Student Presenter: Jeremy Adelstein

Booth Number: 1

Research Mentor: Loren Wold

Project Title: Exposure to PM2.5 Preconception Primes Adult Cardiac Dysfunction

Abstract: Previous studies have demonstrated that particulate matter, or ambient particles less than 2.5 µm (PM2.5) in diameter, exposure during both in utero and postnatal developmental periods triggers electrical remodeling and cardiac dysfunction during adulthood. This shows that PM2.5 can reprogram hearts that are developing in the gestational period. Despite this evidence, the cardiac effects from pre-gestational particulate matter exposure remain inconclusive. This study was carried out to further investigate the potential priming effects of preconception exposure of PM2.5 on global cardiac dysfunction at adulthood. METHODS: Male and female FVB mice were exposed separately to either filtered air (FA) or PM2.5 at a concentration of ~ 51.69 µg/m3 for 6 h/day, 7 days/wk (consistent with exposure in a large metropolitan city) for 3 months. Mice were then cross bred in two groups: (1) FAm X FAf (both parents were FA exposed) and, (2) PMm X PMf (both parents were PM exposed). Offspring born to these crosses (FAFA and PMPM) were analyzed at 3 months of age for in vivo cardiac function via echocardiography, followed by in vitro cardiomyocyte functional analyses. RESULTS: Echocardiography identified increased LVEDd (3.97 ± 0.11 FAFA, 4.32 ± 0.10 PMPM, P=0.04) and LVESd (2.58 ± 0.13 FAFA, 2.93 ± 0.13 PMPM, P=0.1) dimensions in mice born to PMm X PMf parents. Morphological alterations were associated with lower systolic function indicated by reduced fractional shortening % (35.13% ± 1.67 FAxFA, 29.29% ± 1.38 PMxPM, P=0.03) in mice born to PMm X PMf parents. Cardiomyocytes isolated from PMPM offspring showed reduced peak shortening %PS (13.21% ± 0.67 FAFA, 10.15% ± 0.68 PMPM, P=0.002). -dL/dt was significantly increased (-5.38 ± 0.28 FAFA, -4.32 ± 0.33 PMPM, P=0.01) whereas +dL/dt remained unchanged between the groups. CONCLUSION: Similar to our previous study involving in utero exposure, preconception exposure to PM2.5 at realistic concentrations results in adult cardiac dysfunction. These results suggest that abnormalities in developmental potential are not limited to prenatal or postnatal period but are also determined prior to conception.

Student Presenter: Richa Agrawal

Booth Number: 2

Research Mentor: Dmitri Kudryashov

Project Title: Regulation of Cancer Biomarker Plastin 2 Activity by Phosphorylation

Abstract: Regulation of the actin cytoskeleton is integral to many essential cell processes, and plastins (PLS1, 2, 3) are highly conserved proteins that are critical to this dynamic remodeling by binding actin filaments and bundling them together. Unlike isoforms 1 and 3, ectopic expression of PLS2 correlates with enhanced metastatic potential of various epithelial cancers. PLS2 possesses the unique potential to be phosphorylated at Ser5 and Ser7 on its short N-terminal peptide (NTP), and the characterization of the phosphoproteome of many cancers has shown phosphorylation at many other specific sites in PLS2 that have not been previously studied. Moreover, phosphorylation at Ser5 and Ser7 has been directly linked to both enhanced metastasis of prostate and melanoma cancer cells as well as localization to membrane structures characteristic of invasive cancer cells. We aimed to elucidate the regulatory role of the PLS2 NTP phosphorylation via both removal and interchange of this peptide with that from ubiquitously expressed and non-invasive PLS3 isoform, as well as the effect of some of the other sites shown to be phosphorylated in vivo via phosphorylation mimics. To this end, we created NTP-deletion mutants for PLS2 and mutants with interchanged NTPs from PLS2 and 3. We also created five individual phosphorylation-mimicking mutations in wild type PLS2. Subsequent assessment of F-actin binding and bundling abilities compared to wild type PLS2 and previously studied PLS2-S5D indicated that NTP-deletion and replacement mutants are capable of bundling and binding actin as efficiently as wild type protein, suggesting that the NTP does not play a regulatory role in vitro. However, two phosphorylation-mimicking mutations had substantially increased actin binding and bundling abilities, and two lacked bundling ability, which suggests that phosphorylation may play an important role in regulation of PLS2 activity. Overall, clarifying this role and determining the detailed mechanisms underlying the PLS2 regulation may lead to development of new cancer therapy strategies to prevent metastasis.

