing of caspase activation could be helpful in designing apoptosis-targeted therapies. Author contact: czwemer@mail.umw.edu.

Data Science, Computing and Statistics

MACHINE LEARNING TECHNIQUES FOR MALWARE CLASSIFICATION. Yen-Hung (Frank) Hu[1], Abdinur Ali[2], Chung-Chu (George) Hsieh[1] & Aurelia Williams[1]. [1]Department of Computer Science and [2]Department of Mathematics, Norfolk State University. Today's malware is more sophisticated than its predecessors and has the ability to obfuscate and change its activities, which increases the difficulty of detecting and classifying its identity. For instance, it is difficult to detect and identify advanced persistent threats (APTs) if they can clean their attack traces and logs and leave nothing behind. Many approaches have been investigated in the past decade, yet there still lacks a

comprehensive solution to solving such an issue. Machine learning technology could be a promising approach for classifying malware with none or few known traffic patterns and activity logs, because it can learn new information about unknown malware and be trained to adapt to such knowledge. In this research, we study the performance of several machine learning algorithms for classifying malware. Ten machine leaning algorithms are used to classify a Microsoft Kaggle dataset consisting of nine pieces of malware identified by their API calls and N-grams signature patterns. The performance metrics used in this research are Time to Build Model (TBM), Correctly Classified Instances (CCI), Kappa Statistics (κ), Root Mean Squared Error (RMSE), True Positive Rate (TPR), F-Measure, Matthews Correlation Coefficient (MCC), and Receiver Operating Characteristic Area (ROCA). We study and analyze performance metrics of every selected machine learning algorithm against every selected malware. Our research results show that Random Forest machine learning algorithm is the best one for classifying the selected malware since it has the best overall performance. Author contact: yhu@nsu.edu.

EXPLORING DATA REMANENCE IN VOLATILE MEMORY. Travis Bresnahan & Robert Marmorstein, Dept. of Computer Science, Longwood University. Information stored in Dynamic RAM is typically supposed to be volatile in the sense that it disappears when power is removed from the system. Many security mechanisms, including authentication and authorization systems depend on this assumption. Previous work shows that under certain conditions data may be recoverable after a reboot for a substantial period of time. However, previous work has focused on systems running the Windows operating system. In this project, we examined data remanence on Linux workstations. We were unable to demonstrate remanence affects, suggesting that future work is warranted in this area. (Supported by a CURIO grant, Office of Sponsored Research, Longwood University). Author contact: marmorsteinrm@longwood.edu

A CASE STUDY OF WEARABLE TECHNOLOGY VULNERABILITIES – FITBITS. Yen-Hung (Frank) Hu, Felton Blow, Mary Ann Hoppa. Department of Computer Science, Norfolk State University. Wearable devices are being developed and brought to market so rapidly that security and risk management often appear to be overlooked. As the use of wearable devices continues to grow at an incredible rate, so do device vulnerabilities, and along with them security and privacy risks. In the wrong hands, the data that wearable devices collect can potentially cause more harm than data from smartphones and other devices. Wearable devices have created another attack vector, and, if not appropriately controlled or governed, can facilitate the compromise of data confidentiality, availability and integrity for users and organizations. Wearable devices are in high demand because of their ability to deliver useful functionality both conveniently and in real time. These devices also are embedded with sensors that enable the collection of vast amounts of information. Some of the key sensors are accelerometers, gyroscopes, Global Positioning System (GPS), acoustics and voice detection. Since these built-in sensors gather personally identifiable information (PII), users and organizations become subject to vulnerabilities and cyber-threats. This research explored cybersecurity vulnerabilities, threats, and risks related to wearable devices using the Fitbit smartwatch as a popular example. Analysis focused on the sensors that are

integrated into such devices. Understanding how these components work exposed ways they can be exploited, which in turn suggested ways to mitigate potential cyber-attacks on wearable devices. Author contact: yhu@nsu.edu

A NOVEL AUTONOMOUS VEHICLE ROUTE PLANNING SYSTEM. Susan Zehra, Syed R Rizvi, & Stephan Olariu, Dept. of Computer Science, Old Dominion University, Norfolk, VA 23529. We propose and simulate a novel autonomous vehicle route planning system called an Agent-assisted Smart Auction-based Parking (ASAP) system for Autonomous Vehicles (AVs). Urban parking is taken as a use case for illustration and validation. In order to improve parking space allocation, we incorporate an auction mechanism. ASAP leverages truthful bidding from the bidders while providing higher utilization to Parking Facility Providers (PFPs) due to the inherent ability of AVs to move without the presence of an actual human in them, thus increasing revenue. The main contribution of this paper is the introduction of a parking auction through sophisticated software agents that are capable of quickly and seamlessly performing tasks such as parking lookup, negotiation, pricing, and reservation. Simulation results show that the proposed scalable and interactive agents of ASAP enable efficient processing of a vast amount of data, providing cost savings for parkers looking for parking, and improving usability of public and private parking facilities. Author contact: szehra@odu.edu

VULNERABILITY ASSESSMENTS FOR SCADA DEVICES. Yen-Hung (Frank) Hu, Dawn Silverman & Mary Ann Hoppa. Department of Computer Science, Norfolk State University. Supervisory Control and Data Acquisition (SCADA) technology has evolved since its inception in the 1950's through four generations. Each generation has brought new capabilities and a more scalable network as the performance of SCADA devices has increased throughout the years. Each generation has brought new vulnerabilities, challenges, and opportunities for securing SCADA-enabled systems from malicious attacks. SCADA devices have increasingly become targets of malicious actors, alerting industries, governments and private citizens to the need for more effective security measures, particularly for critical infrastructure and industrial control systems (ICS). These systems throughout the United States and abroad are dependent on SCADA devices to automate and monitor processes. They deliver essential services, including electric power and purified water, to residential and commercial properties where a sustained interruption could create a crisis with dire consequences. To address concerns on this issue, a thorough survey and investigation was conducted on cyber-attacks targeting SCADA systems to propose solutions and recommendations for mitigating such attacks. This research first studied some historical perspectives on SCADA and associated risks, including examples of typical attacks. Some general recommendations were made for methodically securing SCADA networks. The long-term objective of this research is to better secure the future of SCADA and, by implication, the critical infrastructures that depend on this technology, through more focused cybersecurity vulnerability assessment and mitigation. Author contact: yhu@nsu.edu

INTERNET OF THINGS COMMUNICATIONS FOR SMART CITY: A HOLISTIC ARCHITECTURE. Susan Zehra, Syed R Rizvi, & Stephan Olariu, Dept.

of Computer Science, Old Dominion University, Norfolk, VA 23529. An architecture based on Internet of Things (IoT) communications for use in a smart city is proposed and simulated in this research. Urban parking is taken as a use case for illustration and validation. The system design is a lightweight, scalable, and adaptable system that automates the workflow of reserving the best parking spots. It employs a novel parking broker – a software agent that leverages valuable route planning information from other traffic information services, and promotes road-safety by minimizing the need for parkers to interact with their smartphones or onboard units, thus reducing distracted driving. In addition, the parking record collected by the system can provide local governments with statistics for building future parking lots. The proposed parking network and architecture, system workflow, strategy model, and simulation highlight the importance of desirable features such as satellite navigation, indoor navigation, event data recording, parking reference, traffic and weather information, and parking reservations. Author contact: szehra@odu.edu

Education

(Not Available)

Entomology

ROLE OF *IXODES SCAPULARIS* SPHINGOMYELINASE-LIKE PROTEIN (*IsSMase*) IN TICK-BORNE PATHOGEN TRANSMISSION. Pravesh Regmi, Supreet Khanal, Girish Neelakanta & Hameeda Sultana, Old Dominion University. *Ixodes scapularis* (hard tick) is one of the major vectors which is involved in arthropod borne disease transmission. Langat virus (LGTV) is a model pathogen to work in the research laboratory, which resembles both antigenically and phylogenetically with other medically important flaviviruses such as Tick-Borne Encephalitis virus (TBEV) and Powassan virus (POWV). Sphingomyelinase-like protein (*IsSMase*) is a molecule present in ticks that helps to catalyze hydrolysis of the sphingomyelin (cell membrane lipid) into phosphorylcholine and ceramide. Our study suggests that *IsSMase* expression is downregulated in presence of tick-borne LGTV-infected cells. Time and dose dependent post-infection was performed to detect the *IsSMase* expression. LGTV loads increased in tick cells, however, *IsSMase* expression was downregulated with the increase in time and dose dependent LGTV post-infection. Similar results were obtained with LGTV-infected unfed Nymphal ticks. Our data suggests that *IsSMase* is downregulated in tick cells and in ticks with the increase in LGTV viral loads. This work was supported by start-up funds from Old Dominion University to H.S. Author contact: Pravesh Regmi and Hameeda Sultana, pregmoo2@odu.edu and hsultana@odu.edu.