Student Presenter: Sanghoon Ahn

Booth Number: 3

Research Mentor: Yune Lee

Project Title: Rhythm sensitivity assists in overcoming acoustic and syntactic challenges during speech listening

Abstract: A growing body of evidence has indicated connections between speech, language, and music. In particular, rhythm processing has been implicated as important in studies measuring various aspects of speech and language proficiencies (e.g., reading, speaking, and listening). Here, we investigated how rhythm sensitivity influences spoken sentence recognition under both sensory (e.g., impoverished acoustic quality) and cognitive (e.g., complex syntactic structure) challenges. Seventy-eight children (age range: 7-17 yrs; mean age: 11.4; 39 females) were recruited through The Ohio State University's Language Pod located at the Center of Science and Industry. All children were native English speakers with normally developed speech, hearing and language abilities, per parent report. Children were administered two tests (each took approximately 10 minutes). First, in the speech/language test, children listened to short spoken sentences that simultaneously varied in their acoustic (clear vs. 15-channel vocoded speech) and linguistic (subject- or object-relative embedded clause) structure. For each sentence, children were asked to indicate the gender of the agent performing the action via button-press. For example, children were instructed to press the "male" button for the sentence, "Boys that kiss girls are happy." Second, in the music test, children were presented with a pair of short rhythm sequences consisting of either 6 or 7 intervals and were to determine if they were the same or different. Half of the pairs contained the same rhythmic patterns, and the other half contained different patterns (the number of intervals were matched in each pair). To identify which factors accounted for performance in the speech/language test, we ran a linear mixed effect (LME) regression analysis in which the fixed effects included children's rhythm test score, age, gender, music training period, language environment (e.g., bilingual), parents' education, syntax (subject/object) and acoustic (clear/15ch) and the random effect included subjects. The LME revealed that music test ($p = 0.002103$), age ($p = 3.662e-06$), syntax ($p = 2.2e-16$), and acoustic difference ($p = .000726$) significantly predicted speech/language performance. Together, we found that rhythm sensitivity helps children better cope with sensory and cognitive challenges that are both simultaneously and independently present in spoken sentences. By controlling for potentially confounding variables (e.g., music training background, age, language environment, etc.), we showed that better performance in the speech/language test was independently driven by rhythmic sensitivity. The present behavioral data lay the groundwork for examining genetic and neural connections between speech, language, and music processes.

Student Presenter: Mustafa Alrahem

Booth Number: 4

Research Mentor: Ganesan Latha

Project Title: TLR4 is weakly expressed in liver compared to other organs and it is not the receptor responsible for clearing circulating LPS

Abstract: During Gram-negative bacterial infections, lipopolysaccharide (LPS), a major component of the sepsis-mediated immune response, serves as a ligand for toll-like receptor 4 (TLR4) on immune cells. Although TLR4 innate immune signaling is critical for eliminating bacterial infection, it can also induce excess cytokine production and death. Apart from the above-mentioned signaling response, the host innate immune system has even more immediate protective mechanisms that clears and inactivate LPS. We have previously reported that majority of circulating LPS is cleared from circulation by the liver especially by liver sinusoidal endothelial cells (LSEC) at a very fast rate than even the kupffer cells (KC). It has been proposed that as a mechanism to control inflammation from LPS, liver expresses less TLR4 and thereby it is not an LPS clearance receptor in LSEC. Testing this prediction, we analyzed TLR4 expression in all major innate immune organs. Quantitative western blot analysis using wild type (WT) and knock out (KO) showed that liver weakly expresses TLR4, with only less than 10% of the total body TLR4. Interesting, spleen, kidney and lungs together contribute for the remaining 90% of the total body TLR4. TLR4 analysis on Immuno-magnetically separated and enriched liver cells suggests that LSEC and KC expresses significantly very less TLR4 protein compared to bone marrow macrophages. Moreover we did not see measurable amount of TLR4 protein in hepatocytes. We then studied the LPS clearance ability of TLR4 receptor by comparing the disappearance of 3H/14C labelled LPS from blood stream of both wild type and TLR4 KO mice. The clearance curves portrays that both TLR4 KO and WT clear ~84% of circulating LPS within 5 min of infusion. The half-life is not significantly different between WT and TLR4 KO mice. These data strongly suggests that TLR4 is not the clearance receptor.

Student Presenter: Colin Angell

Booth Number: 5

Research Mentor: Federica Accornero

Project Title: The effects of BEX1 on muscle fiber size

Abstract: Adult skeletal muscle is highly adaptable. During muscle overload, muscles adapt to overload-induced damage by regenerating and increasing in size (hypertrophy). However, in conditions like muscular dystrophy, where amounts of muscle stress exceed tolerable limits, muscle fibers decrease in size (atrophy) and degeneration occurs. Brain Expressed X-Linked 1 (BEX1), is a stress-induced protein, upregulated during reparative muscle growth. Given the association between its upregulation and muscle growth, we hypothesized that BEX1 influences muscle fiber size in response to stress. To understand its effect on muscle size, we measured muscle cross-sectional area (CSA) in the skeletal muscles of wild-type (WT) and BEX1 knockout (BEX1-KO) mice at baseline and in response to repeated injury. The loss of BEX1 had no effect on baseline fiber size; however, it significantly blunted the reparative growth in the tibialis anterior muscles of BEX1-KO mice in response to repeated barium chloride injections ($p = 0.018$; WT CSA, 1297 μm2 ± 96 μm2; BEX1-KO CSA, 754 μm2 ± 19 μm2). Consistent with the idea that BEX1 affects muscle fiber size, we delivered adeno-associated virus BEX1 (AAV-BEX1) to neonatal WT mice and found that it was sufficient to increase muscle fiber size ($p = 0.045$; AAV-Control CSA, 463 μm2 ± 94 μm2; AAV-BEX1 CSA, 810 μm2 ± 64 μm2). In a dystrophic mice (delta-sarcoglycan knockout, DSG-KO), where BEX1 expression is downregulated and muscle atrophy occurs, the effect of AAV-BEX1 on increasing fiber size was even more profound and sufficient to restore muscle fibers back to baseline size ($p = 0.00$; DSG-KO + AAV Control CSA, 849 μm2 ± 48 μm2; DSG-KO + AAV-BEX1 CSA 1319 μm2 ± 93 μm2). Together, these data show that BEX1 plays a critical role in stress-induced adaptations to muscle fiber size.

Student Presenter: Abdulkadir Bashir

Booth Number: 6

Research Mentor: James Gregory

Project Title: Urban Canyon Wind Characterization Using UAV Mounted Anemometery

Abstract: Drone delivery has been an ultramodern concept until 2013 when Jeff Bezos, the CEO of Amazon, committed to the idea of drone delivery on a large scale. The idea took three years to develop and on December 7, 2016, Amazon introduced Prime Air – a delivery system designed for getting packages to customers in less than half an hour using unmanned aerial vehicles (UAVs). This idea may revolutionize the use of unmanned aerial vehicles in the shipping sector and pose a threat to other shipping companies such as UPS, FedEx, and many others. With this idea in place, the real problems with drone delivery are practical and regulatory. Some of the problems include: drone communication security, limited payload and flight time. Our research is focused on characterizing urban wind canyons, which affect vehicle stability and operational safety in high density urban areas. Urban canyons are the canyon like environments formed when a street is bordered by buildings on both sides; they can modify both the speed and direction of winds resulting in damaged UAVs and/or steering them off course. To fully understand the nature of urban wind canyons, experimental wind measurements are required. Measured wind velocities will be acquired using a sonic anemometer mounted vertically on an existing DJI S1000+ octocopter UAV. The sonic anemometer provides measurements of the three wind velocity components, u, v, and w. We have designed a custom data logger to capture wind speeds and flight vehicle orientation and position. The actual wind velocity vector is corrected by subtracting the measured wind velocity from the induced wind velocity created by the motion of the UAV. The experiment will add to the understanding of UAV stability inside of urban wind canyons. This measured system can be further applied to measuring the Kelvin-Helmholtz instability phenomena occurring within urban canyons.