DEVELOPING A PEST MANAGEMENT PLAN FOR EDAMAME PRODUCTION IN VIRGINIA. Kemper L. Sutton, Thomas P. Kuhar, & Steven L. Rideout, Virginia Polytechnic Institute and State University. Edamame (*Glycine max* (L.) Merr.) has increasing demands from consumers in the United States. Currently, the vast majority of edamame is imported from Asia. As part of a research team at Virginia Tech

working on improving the production of edamame in the United States, our research focuses on pest management of this crop. In 2018, we evaluated 23 varieties of large-seeded soybeans for their potential as an edible edamame crop. Key insect pests included a complex of lepidopteran pests, soybean aphid, stink bugs, potato leafhopper, and Mexican bean beetle. In 2019 I will be focusing my research on the differences among edamame varieties in pest densities and injury by insect and diseases, evaluating and refining a multi pest scouting program, determining the effects of the brown marmorated stink bug on developing edamame pods, and evaluating the efficacy of selected fungicides for control of soybean anthracnose. This work was funded by USDA-NIFA SCRI Project # PA63C42V: Developing edamame varieties for mechanized production and improved consumer acceptance to increase sustainability of the vegetable industry. Author contact: Kemper Sutton, KLSutton@vt.edu

A NEW SPECIES OF *SCIRTES* (COLEOPTERA: SCIRTIDAE) AND A REVISION OF THE GENUS FOR EASTERN USA: A SPECTACULAR EXAMPLE OF BACKYARD ENTOMOLOGY! Charles A Springer & Deborah A Waller, Old Dominion University. *Scirtes goodrichi* Springer and Waller, a new species in the family Scirtidae is described as part of a study of the aquatic beetles of southeastern Virginia. Nine specimens were collected with a light trap in the backyard of the author, and seven more were identified in museum specimens from South Carolina. Two species, *Scirtes ovalis* Blatchley 1924 and *S. piceolus* Blatchley 1924, are synonymized with *S. tibialis* Guerin 1843. *S. tibialis* and *S. orbiculatus* (Fabricius) 1801 are redescribed using defining characters that distinguish them from each other and from *S. goodrichi*. These characters include color, mandibular tooth, prosternal process, elytral convexity, body shape, and male and female genitalia. Distributions are described for the three species, which are sympatric in the type locality of *S. goodrichi*, Norfolk, Virginia. This study demonstrates the need for more critical examination of local species and museum specimens to identify unrecognized species which are increasingly confronted by the biodiversity crisis. Author contact: Charles Springer, bispinatus@cox.net.

BROWN MARMORATED STINK BUG (*HALYOMORPHA HALYS*) ASSOCIATION WITH INDUSTRIAL HEMP. Mika K. Pagani, Kadie E. Britt & Thomas P. Kuhar, Virginia Polytechnic Institute and State University. Industrial hemp is gaining momentum in interest for its various sustainable and medicinal benefits. It's a common misconception that industrial hemp is immune and resistant to pest pressure. Currently, there are only anecdotal observations relating to damage from insect pest pressure and their effects on industrial hemp yield. Studies are necessary to definitively identify the common regional agricultural pests which may pose a threat to the crop. In 2017, hemp field plots from several locations in Virginia were first sampled for insects and their damage. Several insect species were commonly encountered on hemp plants, including the brown marmorated stink bug (*Halyomorpha halys*). Effects of damage to hemp plants from this insect are unknown, so studies were initiated in 2018 to investigate further. Bugs were caged in varying densities for several weeks on seed heads of grain variety industrial hemp in field plots to document damage appearance and yield effects. Seeds were removed from plants in the laboratory, counted, and weighed to assess differences between treatments. In another study, bugs were reared on hemp seed heads

in a lab setting from the second instar to adulthood. We found that bugs developed successfully to adulthood. Results from both studies have been analyzed and will be presented. (Supported by: Virginia Academy of Science & Fralin Undergraduate Research, VA Polytechnic Inst. & State Univ.). Author contact: mika396@vt.edu

BROWN STINK BUG (*EUSCHISTUS SERVUS*) MANAGEMENT THRESHOLDS IN FIELD CORN. Tim B. Bryant & Sally V. Taylor, Virginia Polytechnic Institute & State University. In 2016 and 2017, large numbers of brown stink bugs, *Euschistus servus* (Say) (Hemiptera: Pentatomidae), were found in maize, *Zea mays* L. (Poales: Poaceae), research plots with subsequent reductions of grain yield in eastern regions of Virginia. It is unclear what level of infestation during what period of time in maize development will cause economic injury to grain yield. While previous research has shown a reduction in maize yield from herbivory during both seedling development (VE-V6) and grain fill (R1), no research-based thresholds exist for managing stink bug populations in southeastern Virginia maize. Field experiments were conducted in Suffolk, Virginia in 2018 to determine 1) if infestations during seedling development or during grain fill have a greater impact on grain yield and 2) the infestation levels that result in economic injury at each of these growth stages. Results indicate that stink bug infestations of less than 1 bug/plant during seedling corn development (V2) do not cause a significant decrease in early maize growth or the grain yield. Reproductive corn at stage R1 can also tolerate up to 3 bugs/plant without a significant decrease in grain yield, however this feeding may reduce grain quality. These results suggest that the most important time period for stink bug management in corn, is earlier in reproductive development than previously found in the literature but grain quality reduction may persist through later stages. Author contact: btim2@vt.edu

INSECT PEST EFFECTS ON INDUSTRIAL HEMP. Kadie E. Britt & Thomas P. Kuhar, Department of Entomology, Virginia Polytechnic Institute and State University. Industrial hemp is a reemerging crop to United States agriculture. Due to the crop's prohibition throughout the large part of the past century, there is little scientific information available regarding crop production and management, and no information about hemp pest management in Virginia. Thus, an industrial hemp pilot program was initiated in Virginia in 2016. In 2017, hemp field plots from several locations in Virginia were sampled for insects and their damage. Several insect species were commonly encountered on hemp plants, including corn earworm (*Helicoverpa zea*), which appeared to cause the most damage to hemp seeds and warranted future IPM research. A field study was initiated in 2018 to assess the effects of insect feeding on yield of grain variety industrial hemp. Hemp plants were manually defoliated in the field at levels of 0%, 25%, 50%, and 75% to simulate insect leaf feeding on three specific dates: 20, 40, and 60 days post planting. We found that yield was not affected by any amount or timing of leaf area removal from plants. An additional study used insecticides to selectively control insect pests from feeding on hemp, including plant feeding bugs, larval lepidopterans, and all insects. We found that insecticide treatment had no effect on overall yield of grain variety hemp. Author contact: kadieb@vt.edu.

MARGINED LEATHERWING (COLEOPTERA: CANTHARIDAE) BEHAVIOR AND ACTIVITY THROUGHOUT DAYLONG OBSERVATION PERIODS. Katlyn A. Catron & Thomas P. Kuhar, Virginia Polytechnic Institute & State University. Behavior of individual insects and interactions with conspecifics are often overlooked aspects of insect biology. Beetles in the genus Chauliognathus have been observed guarding nectar-producing inflorescences and fighting with conspecifics over these resources in Central and South America. To determine if North American Chauliognathus marginatus exhibit these or similar behaviors, adult beetles were observed on a variety of wildflowers over 8- to 10-hour periods throughout the summer of 2018. Beetle behavior and interactions were recorded hourly. The most common interaction between beetles was mating, with almost no instances of aggression or resource guarding among beetles. Individuals also engaged in traveling, preening, and resting behaviors throughout the day. Significant relationships existed between time of day, weather conditions, and beetle activity. Future work will address behavioral differences between the beetle sexes and the relationships between host plant and behavior type. (Supported by USDA Southern Sustainable Agriculture Research and Education [SARE] Grant). Author contact: Katlyn Catron, kamos@vt.edu.

Posters

EFFECTS OF FOUR SELECTIVE INSECTICIDES ON SQUASH BUG, *ANASA TRISTIS* (HEMIPTERA: COREIDAE), AND ITS PRIMARY PARASITOID, *GRYON PENNSYLVANICUM* (HYMENOPTERA: SCELIONIDAE). Sean M. Boyle, James M. Wilson, & Thomas Kuhar, Virginia Polytechnic Institute and State University. The squash bug, *Anasa tristis* DeGeer (Hemiptera: Coreidae), is an endemic pest species of the Americas that feeds on plants in the family Cucurbitaceae with a preference for squash and pumpkins. Currently, the most widely adopted strategy for squash bug management is chemical control. However, these chemical tactics mainly utilize broad spectrum insecticides which can have deleterious side effects to non-target organisms as well as promote secondary pest outbreaks. For this reason, more IPM-compatible insecticides and other management techniques are needed to mitigate these negative ecological consequences. We conducted laboratory bioassays to assess the efficacy of several selective hemipteran-specific insecticides on squash bugs and their key natural enemy, egg parasitoid *Gryon pennsylvanicum* Ashmead (Hymenoptera: Scelionidae). Flonicamid, flupyradifurone, pyrifluquinazon, and sulfoxaflor were used as the selective insecticide treatments while λ-cyhalothrin was included as a broad spectrum pyrethroid treatment. In the *A. tristis* nymph bioassays, none of the four selective insecticides provided effective control (> 50% mortality) after 48 hrs. Comparatively, flonicamid, flupyradifurone, and pyrifluquinazon were found to have minimal toxicity to adult *G. pennsylvanicum*. In both insects, λ-cyhalothrin treatments resulted in high mortality (> 90%). Although our four selective insecticides proved ineffective for controlling squash bug, their lower toxicity to *G. pennsylvanicum* supports their application as IPM-compatible chemical controls for other cucurbit pests such as aphids and whiteflies. Author contact: seanboyle@vt.edu

NEW INVESTIGATIONS OF SPOTTED LANTERNFLY IN VIRGINIA. Andrew C. Dechaine[1], Douglas G. Pfeiffer[1], Thomas P. Kuhar[1], Scott M. Salom[1] & Tracy C. Leskey[2], [1]Department of Entomology, Virginia Polytechnic Institute and State University, [2]USDA-ARS, Appalachian Fruit Research Station, Kearneysville, West Virginia. *Lycorma delicatula* (spotted lanternfly) is a new invasive Fulgoridae species native to China that was first detected in Winchester, VA in January 2018. During that year, *L. delicatula* expanded its range from one square mile to 18 square miles. *L. delicatula* is a phloem feeder and has been reported to feed on over 70 host plant species and has the potential to be an economically important pest to fruit trees, vineyards, and forests throughout the state. In 2019, *L. delicatula's* phenology and host plant preference will be recorded weekly from early April to November within the infestation zone in Winchester, VA. During the winter of 2019-2020, surveys will be conducted in Winchester to determine the vertical distribution of *L. delicatula* egg masses on *Ailanthus altissima* (tree-of-heaven) via visual estimation and a physical count on felled trees. *L. delicatula* phenology and egg mass distribution will aid in the development of integrated pest management strategies that will ultimately help control the spread and impact of this insect. U.S. Forest Service Cooperative Forest Health project PV6VVEDP. Author contact: Andrew Dechaine, dechaine@vt.edu.