Student Presenter: Emily Bopp

Booth Number: 7

Research Mentor: Nilay Shah

Project Title: The Synergistic Targeting of Pediatric Solid Tumors with BRD4 and AURKA Inhibitors

Abstract: Children diagnosed with the pediatric cancers neuroblastoma and Ewing sarcoma face considerable clinical challenges. Despite surgery and chemotherapy, many patients have treatment-refractory or recurrent disease, ultimately dying of the cancers. Novel therapeutics have been developed to target biological pathways in these cancers, including the BRD4 inhibitor, IBET-151, and the aurora kinase A (AURKA) inhibitor, MLN8237. Both classes of drugs were tolerated in clinical trials but lacked efficacy alone. Our in vitro studies show that, when used together, the drugs synergistically inhibit cell growth and viability in both cancers. We hypothesized that BET-151 and MLN8237 act synergistically against neuroblastoma and Ewing sarcoma by targeting common pathways through different mechanisms. We tested this hypothesis through two specific aims: 1) validation of the synergistic effects of the drug combination against neuroblastoma and Ewing sarcoma tumor xenografts in immunodeficient mice and 2) confirmation of the pharmacodynamic effects of dual drug treatment on common biological targets through RNA and protein analysis. Dual drug use significantly slowed xenograft growth in all models tested as compared to control (p<0.03). The combination of IBET-151 and MLN8237 significantly extended survival as compared to either drug alone in two neuroblastoma cell lines, SK-N-AS and SK-N-SH, and one Ewing sarcoma cell line, TC71, (p<0.025). The use of both drugs was more effective than either drug alone at repressing protein expression downstream targets, including MYC, MYCN, MCL1, CDK4, and CDK6, as evaluated by western blot. These data provide support for advancing the drug combination towards clinical trial alone or in combination with standard treatment, to inhibit tumor growth and improve survival in patients with pediatric solid tumors.

Student Presenter: Ashley Braddom

Booth Number: 8

Research Mentor: Jesse Kwiek

Project Title: Human-Bat Interactions in Iringa, Tanzania

Abstract: In recent years, the role of bats in the transmission of pathogens concerning to global health has become clear. Research into disease transmission by bats has focused on populations in sub-Saharan Africa because these bats carry the most viruses able to infect humans, and thus have the greatest potential for zoonotic transfer events. While programs such as USAID's PREDICT-1 have sought to catalogue viruses carried by bats in Tanzania and identify potential threats to public health, little work has been done to characterize the way people encounter bats, a crucial aspect of disease transmission between the species. Through the use of a short survey administered in the towns of Iringa, Igeleke, and Ipogoro, this project sought to investigate the frequency and type of these interactions in Tanzania. Of fifty people surveyed, 82% reported seeing bats and 72% reported bats roosting in their homes within the past year. Participants also reported seeing bats at work (23%), school (19%), and caves (17%). The majority of participants reported little contact with bats beyond visual sightings, however, certain subgroups were participating in activities with increased transmission potential, such as contact with bat guano (20%) and removing bats from the home (40%). Only 25% of participants were aware bats can transmit diseases, meaning people may not be taking protective precautions when interacting with bats, further increasing the risk of disease transmission. This work, while preliminary, shows that encounters with bats do occur in Iringa, and demonstrates a need for further investigation into the extent of these interactions so resources can be best focused to reduce disease transmission in the region.