THE ANT (HYMENOPTERA: FORMICIDAE) FAUNA OF VIRGINIA'S REMNANT PYROPHYTIC COMMUNITIES. Kal Ivanov & Liberty Hightower, Department of Recent Invertebrates, Virginia Museum of Natural History, Martinsville VA, 24112. Prior to European settlement, longleaf pine (*Pinus palustris* Mill.) forests stretched across the southern United States from Virginia in the north, south to Florida and westward to Texas. Land clearing, logging, and the interruption of natural fire regimes have greatly reduced the extent of these communities, making them one of the most threatened ecosystems in the United States. Although these pyrophytic communities host a remarkable diversity of plant and animal life, little is known about the arthropods associated with them. Between 2015 and 2018, we surveyed ants in three protected southeastern Virginia sites in the early stages of long leaf pine restoration. Overall, we collected 54 ant species in 24 genera and 6 subfamilies. Eight of these species represent new Virginia records, three are northward range extensions, and one, *Solenopsis invicta* Buren, is an invasive species. Virginia's sandhill habitats represent unique "islands" allowing for the establishment and continued persistence of ant taxa associated with deep sand deposits many of which are only rarely encountered in the state. Despite being rather uncommon in Virginia, these unique and fragile habitats harbor nearly one-third of the ant species known from the state at present. Author contact: kal.ivanov@vmnh.virginia.gov.

Environmental Science

(Not Available)

Medical Sciences

CAFFEINE CONSUMPTION ATTENUATES THE CARDIOPROTECTIVE EVENTS OF THE DIVE REFLEX. Vhuthuhawe T. Madzinge, Dept. of Biology and Chemistry, Liberty Univ. The dive response promotes bradycardia (increased vagal tone), blood shift, splanchnic circulation, increased HRV (heart rate variability), and peripheral vasoconstriction through the activation of cutaneous facial thermoreceptors innervated by the trigeminal nerve fibers following facial immersion in cold water. A quasi-experimental study of 84 healthy participants was conducted utilizing HRV, variations in beat-to-beat intervals, to assess the autonomic nervous system (ANS) function during the dive response under the influence of caffeine (a sympathomimetic). We hypothesized that caffeine would decrease HRV (the standard deviation of normal RR intervals - SDRR), which evaluates the balance between the parasympathetic (the root mean square of RR intervals - RMSSD, and high-frequency -HF) and sympathetic (low-frequency – LF, and LF/HF ratio) nervous system during tidal breathing, breath holding, and submersion in 14°C water. The second trial was run 30-45min after the consumption of 200mg of Equate Stay Awake Caffeine. The main effect of caffeine on SDRR ($F(1,83)=0.618$, $p=0.434$), RMSSD ($F(1,74)=2.41$, $p=1.148$), LF ($F(1,49)=1.115$, $p=0.296$), and HF ($F(1,49)=0.626$, $p=0.433$) was not statistically significant, as opposed to LFHF ratio ($F(1,74)=4.023$, $p=0.049$). The main effect of the dive response on SDRR ($F(1,83)=28.778$, $p<0.0005$), RMSSD ($F(2,148)=10.879$, $p<0.0005$), LF ($F(1,49)=12.705$, $p=0.001$), HF ($F(1,49)=11.490$, $p=0.001$), and LFHF ratio ($F(1.471,108.889)=26.504$, $p<0.0005$) was statistically significant. In addition, SDRR ($F(1.467.121.799)=4.977$, $p=0.016$), RMSSD ($F(1.410,111.382)=3.730$, $p=0.0420$) and LFHF ratio ($F(1.428,105.701)=7.089$, $p=0.004$) exhibited a statistically significant interaction between caffeine and the dive response. These results indicate that although HRV increases during the dive response, the consumption of 200mg of caffeine diminishes this increase and can attenuate the cardioprotective properties of the dive response. Therefore, caffeine should not be taken prior to a dive due to its negative impact on HRV. This research is made possible in part by support from the Liberty University's Center for Research & Scholarship Provost Research Initiative grant awarded to Dr Ben Kalu. Author contact: vmadzinge@liberty.edu.

THE EXPRESSION OF CONNEXIN-43 BY DENDRITIC CELLS IS REQUIRED TO MAINTAIN $CD4^+$ $FOXP3^+$ REGULATORY T CELL POPULATION. Caroline T. Miller, Lauren M. Browning & Piotr J. Kraj, Department of Biological Sciences, Old Dominion University. Immunosuppressive $Foxp3^+$ regulatory T cells (T_R) are a subset of $CD4^+$ T cells that maintain homeostasis of the immune system. They have been shown to be sustained by the interaction between Major Histocompatability Complex (MHC) present on antigen presenting dendritic cells and the T Cell Receptor (TCR) expressed on T_R cells that is specific for the MHC with antigenic peptide. Here we show that in addition to MHC/TCR interaction, Connexin-43 (Cx43) expression by dendritic cells is required to maintain the T_R population. CD11c+ dendritic cells represent a major subset of antigen presenting cells. We have observed that mice that lack Cx43 expression on CD11c+ dendritic cells have a lower percentage of T_R cell population, which in turn also have a lower level of Foxp3 expression. These mice showed increased incidence of

dermatitis as they age, even though we show that their dendritic cells can efficiently present antigen to naive T cells. The decrease in the presence of T_R cells was associated with an altered phenotype of these cells, demonstrated by lower expression of CD39 and higher expression of CD73,which are ectonucleotidases involved in its immunosuppressive function. We propose that the presence of Cx43 on the surface of dendritic cells is required for effective communication between T_R cells and dendritic cells so as to sustain T_R cell proliferation and Foxp3 expression. Author contact: cmill012@odu.edu.

Posters

THE NEUTRALIZING ACTIVITY OF HUMAN SERA ON CYTOMEGALOVIRUS SHED IN URINE. Lonneke L. Palmer[1], Li He[2], & Michael A. McVoy[2], [1]John Tyler Community College and [2]Department of Pediatrics, Virginia Commonwealth University. Cytomegalovirus (CMV), a member of the *Herpesviridae*, is responsible for about three percent of congenital abnormalities in the United States. Despite being such a threat to one of the nation's most vulnerable populations, an efficacious vaccine has yet to be produced and many remain ignorant to the existence and/or potential of this virus. The urine and saliva of a person infected with CMV have been identified as the main infectious materials by previous studies due to the abundance of virions in these bodily fluids and are perceived to be contracted by others by the oral route. Therefore, the ideal vaccine should garner defense against this virus starting in the mouth. To do this, an adequate number of neutralizing antibodies need to be present in the saliva, oral submucosa, or oral lymphatics. However, our group recently found that, in contrast to CMV produced in cell culture, CMV shed in the urine of infected newborns or toddlers is highly resistant to neutralization by monoclonal antibodies or polyclonal antibodies purified from the blood of CMV-positive (immune) donors (*e.g.*, CytoGam). The current experiment was designed to determine if antibodies in the context of human sera (as opposed to purified IgG) can neutralize CMV in urine obtained from infected babies. CytoGam as well as sera from one CMV-negative (naive) and two CMV-positive adults were serially diluted and each dilution was combined with CMV-positive urine and incubated for an hour at 37°C. Mixtures were then introduced into wells of a 96-well plate containing confluent MRC-5 fibroblasts, incubated for 7 days, and stained for CMV Immediate Early proteins by immunofluorescence. At a 1:2 final concentration CMV-positive and CMV-negative sera had neutralizing activities that were presumably not antibody mediated. At a 1:6 final concentration the two CMV-positive sera partially neutralized infectivity of CMV in urine but CMV-negative serum did not. CytoGam at 640 µg/ml alone or combined with negative serum (diluted 1:6) had no activity. These results suggest that urine CMV is sensitive to non-specific antiviral factors in serum at high concentrations and that CMV-specific serum neutralizing antibodies can partially overcome urine CMV's resistance to antibody neutralization, but again only at high serum concentrations. Factors in CMV-negative serum failed to enable the neutralizing activity of CytoGam, but the concentration tested may have been inadequate. CMV is able to live in the body for a life-time without suspicion in healthy individuals but can be very problematic for the young, the elderly, and those suffering from a weakened immune system. To formulate an impactful vaccine for this virus, it is important to understand

how, where, and when antibodies are able to effectively neutralize the virus's potential in vivo. (Supported by NIH, VCU Bridges to the Baccalaureate R25GM102795). Author contact: michael.mcvoy@vcuhealth.org.

ADVANCEMENT OF THE IN-VITRO IDIOPATHIC PULOARY FIBROSIS DISEASE MODEL THROUGH ISOLATION OF SENESCENT AND ACTIVE FIBROBLAST PHENOTYPES. Brieann H. Sobieski[1], Luis R. Rodriguez[1], Steven D. Nathan[2] & Geraldine Grant[1], [1]Dept. of Biol., George Mason Univ. [2]Adv Lung Disease and Transplant Program, Inova Heart and Vascular Institute. Idiopathic Pulmonary Fibrosis (IPF) is a heterogenous disease for which there is no known cure, resulting in more than 40,000 deaths annually. Due to the heterogenous nature of IPF, the senescent phenotype is one of many in the IPF lung. Explant isolation is the primary method for isolating fibroblasts, which may preferentially select the senescent phenotype. We have previously demonstrated a novel isolation methodology, differential binding, that we hypothesize selects for an active non-senescent phenotype. Our focus in this study is therefore to investigate cell senescent markers in two fibroblast populations isolated by different techniques. IPF (n = 10) lung transplant tissue was isolated from each sample using both isolation techniques. DNA and RNA were extracted using the Wizard™ Genomic DNA purification Kit (Promega) and Qiagen RNeasy kit (Qiagen). Markers of senescence (p16 and p21) were quantified by qPCR. Explant fibroblasts demonstrated an increase in p16 and a decrease in p21 expression. Further investigation revealed that TGF-ß1 signaling was inducing increased p21 expression in fibroblasts isolated via differential binding. These results indicate the successful isolation of a cell type which is both active and non-senescent. Designing experiments including fibroblasts isolated via explant and differential binding techniques may yield a more accurate *in-vitro* model for the IPF lung. Supported by: INOVA Lung Fund and GMU OSCAR). Author contact: Brieann Sobieski, bsobiesk@gmu.edu.

Natural History and Biodiversity

HISTOLOGICAL COMPARISON OF PARASITE INDUCED PATHOLOGY IN MALE MORPHOTYPES OF BLUEGILL SUNFISH (*LEPOMIS MACROCHIRUS*). Candace E. Ashworth & Michael R. Zimmermann. Shenandoah University. Bluegill sunfish (*Lepomis macrochirus*) are a sexually dimorphic North American sport fish possessing multiple male morphotypes that differ in territoriality, diet, and behavior. The larger α-males invest heavily in courtship and parental care, while the subordinate β-males partake in mating strategies involving sneaking or mimicking behaviors, resulting in significantly less gene transmission than α-males. This raises the question of why an alternative male morphotype is necessary in *L. macrochirus* populations, given its low reproductive success. Previous studies regarding parasitism in *L. macrochirus* have not accounted for these distinct morphotypes, but this study investigated whether differences in parasite loads and host adaptive immunity contribute to the maintenance of alternative male morphotypes within *L. macrochirus* populations. Over 1,500 *L. macrochirus* were collected from 14 lakes and ponds in northwestern Virginia and examined for parasite infections. Histological sectioning of the visceral

organs of several *L. macrochirus* was conducted to observe potential differences in the host immune response to parasites. Comparisons of α-male and β-male tissue may demonstrate different patterns of humoral or cell-mediated responses to parasite infection, necessitating the presence of an alternative male morphotype within *L. macrochirus* populations. Differences between the immune responses of the male morphotypes may indicate that the parasite load may negatively impact α-males, attributing to the maintenance of a male β-morphotype with low reproductive success and alternative mating strategies. This is the first evidence of the parasitism differences between morphotypes having varying impacts on health, which may be important to the maintenance of larger, healthier *L. macrochirus* fisheries. (Supported by: Mednick Fellowship Award from the Virginia Federation of Independent Colleges). Author contact: Candace Ashworth cashwort16@su.edu.

UPPER THERMAL LIMITS VARY AMONG AND WITHIN NATIVE BEE SPECIES IN RELATION TO SEASON, VOLTINISM, AND NEST TYPE. Kálmán K Csigi[1], Salvatore J Agosta[2] & Karen M Kester[1]. [1]Department of Biology and[2] Center for Environmental Studies, Virginia Commonwealth University. Native bees are recently gaining attention for the essential pollination and ecosystem services they provide. These services may be threatened by warming temperatures associated with global climate change. Voltinism - the number of generations produced annually- is an important factor in determining the thermal conditions experienced during development and while foraging. Hypothetically, upper thermal limits (UTLs) of adult bees should reflect adaptations to temperatures experienced during development and foraging. Over the foraging season in 2018, 97 native bee species were collected in and around the City of Richmond. UTLs were quantified using dynamic ramping trials to determine the fatal knockdown point (FKP). Univoltine species that emerged later in the season had higher FKPs than univoltine species emerging earlier in the season. Later generations of multivoltine species had higher FKPs than earlier generations. FKPs recorded for all species were higher than historic air temperatures of the study region, but within several degrees of the highest recorded maximum daily temperature. While native bees still face a potential myriad of other issues brought on by climate change, observed increases in FKP over the season suggest that these essential insects have a limited physiological capacity to adapt to a warming climate. (Supported by VCU Rice River Center Graduate Research Scholarship). Author contact: Karen Kester, kmkester@vcu.edu.

ANALYZING THE FLIGHT PATTERNS AND BEHAVIOR OF DRAGONFLIES ENGAGED IN AERIAL TERRITORY BATTLES. Brandon T. Hastings & Brandon E. Jackson. Longwood University. It has previously been determined that dragonflies who occupy the most suitable territory within a habitat have a higher muscle capacity than those who occupy poor territories, but it is unknown how this increased muscle capacity relates to their flight patterns. This study examined the flight patterns of dragonflies engaged in aerial territory battles to investigate differences in maneuverability. 3D video data of dragonflies interacting in a natural habitat was analyzed for interacting (<0.5 m apart) and non-interacting flights. Non-interacting dragonflies showed higher linear velocities and accelerations, while interacting dragonflies showed higher angular velocities. With further data collection, we can

categorize the winners and losers of these territory battles and provide a link between flight maneuverability and muscle capacity in dragonflies. Author contact: Brandon Hastings, brandon.hastings@live.longwood.edu.

INTRASPECIFIC VARIATION IN THE SECRETION AND MORPHOLOGY OF THE SCENT GLANDS OF A NETROPICAL COSMETID HARVESTMAN. Amanda C. Albert, Victor R. Townsend, Jr. & Maynard H. Schaus. Dept. of Biol., Virginia Wesleyan Univ. Intraspecific variation in the use of chemical defenses by cosmetid harvestmen has not been previously investigated. In this study, we examined variation in the emissions from the scent glands and the morphology of the ozopores of *Erginulus clavotibialis*. Most individuals did not secrete when seized by leg IV, however, when the body was grasped firmly with forceps, 76% of the harvestmen (n = 96) responded by releasing enteric fluid (clear, no odor) or secretions from the scent glands (reddish-brown, distinct odor), most commonly in the form of globules near the ozopores. Adults and penultimate nymphs rarely (less than 5% of all trials) exhibited leg dabbing, an unusual defensive behavior generally associated with cosmetid harvestmen. Males released enteric fluid significantly more than females or nymphs. Nymphs emitted secretions from scent glands at a significantly greater frequency than males or females. The morphology of the ozopores varies between adults and nymphs but not between males and females. The openings of the ozopores of nymphs are circular and are not obscured by the dorsal posterior process of coxa I and the dorsal anterior process of coxa II. In contrast, adults have subtriangular ozopores that are difficult to observe without dissection because they are partially blocked by the dorsal processes of coxae I and II. Author contact: Victor Townsend, vtownsend@vwu.edu.

SEM-BASED STUDY OF FECAL SAMPLES FROM A NEOTROPICAL COSMETID HARVESTMAN. Sara A. Wiltshire, Victor R. Townsend, Jr. & Maynard H. Schaus. Dept. of Biol., Virginia Wesleyan Univ. In contrast to the flattened structure of adults, cosmetid nymphs have elongate pedipalps adorned distally with a delicate pretarsus. Relatively little is known about the diet of these harvestmen or any ontogenetic changes in feeding habits that reflect differences in pedipalp morphology. Observations of individuals feeding upon fruit and termites revealed that adults use their pedipalps to grasp and manipulate food items, whereas the nymphs rely exclusively upon their chelicerae while feeding. We used scanning electron microscopy (SEM) to examine approximately 30 fecal samples from individuals of *Erginulus clavotibialis*, a common cosmetid harvestman in Belize. Fecal material included samples from multiple adults (males and females) and several penultimate nymphs. As an aid to the identification of prey items, we also examined fecal samples collected from captive *Leiobunum formosum* that were fed specific diets of baby food, mushrooms, dog food, apples or termites. Our results suggest that both nymphs and adults are omnivores and that they consume a variety of food items. From the fecal samples, we identified bacteria, plant material (tissue and pollen), fungal hyphae, annelid setae, lepidopteran scales, a hymenopteran ovipositor, and legs, setae, eyes, and body parts of several types of arthropods. We did not find any major differences in diet between nymphs and adults. Author contact: Victor Townsend, vtownsend@vwu.edu.

INTRASPECIFIC VARIATION IN THE DISTRIBUTION OF ELEMENTS IN THE CHELICERAE AND CLAWS OF A NEOTROPICAL COSMETID HARVESTMAN. Shelby A. Wright, Victor R. Townsend, Jr. & Sara A. Wiltshire. Dept. of Biol., Virginia Wesleyan Univ. In many arthropods elements that are used to mineralize and harden the cuticle include Ca (shells of crustaceans), Fe (ovipositors of insects), and Zn (jaws of annelids). In this study, we used energy dispersive spectrometry (EDS) to investigate the elemental composition of the exoskeleton of the cosmetid harvestman *Erginulus clavotibialis*. We examined samples from alpha males, beta males, females and penultimate nymphs (n = 3 for each). Spectra were collected at each sample site using accelerating voltages of 10 kV (surface) and 20 kV (subsurface). Our results indicate that the composition of the exoskeleton varies sexually, ontogenetically and between different regions of the body. The most common elements (>1%) were Al, Cl, Ca, Fe, S and Si. Spectra collected at 10 kV, generally had higher levels of Al, Cl, and S. In contrast, spectra collected at 20 kV had higher relative percentages of Ca. We found considerable amounts of Si at 10 kV, but only in association with the tubercles of femur IV and the pedipalp. We also found the highest percentages of Fe in the chelicerae. Nymphs had the lowest relative percentages of Al, Fe and S at 10 kV. The results of our study that harvestmen do not use Zn in their exoskeleton. In addition, we did not regularly observe Mn. Author contact: Victor Townsend, vtownsend@vwu.edu.