Student Presenter: Camille Bratton

Booth Number: 9

Research Mentor: Shahid Nimjee

Project Title: Aptamer Inhibition of Von Willebrand Factor Ameliorates Ischemic Stroke Burden Following Murine Thrombotic Middle Cerebral Artery Occlusion

Abstract: Background: Recombinant tissue plasminogen activator (rTPA) is the current standard of care for ischemic stroke treatment. Due to a significant risk of intracranial hemorrhage, rTPA therapy is only indicated within 4.5 hours of symptom onset, resulting in <90% of stroke patients ineligible for treatment. For the approximately 10% of patients who do receive rTPA, recanalization is minimal (~30%) and often transient, commonly resulting in restenosis and loss of initial neurological improvement. We have previously developed an RNA aptamer which effectively and specifically inhibits Von Willebrand Factor (VWF) ex vivo and in vivo. Preliminary data demonstrates that VWF aptamer effectively restores reperfusion following murine ferric-chloride-induced carotid artery occlusion more effectively than rTPA. We will now extrapolate these results to a murine model of occlusion created from autologous blood. Hypothesis: VWF aptamer will restore reperfusion following thrombotic middle cerebral artery occlusion (MCAO) and ameliorate stroke burden with greater efficacy than rTPA. Methods: Adult wild-type (C57BL/6J) mice were anesthetized, the right carotid artery exposed and a 32-gauge intracranial catheter advanced within the carotid artery. Murine autologous blood was withdrawn, mixed with 10 µL saline and 1 µL murine thrombin, stabilized for 15 minutes, and injected back into the MCA. Twenty minutes after autologous clot injection, vehicle (n=5), VWF aptamer (n=6), and rTPA (n=7) were infused intravenously.Magnetic resonance imaging (MRI) was performed at 24 hours to assess ischemic stroke and hemorrhage volumes. Results: No mice receiving rTPA treatment survived 24 hours to receive an MRI. Ischemic stroke volumes were significantly decreased in mice treated with VWF aptamer (5.49 ± 5.01 mm3) compared to vehicle (35.34 ± 9.57 mm3, p<0.05). No evidence of intracranial hemorrhage was identified in either VWF aptamer or vehicle treated animals. Conclusion: VWF aptamer ameliorates ischemic stroke burden in a murine model of MCAO without a significant risk of hemorrhagic conversion.

Student Presenter: Katie Brown

Booth Number: 10

Research Mentor: Kerry Ard

Project Title: The moderating effect of stress on the relationship between pollution and self-rated health in racial minorities

Abstract: Minorities have long been discriminated against in the United States, and redlining policies pursued in the 1920s-60s prevented African-Americans from moving outside polluted inner city neighborhoods. This policy resulted in the siting of many environmentally hazardous facilities in these neighborhoods, exposing racial minorities to increased levels of air pollution that persist to this day. Exposure to air pollution is associated with low birth weight, asthma, diabetes, heart attacks, strokes, and obesity. In addition to increased exposure to air pollution, minorities also experience higher levels of perceived discrimination, which is a reliable predictor of chronic stress. Chronic stress leads to constant output of the stress hormone cortisol, which increases blood pressure, insulin resistance, cholesterol, and weight, as well as decreases immune function, memory, and sleep quality. The effects of a lifetime of increased stress are hypothesized to compound the effects of disproportionate exposure to air pollution to impact all age groups, from infants to senior citizens, and make African-Americans more susceptible to diabetes, heart disease, stroke, obesity, and asthma than whites. These disparate health outcomes culminate in a 10% decrease in life expectancy for African-Americans compared to their white counterparts. This study aims to explore the effects of stress on the well-established relationship between air pollution exposure and health outcomes by analyzing self-reported health and stress data collected throughout Ohio. It is the researcher's hope that controlling for stress in data analysis will increase the predictability of health outcomes when looking at populations with various levels of exposure to air pollutants. Establishing the effect of stress on this relationship could help explain variation in health outcomes among Ohioans, especially along racial and geographic lines. The findings could be used to target high risk populations, such as children and pregnant women, for public health interventions geared towards stress management and exposure reduction.