INTERSPECIFIC, ONTOGENETIC AND SEXUAL VARIATION IN OZOPORE MORPHOLOGY AMONG COSMETID HARVESTMEN. Victor R. Townsend, Jr.[1], Saoirse Teevan-Kamhawi[2] & Devin Calpo[2]. [1]Dept. of Biol., Virginia Wesleyan Univ. and [2]Maury High School. The ozopores of cosmetid harvestmen rest upon lateral projections of the carapace, have simple or highly reduced channels, and are partially obscured by enlarged dorsal processes associated with coxae I and II. Relatively little is known about interspecific variation in ozopore morphology among these harvestmen. In this study we used SEM to examine the ozopores of males and females of nine species as well as those of antepenultimate nymphs for two species. For adults, we found differences between species in the shapes of the ozopores, the morphology of the dorsal and lateral channels, and the relative size, shape and armature of the dorsal posterior process (dpp) of coxa I and the dorsal anterior process (dap) of coxa II. Our observations suggest that the morphology of the coxal processes could be sources for systematic characters in future phylogenetic studies. We observed ontogenetic differences but relatively little intersexual variation in the morphology of the ozopore. Nymphs have ozopores that are generally more oval than those of adults with an opening that is also less obstructed, if at all, by the dorsal coxal processes. These morphological differences suggest that nymphs may use scent gland secretions in a manner different from that of adults. Author contact: Victor Townsend, vtownsend@vwu.edu.

FECUNDITY OF NATIVE VIRGINIA LONGLEAF PINE AT JOSEPH PINES PRESERVE, SUSSEX COUNTY VIRGINIA. Phil Sheridan, Noelle Delaney Stevens & Emily Vollmer. Meadowview Biological Research Station. Longleaf pine reaches its northern limit in Virginia and is a keystone species in an ecosystem covering millions of hectares in the southeastern U.S. Large-scale longleaf pine ecosystem restoration efforts are underway at the federal, state, and local level and are the largest forest ecosystem

restoration effort in North America. Our research has provided evidence that the Virginia longleaf pine genotype is superior for in-state planting and restoration because of higher survival rates and faster growth. Other researchers have found that Virginia longleaf pine has a higher water use efficiency than southern populations. We have also found in a previous research project that the Virginia longleaf pine genotype is able to produce female cones at an earlier age than other longleaf pine provenance. In this study, we were able to replicate and validate the ability of Virginia longleaf pine to reproduce at an earlier age at the Joseph Pines Preserve in Sussex County, Virginia. Cone production did not correlate with either height or stem diameter. The reason for the ability of Virginia longleaf pine to reproduce at an early age awaits further investigation. Author contact: meadowview@pitcherplant.org.

LONGLEAF PINE HABITAT RESTORATION RAISES GROUNDWATER LEVELS. Phil Sheridan, Noelle Delaney Stevens & Emily Vollmer. Meadowview Biological Research Station. We had observed that pitcher plant bogs seemed to be getting wetter as we proceeded with longleaf pine habitat restoration at the Joseph Pines Preserve in Sussex County, Virginia. Habitat restoration involved large-scale (multi-hectare) mulching, chipping, burning, and herbicide spraying of dense stands of 20-year old hardwoods and pines. We hypothesized that conversion of a dense hardwood/pine stand to a longleaf pine savanna would raise groundwater levels. A hydrologic study was conducted by a graduate student and calculations indicated that our habitat restoration methods resulted in a 25% reduction in evapotranspiration, potentially leading to higher groundwater levels. In 2016 a clear-cut logging operation was performed on part of the watershed at Joseph Pines Preserve and we were able to test the effects of this habitat restoration method on groundwater levels. The clear-cut of the forest raised ground water levels as predicted, supporting our initial hypothesis. Ground water levels rose by as much as 15 cm and the effect was greatest the closer the measurement was made to the clear-cut. The net effect was to increase groundwater by seven million liters on a 10-hectare watershed. Author contact: meadowview@pitcherplant.org.

MICROBIAL ASSEMBLAGES AS DRIVERS FOR CRAYFISH ECTOSYMBIOTIC BRANCHIOBDELLIDAN COMMUNITIES. Matthew Cooke, Gabriel Hooper, Luke Fisher, John Hoverson, Kaleb Bohrnstedt, Mark Fischer, Nathan Edmondson, Thomas Kepler, Matthew Becker & Kyle Harris, Dept. of Biology and Chemistry, Liberty University. Crayfish participate in a dynamic cleaning symbiosis with branchiobdellidan worms (BW), which consume bacteria from the carapace and gill filaments of crayfish. In our first experiment, we inoculated a test group of crayfish with four BW each and removed all BW from the control group. We hypothesized that BW presence would alter the host's dissolved oxygen (DO) uptake and the microbial community assemblages (MCA) on the carapace. No significant effect on the DO uptake was seen. We found that taxa of bacterial isolates differed between the two groups with no observed overlap. In our second experiment, we collected swabs from crayfish with varying loads of BW in a stream continuum. Different microbial samples were collected from the carapace of the crayfish, water, and sediment. These were collected in first and second order streams. 16S gene sequencing was utilized in conjunction with QIIME 2 to analyze the microbial swabs. The MCA alpha diversity was compared between stream

orders, sample types, and number of BW. QIIME2 analysis revealed significant differences in the alpha diversity between sample types ($p < 0.001$). There was no significant difference in MCA from different stream orders or from crayfish with and without BW. However, potential dissimilarity was noted when crayfish samples were separated into cohorts based on the number of BW present. (Supported by: Provost Research Initiative (PRI) Grant, Liberty University). Author contact: Kyle Harris, kjharris@liberty.edu.

Posters

CORRELATION BETWEEN MORPHOLOGY, PREDATOR ESCAPE PERFORMANCE, AND MATERIAL PROPERTIES OF THE VERTEBRAE IN YELLOW PERCH, *PERCH FLAVESCENS* (*PISCES: PERCIDAE*): INTRASPECIFIC DIVERGENCE IN FUNCTIONAL DESIGN. Takashi Maie, Lilli E. Altenburg & Douglas B. Dickerson, Dept. of Biol, University of Lynchburg. Many teleosts exhibit intraspecific variation that often correlates with differences in resources and habitat. We evaluated the extent of variation in *Perca flavescens* from two ecologically distinct lakes by examining body morphology, kinematics and performance of predator escape response, and material properties of the vertebrae. The fish from the mining-influenced lake (with high calcium bioavailability, low pH, and low visibility) showed greater angular velocity and acceleration during the escape response than the fish from the spring-fed lake (with low calcium, high pH, and high visibility). The differences in escape kinematics and performance appear to be correlated with body morphology and material properties of the vertebrae. Compared to the fish from the spring-fed lake, the fish from the mining-influenced lake showed shorter and deeper body with a wider caudal peduncle, perhaps contributing to the maneuverability rather than the ability to cruise. The vertebrae in the fish from the mining-influenced lake showed greater strength and Young's modulus than those in the fish from the spring-fed lake, contributing to the greater recoilability of the vertebral column. In the predator-prey interaction, perhaps occurring at the different proximity, body morphology and vertebral material properties change in the way that these components of locomotor design in *P. flavescens* contribute to enhance their escape performance; therefore, fitness of the population. Author contact: Takashi Maie, maie.t@lynchburg.edu.

INTERSPECIFIC VARIATION IN THE PREVALENCE AND INTENSITY OF LARVAL ECTOPARASITIC MITES UPON A NEOTROPICAL COSMETID HARVESTMAN. Elizabeth A. Roberto, Victor R. Townsend, Jr. & Maynard H. Schaus. Dept. of Biol., Virginia Wesleyan Univ. Larval erythraeid mites are common ectoparasites of terrestrial arthropods, including harvestmen (Order Opiliones). In this study, we investigated intraspecific variation in prevalence, intensity and attachment sites of larval mites (*Leptus* sp.) infesting *Erginulus clavotibialis*, a cosmetid harvestman from Belize. We did not observe any significant sexual and ontogenetic differences in the prevalence or intensity of infestation. Across three sites, the prevalence ranged from 18-71% and the intensity varied from 2-4 larval mites per host. Larval mites exhibited a non-random distribution with respect to attachments sites, with significantly more mites occurring on femur IV. Larval mites were absent from the tarsi of the walking legs and

were rarely observed attached to the pedipalps or chelicerae of the harvestmen. An SEM-based examination of attachment sites revealed that the mites prefer areas on the host that have been previously used by other larval mites (as evidenced by the presence of abandoned cones). In addition, the distal tips of the chelicerae of the mites are adorned with numerous processes (cilia or stereocilia) that may aid in feeding upon the hemolymph and tissues of the host. Author contact: Victor Townsend, vtownsend@vwu.edu.

FORCE AND ENDURANCE OF ADHESION IN WATERFALL-CLIMBING GOBIES. Samuel T. Vickers & Takashi Maie, Dept. of Biol, University of Lynchburg. Many amphidromous sicydiine gobies exhibit rock-climbing behavior during upstream migration along rivers and streams. Using the pelvic sucker, formed by fused pelvic fins, these gobies generate suction for adhesion on the climbing surface. By measuring performance variables that correlate to successful rock-climbing capability, we evaluated suction force for adhesion and fatigue time during sustained adhesion on the climbing surface in a power-burst waterfall-climbing goby, *Sicydium punctatum*, from Dominica, West Indies. An adult *S. punctatum* individual with body mass of 8.27 g generated the maximum suction force of 0.208 N, which is calculated to be supporting approximately 2.56 times body mass. This individual exhibited the fatigue time of 31.4 seconds. Compared to the scaling pattern of fatigue time known for waterfall-climbing gobies (from *Sicyopterus japonicus* with $LogT_{fatigue} = -8.48x(LogBM-0.58)^2+1.71$), *S. punctatum* might have a higher endurance capacity in its pelvic muscles. Author contact: Samuel Vickers, vickers_st@lynchburg.edu.