Student Presenter: Seth Bryson

Booth Number: 11

Research Mentor: Michael Barton

Project Title: Determination of Oxygen Fugacity using Olivine-Melt Equilibrium: Implications for the Redox States of Island Arc Basalt Mantle Source Regions

Abstract: In order to connect volcanic rocks to their mantle sources, it is essential to consider redox equilibria and their dependence on temperature, pressure, chemical composition, and oxygen fugacity. Oxygen fugacity (fO2) is an intensive variable that strongly affects the behavior of those elements in magmas that are sensitive to changes in redox state, such as Fe, and therefore Mg-Fe silicates, such as olivine. Since fO2 plays an important role in fractional crystallization, in principle it is possible to estimate fO2 from analyses of olivine in equilibrium with the melt. This research describes a new method based on this principle called the Olivine-Melt Equilibrium Method. The Fe3+ and Fe2+ contents of melt in equilibrium with olivine are calculated from the relationship of Gee and Sack (1988) that describes the partitioning of Mg and Fe2+ between olivine and melt. The Fe3+ and Fe2+ contents of the melt are then used to calculate the fO2 at which olivine and melt are in equilibrium using the model of Kress and Carmichael (1991) for the relationship between Fe3+/Fe2+ , fO2, T, P, and melt composition. The results for MORB and OIB calculated at OSU potentially provide evidence for redox heterogeneity in the mantle, possibly as the result of crustal recycling. We have calculated oxygen fugacities from published analyses of coexisting melt and olivine pairs in samples from volcanic arc geological settings to examine the effects of recycling on redox state. We obtain $\Delta FMQ = +1.03 \pm 0.52$ for olivine-melt pairs from Sunda arc basalts. However it is necessary to evaluate the possibility that fO2 changes during magma ascent before concluding that the oxygen fugacities of erupted magmas directly reflect those of the mantle source regions.

Student Presenter: Kaitlin Carson

Booth Number: 12

Research Mentor: Dana McTigue

Project Title: Spinal Cord Injury Causes Chronic Liver Pathology in Mice

Abstract: Spinal cord injury (SCI) disrupts the connections between the central nervous system and many peripheral organs. These altered connections cause chronic health complications that can result in significantly shorter life spans for SCI patients compared to the general population. One of these major health issues is metabolic dysfunction, and an organ critical for metabolic control is the liver. Studies from our lab have shown that a midthoracic contusion SCI in rats results in chronic liver inflammation and fat deposition, both symptoms of non-alcoholic fatty liver disease (NAFLD), a sign of metabolic syndrome in the liver. It is unknown if similar liver pathology occurs after SCI in mice. Thus, the purpose of this study was to investigate inflammatory and fatty changes to the mouse liver after SCI. We employed a moderate, midthoracic contusion SCI model and characterized the expression of liver Kupffer cell markers CD11b and CD68, liver fibrosis markers GFAP and PDGFRβ, and liver fat deposition via Oil Red O histology across a span of acute and chronic time points. Liver CD68 expression on phagocytic Kupffer cells was significantly reduced at 18 days post injury (dpi) and then significantly increased at 180 dpi, compared to naïve levels. Conversely, liver CD11b expression on cytokine-producing Kupffer cells was significantly increased at 28 dpi and then returned to naïve levels by 180 dpi. Interestingly, GFAP and PDGFRβ levels peaked at 18 dpi and returned to naïve levels by 180 dpi. Finally, Oil Red O+ fatty droplet staining was significantly increased at 28 dpi and remained elevated at 180 dpi. These results provide novel evidence that SCI causes chronic liver pathology in the mouse.