Psychology

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THE INFLUENCE OF GREEK LIFE ON ALCOHOL EXPECTANCIES. Mary Doberneck[1], Jalen Ragsdale[1], Melissa Colangelo[1], & Abby L. Braitman[1,2], [1]Old Dominion University, [2]The Virginia Consortium Program in Clinical Psychology. Fraternities and Sororities are notoriously known for having high levels of alcohol consumption. The normalization of binge drinking in a specific college group as such could have impacts on the alcohol expectancies those students have. The current study examined drinking habits in participants ($N = 475$) who were 18-28 years old ($M = 19.88$, $SD = 1.71$) and had consumed at least one drink in the past 30 days. A one way ANOVA test revealed a statistically significant difference in the liquid courage subscale of alcohol expectancies, $F(3,471) = 3.59$, $p = .014$, between Greek members ($M = 15.83$, $SD = 3.32$) and non-Greek students who do not attend events ($M = 14.05$, $SD = 3.91$), $p = .003$. An LSD post hoc test also revealed that the risk and aggression subscale of alcohol expectancies was significantly higher for current Greek members ($M = 13.67$, $SD = 3.74$) than either non-members who attend Greek events regularly ($M = 11.63$, $SD = 3.85$), $p = .003$, or non-members who do not attend events regularly ($M = 10.95$, $SD = 4.03$) $p < .001$. These results show that there are differences in certain alcohol expectancies between Greek and non-Greek members. Future research should examine why the only

alcohol expectancy subscales with any significant difference are liquid courage, and risk and aggression. Author contact: Abby L. Braitman, abraitma@odu.edu.

SEX DIFFERENCES MODULATE BEHAVIORAL AND STRESS INFLUENCES ON SEROTONIN AND DOPAMINE RECEPTORS IN RAT BRAIN. W. David Knight, Joseph Picone, Susannah Garber, & Olga Lipatova, Department of Molecular Biology and Chemistry and Program in Neuroscience, Christopher Newport University. Stress differentially modulates inhibition of behavioral responses in males and females. We examined the role of striatum function in the mechanism for this behavioral sex difference. Dopamine and serotonin signaling in the dorsolateral striatum (DLS) contribute to learned habitual responses, while activity in the dorsomedial striatum (DMS) is involved in the goal-directed operant learning. Quantification of gene expression for serotonin 6 (5-HT6R) and dopamine (D1 and D2) receptors in the DLS and DMS of male and female rat brains suggested that stress induces increased dopamine signaling in the DLS of female rats compared to male rats. Stress does not induce differential response in the DMS of female or male rats. Interestingly, receptor expression in the DMS was greater in rats learning to navigate a spatial task using a goal-directed strategy compared to the rats that learned a habitual directional response. These findings are consistent with the differences in the DLS vs DMS function. The sex-specific dopaminergic and serotonergic modulations in the DLS are suggested to be potential reasons for the sex differences in habit formation and inhibition of behavioral responses. Author contact: david.knight@cnu.edu

DOES CANNABIS USE VARY BY RACE AND GENDER AMONG COLLEGE STUDENTS? Monae Porter[1], Nydesha Brown[1], Melissa Colangelo[1], & Abby L. Braitman[1,2], [1]Old Dominion University, [2]The Virginia Consortium Program in Clinical Psychology. Early studies on substance use have shown that drug use is typically at its height between late adolescence and early twenties. The purpose of the current study was to determine if cannabis use varies by race and gender. The study's sample consisted of 477 undergraduate college students, ages 18-2, attending a university in the southeastern U.S. Findings in the study revealed that cannabis use did not differ by gender, χ^2 (1) = 0.75, p = .384. However, cannabis use was found to be significantly different by race, χ^2 (3) = 7.82, p = .0498. Multiracial college students (80.0% users) were more likely than Caucasian or White (64.1% users) and Asian or Pacific Islander students (51.7% users) to have used cannabis. However, none of these groups' lifetime cannabis use differed significantly from African American or Black students (67.3% users). Future research should focus on multiracial student substance use. Author contact: Abby L. Braitman, abraitma@odu.edu.

DRINKING MOTIVES AND EXPECTANCIES: DIFFERENTIAL STRENGTH OF PREDICTION FOR ALCOHOL USE AMONG COLLEGE STUDENTS. Helen H. Smith[1], Anthony G. Ladikos[1], Melissa R. Colangelo[1], & Abby L. Braitman[1,2], [1]Old Dominion University, [2]The Virginia Consortium Program in Clinical Psychology. Alcohol expectancies and drinking motives have both been shown to be predictors of alcohol use among college students in previous research. The present study compared motives and expectancies to determine which is a better predictor of alcohol use (quantity

and frequency). These data come from a larger study funded by the NIAAA ($N = 471$). Two linear regressions were used to compare alcohol expectancies and motives on both quantity and frequency of alcohol consumption. Cognitive and Behavioral Impairment expectancies were found to be negatively associated with alcohol quantity ($\beta = -0.11$, $p = .032$), while Risk and Aggression expectancies were positively associated with quantity ($\beta = 0.17$, $p = .008$). As for drinking motives, both Social ($\beta = 0.20$, $p = .004$) and Enhancement ($\beta = 0.15$, $p = .025$) motives were positively associated with alcohol quantity. In terms of frequency of alcohol use, sexual expectancies were positively related to alcohol frequency ($\beta = 0.11$, $p = .036$), while Cognitive and Behavioral Impairment expectancies was negatively related to frequency ($\beta = -0.17$, $p = .002$). Lastly, drinking to cope was positively related with alcohol frequency ($\beta = 0.13$, $p = .025$). These results show that both alcohol expectancies and drinking motives predict alcohol use about equally. However, the study results show that social motives are the best predictor of alcohol quantity, whereas cognitive and behavioral impairment expectancies are the best predictor of alcohol frequency. Author contact: Abby L. Braitman, abraitma@odu.edu.

Structural Biology, Biochemistry and Biophysics

MICROFLUIDIC INVESTIGATIONS OF THE TEMPORAL DYNAMICS OF CASPASE ACTIVITY IN LIVING CELLS. Randall D. Reif, Dept. of Chem., Univ. of Mary Washington. Apoptosis, a process in which a cell systematically triggers its own death in response to DNA damage or external stimuli, is widely utilized in the body. Malfunction of the apoptosis process can lead to serious health problems such as cancer. There are two major pathways for the cell to undergo apoptosis: extrinsic and intrinsic. Each is dependent on the method of induction. The goal of this research project is to elucidate and compare the temporal dynamics of apoptosis in Jurkat T-Lymphocytes with respect to caspase activity, through both the intrinsic and extrinsic pathways using fluorescence microscopy. Polydimethylsiloxane (PDMS) based microfluidic devices were fabricated with a channel coated with antibodies to trap cells in a controlled environment over the course of the studied period (6 hours). The extrinsic pathway studies used anti-CD95 to capture the cells and induce apoptosis. The experiments examining the intrinsic pathway used anti-CD71 to capture the cells while they were exposed to 50 mM hydrogen peroxide to induce apoptosis. The fluorogenic caspase probe, L-bisaspartic acid Rhodamine 110 (D_2R), was used to visualize general caspase activity while a derivative of the probe ($DEVD_2R$) was used to monitor caspase-3. For the intrinsic pathway, overall caspase activity initiated from 4.3 to 5.3 hours after induction, lasting 40 to 60 minutes, while caspase-3 activity started 5.3 hours after induction and lasted 20 to 40 minutes. For the extrinsic pathway, overall caspase activity started 3.3 to 5.3 hours after induction and lasted between 1.3 and 4.6 hours, while caspase-3 activity was shown to start 5.3 hours after induction and lasted 20 to 40 minutes. This indicates that the timing of executioner caspase activation is independent of induction pathway. Knowledge of the timing of caspase activation could be helpful when designing therapies that affect apoptosis.

A WEBSITE TO AID IN TEACHING STRUCTURAL BIOLOGY TO UNDERGRADUATES. Nathan T. Wright, Dept. of Chem. and Biochem., James Madison Univ. Protein structures are frequently used in both textbooks and in lecture to demonstrate fundamental biochemical concepts. Despite structural biology's important position in the pantheon of teaching tools, undergraduate students rarely learn the tools of how these pictures are generated, or how to evaluate the validity of these structures. This is, in part, due to a lack of undergraduate-specific teaching tools on the subject. Over the past five years, our lab has sought to create accessible structural biology content. Here, we present a new website (https://osf.io/r73dc/) that allows users to access a wide variety of structural biology data, along with detailed instructions of how to analyze these data. Each experiment can be easily implemented into a biochemistry lab, and can possibly be assigned in a larger class. Instructions of how to download all free software are included. These data were all tested in a senior-level undergraduate biochemistry lab, and in every case students were able to generate publication-worthy data analysis. As this website grows, we hope to include more theory behind these modules, and also to expand the amount of data that are offered. (Supported by the NSF RUI:MCB 1607024). Author contact: wrightnt@jmu.edu.

MOLECULAR DYNAMICS SIMULATIONS OF THE B-GRASP SUPERFAMILY. J. T. Bedford, J. Poutsma, & L. H. Greene, Old Dominion University. Molecular dynamics is a computational field of research where Newton's equations of motion are applied to molecular systems in an *in silico* environment. This technique can be skillfully employed to study protein folding. My research focuses on a group of proteins that share a similar β-grasp topology. Using molecular dynamics allows for the investigation into the role of long-range interactions in determining the structure, folding, and stability of proteins. We propose that a protein's topology is determined, at least in part, by key long-range interactions within the protein. To support this hypothesis two proteins, the immunoglobulin-binding domain of protein G and the small archaeal modifier protein 1, were assessed for persistence of long-range interactions over time. The RMSD was monitored as an indicator of the unfolding process. Simulations with an increased RMSD were found to have fewer long-range interactions and interestingly these interactions were predominately lost between specific secondary elements. Author contact: Lesley Greene, lgreene@odu.edu

PREFERENTIAL PHOSPHATIDYLINOSITOL 5-PHOSPHATE BINDING CONTRIBUTES TO A DESTABILIZATION OF THE VHS DOMAIN STRUCTURE OF TOM1. Wen Xiong[1], Tuo-Xian Tang[1], Evan Littleton[1], Arba Karcini[2], Iulia M. Lazar[2] & Daniel G. S. Capelluto[1], Department of Biological Sciences, Biocomplexity Institute, and Center for Soft Matter and Biological Physics, Virginia Tech, [2]Department of Biological Sciences, Virginia Tech. Target of Myb 1 (Tom1) transports endosomal ubiquitinated proteins that are targeted for degradation in the lysosomal pathway. In a bacterial infection model, Tom1 was observed to promote the synthesis of phosphatidylinositol-5-phosphate (PtdIns5P), which switches Tom1 from its cargo trafficking function to a bacterial survival signaling. Tom1 preferentially binds PtdIns5P *via* its VHS domain, but the effects of PtdIns5P on the domain structure and function are unknown. Thermal denaturation studies demonstrate that the monomeric

Tom1 VHS domain exhibits a three-state transition behavior. Binding of Tom1 VHS to PtdIns5P leads to local conformational changes that reduced thermostability, interhelical contacts, and conformational compaction of Tom1 VHS, suggesting that PtdIns5P destabilizes the protein domain. Isothermal calorimetry data analysis indicates that Tom1 VHS endothermically binds to PtdIns5P through two noncooperative binding sites. These findings provide mechanistic insights about the recognition of PtdIns5P by the VHS domain that may explain how Tom1, when in a different VHS domain conformational state, interacts with downstream effectors under bacterial infection. Author contact: wxiong@vt.edu

DEVELOPING SMALL MOLECULE INHIBITORS FOR CALPAIN DEPENDENT DEGRADATION OF DESMOPLAKIN. Kendahl L. Ott[1], Taylor L. Albertelli[1], Nathan T. Wright[1], Heather Manring[2], Maegen A. Ackermann[2] & Stuart Campbell[3], [1]Department of Chemistry and Biochemistry, James Madison University, [2]Department of Physiology and Cell Biology, Ohio State University, [3]Department of Biomedical Engineering, Yale University. Desmoplakin (DSP) is a large (260 kD) protein found in the desmosome, a subcellular structure that links the cytoskeleton of one myocyte to that of its neighbor. In cardiomyocytes, desmoplakin's main function is to maintain cell-to-cell adhesion and synchronization during heart contractions. A mutation hot-spot, centered around the SH3 domain of DSP, is associated with arrhythmogenic cardiomyopathy, but the underlying mechanism(s) of this association isn't well studied. Through various fluorescence techniques, it can be shown that many of these disease-causing mutations display increased calpain sensitivity. Additionally, structural and computational studies on DSP variants show that this cleavage event is driven not through a gross structural change, but instead through the discrete exposure of a normally-occluded calpain cleavage site. Initial *in silico* and *in vitro* screens of small molecules suggest the feasibility of developing a pharmaceutical solution to prevent calpain-mediated DSP cleavage. (Supported by: NSF REU (CHE-1757874), NSF RUI MCB-1607024, Henry Dreyfus Teacher-Scholar Award & VAS Undergraduate research minigrant). Author Contact: Kendahl L. Ott, ottkl@dukes.jmu.edu

THE FUNCTIONAL BASIS OF PHAFIN2 IN AUTOPHAGY. Tuo-Xian Tang & Daniel G. S. Capelluto, Dept. of Biol., Virginia Tech. Autophagy is a highly conserved cellular pathway in the eukaryotic cells. A portion of the cytosol, which contains invading pathogens and long-lived proteins, is taken up by an autophagosome. This double-membrane organelle fuses with lysosomes, where the contents were digested by the lysosomal enzymes. Previous data showed that Phafin2 was involved in autophagy. After the induction of autophagy, Phafin2 and Akt accumulate on the lysosomal membranes through the interactions between Phafin2 and phosphatidylinositol 3-phosphate (PtdIns(3)P). Phafin2 has two domains, one N-terminal PH (Pleckstrin Homology) domain and one C-terminal FYVE (Fab 1, YOTB, Vac 1, and EEA 1) domain. In this study, the binding affinity between PtdIns(3)P and Phafin2 was studied by surface plasmon resonance. Results showed that Phafin2 binds PtdIns(3)P with high affinity, triggering minor conformational changes in the protein. We also demonstrated that Phafin2 FYVE domain is responsible for the binding of PtdIns(3)P. Another interesting finding is that Phafin2 can cause membrane curvature, which may be required

for tethering of lysosomes to autophagosomes, and consequently initiating autophagy. Author contact: tangtx@vt.edu.

THE STRUCTURE AND FUNCTIONAL CHARACTERIZATION OF LEISHMANIA DONOVANI'S UFM-YLATION PATHWAY. Adrianne D. Lee & Christopher E. Berndsen, Dept. of Chem. and Biochem., James Madison Uni.. Ubiquitin fold modifier 1 (Ufm1) a ubiquitin-like protein and Ubiquitin fold modifier activating enzyme (Uba5, E1) are proteins found in eukaryotic organisms that play a crucial role in cell cycle regulation, signal transduction, and ER stress. Leishmania donovani (Ld) is a trypanosomatid parasite that has been shown to have enzymes homologous to Uba5 and Ufm1. Leishmania Ufm1 and Uba5, as well as the substrate-targeted proteins, are associated with the mitochondria which have not been observed in other organisms. This suggests that these Leishmania proteins may have physiological roles not yet described in other organisms. Leishmania donovani causes leishmaniasis, a disease that is accompanied by sores and lesions that will appear at varying depths of the body depending on the type and increases the host's susceptibility to co-infection with other diseases. There are currently no effective vaccines for leishmaniasis. LdUfm1, an N-terminally truncated form of LdUfm1, and LdUba5. LdUfm1 and LdUfm1(tr.) were successfully purified and were characterized with SEC-MALS. We then performed gel migration shift assays to demonstrate the compatibility of the human and Leishmania systems to conjugate LdUfm1. We found that full-length Leishmania Ufm1 but not the truncated form were viable substrates for human Uba5, suggesting a role for the N-terminus of Ufm1 conjugation. We are currently working to purify LdUba5 further for functional and structural comparisons to the human enzyme. Additionally, we began setting crystal trays to obtain protein crystals for structure determination. We have preliminarily obtained crystals of the truncated Ufm1. Future work will optimize these crystals, perform further experiments for structural characterization and explore the cross-reaction between the human and Leishmania enzymes. Characterization of the Leishmania donovani conjugation pathway could facilitate the development of therapeutic treatments for leishmaniasis. Author contact: Christopher Berndsen, berndsce@jmu.edu

IONIC STRENGTH-INDUCED TETRAMER FORMATION IN THE PAR-4 TUMOR SUPPRESSOR. Andrea M. Clark, Komala Ponniah, Meghan S. Warden, Emily M. Raitt, Benjamin G. Smith & Steven M. Pascal, Department of Chemistry and Biochemistry, Old Dominion University. The prostate apoptosis response-4 (Par-4) tumor suppressor can selectively kill cancer cells via apoptosis while leaving healthy cells unharmed. Full length Par-4 has been shown to be predominantly intrinsically disordered *in vitro* under neutral conditions. As part of the apoptotic process, cellular Par-4 is cleaved at D131 by caspase-3, which generates a 24 kilodalton C-terminal activated fragment (cl-Par-4) that enters the nucleus and inhibits pro-survival genes, thereby preventing cancer cell proliferation. Here, the structure of cl-Par-4 was investigated using circular dichroism (CD) spectroscopy, dynamic light scattering (DLS), intrinsic tyrosine fluorescence, and size exclusion chromatography with multi-angle light scattering (SEC-MALS). Biophysical characterization shows that cl-Par-4 aggregates and is disordered at low ionic strength. However, with increasing ionic strength, cl-Par-4 becomes

progressively more helical and less aggregated, ultimately forming highly helical tetramers at high NaCl concentration. These results, together with previous results showing induced folding at acidic pH, suggest that the *in vivo* structure and self-association state of cl-Par-4 may be strongly dependent upon cellular environment. Author contact: Andrea Clark akorell@odu.edu and Steven Pascal spascal@odu.edu.

Posters

MICROPLASTICS IN FRESHWATER WETLAND SOILS. Camilla Anne Alsobrook[1] & Scott Neubauer[2]. [1]John Tyler Community College and [2]Department of Biology, Virginia Commonwealth University. Microplastics, which are small particles less than 2mm in length and less than 1 mm in diameter, were first found in nature in 2004. Microplastics are dangerous due to their effect on the trophic structure of an ecosystem. Research has shown that microplastics have sorption qualities, which is troubling due to the known toxic effects caused to crustaceans. This is crucial to human health due to the possible of bioamplification of toxins. In the 14 years since the initial discovery of microplastics, it has been an ongoing struggle to find a cost-effective and relatively simple approach to extract microplastics in order to study them to understand their effect on the ecosystems they've come to overwhelm. I believe that if we examine soil samples from different depths and geographic locations, then we will be able to quantify the different types of plastics present. This is important because no one has studied the effect of microplastics on freshwater wetland soils. In my project, I used the Sediment-Microplastic Isolation Unit (SMI). The SMI uses a density separation method where lighter particles (e.g., microplastics) float to the top of the device while the denser particles (e.g., sediments) sink to the bottom. I used this device isolate microplastics from soil samples from three tidal freshwater wetland sites in Virginia. Soils were collected at different depths, ranging from 0-33 cm. Two of the study sites were herbaceous marshes (one each on James and Pamunkey Rivers) whereas the third site was a wetland on the Rappahannock River characterized by shrub-scrub vegetation. In analyzing the microplastics, I will be categorizing them based on location, depth found, appearance (size and color), as well as state of erosion. This data will allow me to build a solid database of microplastics, which I will then be able to use to understand trends in the depths and types of microplastics. In future studies, I will take the quantification data and use it to create a timeline of microplastic introduction to the area and which industries create the most microplastics. I will then use this data to determine which types of microplastics are most harmful to the environment they've been introduced to, with special attention to the trophic structure of the ecosystems they're found in. Studies show that microplastics are harmful to aquatic life, however their impacts on freshwater life are widely unknown given the lack of in-depth research in that area. This experiment should shed light on the life cycle of plastics and their distribution. In further studies, this information will be used when studying the trophic levels of marshes to determine how microplastics have interacted with the native organisms. (Supported by NIH, VCU Bridges to the Baccalaureate R25GM102795). Author contact: sneubauer@vcu.edu

OPTIMIZING A BIOSENSOR-BASED ASSAY FOR UBIQUITINATION ACTIVATION. Roma L. Broadberry & Christopher E. Berndsen, Dept. of Chem. and

Biochem., James Madison Uni. Ubiquitination is a post-translational modification which regulates protein degradation, DNA damage signaling, and inflammatory response. Three transfer enzymes catalyze the reaction's pathway: the E1 activating enzyme, the E2 conjugating enzyme, and the E3 ligating enzyme, respectively. Despite the identification of these enzymes' structure and function, an understanding of their catalytic mechanisms remains incomplete. Due to ubiquitin's extensive involvement in eukaryote biology and protein degradation, clarifying the ubiquitination mechanism holds great potential for anti-cancer therapeutics. E1 uses ATP to adenylate the C-terminus of ubiquitin, forming pyrophosphate and AMP. Most available assays for ubiquitination are either qualitative or use radioactive tracers, thus we wanted to develop a quantitative fluorescent assay to avoid these limitations. The proposed assay relies on a genetically-encoded fluorescent biosensor, known as Perceval, to monitor real-time changes in concentration of ATP during cleavage of ATP to AMP. Developed in the Yellen Lab at Harvard Medical School, Perceval was designed to report sub-second changes in cellular energy as a result of its competitive binding of ATP and ADP. We have worked to adapt the Perceval biosensor toward measuring ATP hydrolysis of E1 in the ubiquitination pathway in vitro. We first started to optimize by examining the fluorescent changes for protein solutions with ATP and AMP. We then tested the sensor at varying concentrations of ATP/AMP. Preliminary data show promising assay abilities for the detection of ATP loss in the presence of different Ubls and E1s, suggesting that the enzymes and protein substrates will not interfere with the sensor. Future directions will work to directly test E1 activity, and then perform assays of the entire cascade. Author contact: Christopher Berndsen, berndsce@jmu.edu

ANTAGONIZING SEROTONIN 2A RECEPTORS INCREASE THE ANALGESIC RESPONSE MEDIATED BY OXYCODONE IN A MOUSE MODEL OF ANTINOCICEPTION. X. K. Cuno Lavilla[1], S. Sierra San Nicolás[2], D. Stevens[3] & J. González-Maeso[2], [1]Thomas Nelson Community College and [2]Dept. of Physiology & Biophysics and [3]Dept. of Pharmacology & Toxicology, Virginia Commonwealth University. Among the vast serotonin receptor family, 5-HT_{2A} receptors are involved in a number of physiological processes including nociception. However, the role of the 5-HT_{2A} receptors in the spinal cord is somewhat controversial. Whereas early studies showed contradicting results upon the intrathecal administration of the $5HT_{2A}$ agonist DOI, probably due to differences in dosage, more recent studies support the pronociceptive role of $5HT_{2A}$ in the spinal cord. The purpose of this study was to identify the presence of 5-HT_{2A} receptors in the tail-flick reflex (TFR) circuit and determine the contribution of 5-HT_{2A} receptors to the analgesic response mediated by oxycodone. In order to dissect the TFR circuit, we extracted and processed the dorsal root ganglion (DRG) and lumbar spinal cord from three C57BL/6 male mice. After three days, we performed an immunohistofluorescence in both of them to detect $5HT_{2A}$ receptors in the soma of bipolar neurons (sensory afferents) and ventral horn neurons (motor efferent). For the behavior experiments, we used 20 adults C57BL/6 male mice and 5 adults $5HT_{2A}$ knock-out mice of 129S6/Sv background. Mice were pretreated with i.p injections of volinanserin (antagonist of $5HT_{2A}$ receptors) at a dose of 1, 5 and 10 mg/kg and then cumulative doses of oxycodone (mu opioid receptor agonist) p.o. 1, 2, 4, 8, 16, 32, 64 mg/kg. The measurement of acute thermal nociceptive activity was performed by

the hot thermal immersion test. We identified the presence of 5-HT_{2A}receptors in the DRGs and ventral horn neurons of the spinal cord. Behavior experiments showed that animals pretreated with high doses of volinanserin (5 and 10 mg/kg) showed increased analgesic potency in WT mice treated with oxycodone. Similarly, the administration of oxycodone to KO mice induced a significant increased analgesic response compared to WT mice. Together, these results suggest that the combination of oxycodone with a selective 5-HT_{2A} receptor antagonist could represent a therapeutic strategy to reduce pain state. (Supported by NIH, VCU Bridges to the Baccalaureate R25GM102795). Author contact: javier.maeso@vcuhealth.org

AUTOINHIBITION MECHANISM OF THE ENDOSOMAL TRAFFICKING PROTEIN TOM1. Evan Littleton [1], Wen Xiong [1], Anne Brown [2], and Daniel G. S. Capelluto [1], [1] Department of Biological Sciences and [2] University Libraries Department, Virginia Polytechnic Institute and State University. In eukaryotes, Tom1 is a protein involved in trafficking of proteins (cargo) through the early endosomes for their degradation. During bacterial infection, Tom1 is recruited to signaling endosomes, rather than early endosomes, leading to a delay of the protein degradation pathway. This occurs because bacteria induce production of phosphatidylinositol 5-phosphate [PI(5)P] in the host cell, increasing the intracellular levels of PI(5)P. It is proposed that, in order to keep the host cell alive, bacteria cause this increase in PI(5)P to prevent the degradation of Tom1-mediate host proteins required for bacterial survival. Tom1 possesses a N-terminal VHS domain that can bind to ubiquitin on ubiquitinated proteins, but this may be altered by high levels of PI(5)P. Despite the ability of the VHS domain to bind to PI(5)P, the full length Tom1 protein has not been shown to bind to PI(5)P. It is hypothesized that this self-regulation may be due to a short DXXLL motif located near the VHS domain in Tom1 that can compete with PI(5)P for VHS binding. To test this, mutagenesis of the DXXLL motif was performed to generate Tom1 mutants. These protein mutants were tested for their ability to bind to PI(5)P and compared to wild type Tom1. Mutagenesis of this region led to recovery of Tom1 binding to PI(5)P and shows similar binding as PI(5)P to VHS binding. This unveils a crucial role for the DXXLL motif in regulating binding of Tom1 to PI(5)P, and subsequently regulating the effects of bacterial infection on the endosomal protein trafficking pathway. Author contact: Evan Littleton evanlitt@vt.edu.

CHARACTERIZATION OF THE UFM-YLATION ACTIVATION MECHANISM BY UBA5. Benjamin Ruszala & Christopher E. Berndsen, Dept. of Chem. and Biochem., James Madison Univ. Post translational modification designate proteins for re-localization, changes in function/activity, and degradation. Ubiquitination is a type of post translational modification carried out by three classes of enzymes: E1 activating enzymes, E2 conjugating enzyme, and E3 ligating enzymes. E1 enzymes regulate the initial step of the pathway and fall into two classes: canonical and non-canonical. Uba5 is a non-canonical E1 enzyme which activates the ubiquitin like molecule, Ufm1. Uba5 activates Ufm1 through adenylation of the C-terminus of the molecule which is followed by a thioesterification step. This latter reaction forms a covalent bond between Uba5 and Ufm1. The details of this mechanism are not clearly understood. This project modeled the structure of Uba5 through the dimerization step, ATP binding, Ufm1 binding, and the

adenylation reaction to predict changes in dynamics and amino acid pKA. Molecular dynamics simulations were ran for using the AMBER14 force field and the data analyzed in R. Out simulations suggest that Uba5 becomes less dynamic as the mechanism progresses. Moreover, we have identified a number of interesting weak interactions which may play a role in substrate binding. These models will be empirically tested and refined based on the results of biochemical studies. Author contact: Christopher Berndsen, berndsce@jmu.edu

INTERACTIONS BETWEEN AN ANTI-CANCER DRUG AND THE PAR-4 TUMOR SUPPRESSOR. Laura E. Sweet, Andrea M. Clark, Komala Ponniah & Steven M. Pascal. Department of Chemistry and Biochemistry Old Dominion University. Par-4 is an intrinsically disordered protein that acts to inhibit pro-survival pathways in cancer cells. The activated fragment, cl-Par-4, is produced upon cleavage by caspase-3. Due to its disorder, the structure of Par-4 is difficult to determine via standard protein characterization techniques. We have used extreme conditions to induce folding; however, these conditions are far from physiological and therefore may not apply to the therapeutic approach of cancer treatment. The disorder seen is likely caused by electrostatic repulsions of amino acid residues in the coiled coil domain that destabilize the structure. To help overcome this repulsion, we have employed an anti-cancer drug as a cross-linking agent. Circular dichroism experiments of cl-Par-4 show partial disorder in physiological conditions, but upon the addition of the drug, cl-Par-4 becomes helical and folded. We expect that this stabilized structure will be more effective at killing cancer cells. Author contacts: lswee001@odu.edu, spascal@odu.edu.