Student Presenter: Ashlee Chadwick

Booth Number: 13

Research Mentor: Jill Rafael-Fortney

Project Title: Identification of Adamts1 and Per3 as Direct Transcriptional Targets of Mineralocorticoid Receptor in Skeletal Muscle

Abstract: Duchenne Muscular Dystrophy (DMD) is a sex-linked genetic disease that affects striated muscles, including cardiac and skeletal muscles. This disease effects 1 in every 5000 boys, with these patients having an average life span of 25 years old with limited therapies available. Mineralocorticoid Receptor (MR) Antagonists are FDA approved drugs used to treat heart failure. Previous studies from our laboratory showed that MR antagonists have a beneficial effect on skeletal muscles in addition to the heart in preclinical trials in a mouse model of DMD. In healthy human differentiated skeletal muscle myotubes in cell culture, treatment with aldosterone resulted in up to 200 gene expression changes as detected by mRNA microarray. In dystrophic mice, MR antagonist treatment also led to many gene expression changes in microarrays of skeletal muscle. Approximately 12 genes repeatedly demonstrate expression changes both in vivo and in vitro, including Adamts1 and Per3. Adamts1 is a key remodeling enzyme for the extracellular matrix and has an important role in connective tissue organization and inflammation. Per3 is an important gene in circadian rhythm. MRcko mice have MR conditionally knocked out in skeletal muscle. Quadriceps tissues were isolated from dystrophic and control mice, as well as MR conditional knockout (cko) dystrophic mice. RNA was isolated from these samples and transcribed into cDNA. Primers for Per3 and Adamts1 were designed and tested for qPCR. QPCR is currently being performed on cDNA samples, where we expect a 2.5-fold increase in expression for Adamts1 and a 2.5-fold decrease in expression for Per3 in MRcko dystrophic samples. The levels will be normalized by using Beta-actin as a control in qPCR, allowing equal comparison.

Student Presenter: Pierce Ciccone

Booth Number: 14

Research Mentor: Jill Rafael-Fortney

Project Title: Development and Validation of the Fiona/dko Mouse Model

Abstract: Duchenne Muscular Dystrophy (DMD) is a degenerative neuromuscular disorder affecting 1 in 5,000 males [1]. Characterized by the progressive damage and weakness of heart and skeletal muscle tissue, this recessive, X-linked condition arises from a lack of the cytoskeletal protein dystrophin. Primary cause of death for DMD patients is heart failure caused by cardiomyopathies. The purpose of this project is to develop and validate a new mouse model capable of adequately assessing the long-term efficacy of cardiac treatments. In mice, when utrophin (compensatory equivalent protein to dystrophin in terms of function) is absent in addition to dystrophin (utrn-/-;mdx or dko or double utrophin/dystrophin knockouts) severe and early onset cardiomyopathy develops, modeling the onset in DMD patients. However, this model is complicated by mortality due to skeletal muscle pathology around 10-12 weeks of age. By crossing the “Fiona” utrophin transgenic mouse model onto the dko mouse model background to make “Fiona/dko” mice, [7] a human skeletal actin promoter region drives expression of the utrophin protein-coding region in differentiated skeletal muscle only. We have now re-made a dko model where skeletal muscle related mortality is no longer an issue [8]. H&E staining of this model has demonstrated increased fibrosis in the heart but not in skeletal muscle. In addition, through immunofluorescence we have demonstrated an up-regulation of utrophin in the Fiona TA but no such expression in cardiac tissue. Further, we have visualized a decreased presence of the claudin 5-protein in the Fiona heart sections. Ongoing western blots to indicate utrophin expression in rescued skeletal muscle tissue only and echocardiography to formulate a time-point specific course of cardiomyopathy development to end stage heart failure are being completed. The goal for this project is to confirm the reliability of the Fiona/dko mouse model to identify informative time-points for long-term Claudin AAV based therapeutics.

Student Presenter: Emma Clark

Booth Number: 15

Research Mentor: Gayle Gordillo

Project Title: Multidrug Resistance Protein-1 Inhibition by Natural Berry Extract as a Therapeutic Strategy for Endothelial Cell Tumors

Abstract: Hemangiomas, a type of endothelial cell (EC) tumor, are the most common soft-tissue tumors in infants, where 10% obstruct ears, eyes, noses, or airways and 1% threaten lives. Pharmacological treatments for hemangiomas have high-risk side effects. The purpose of this work was to identify how a safe natural berry extract (NBE) can inhibit EC tumor growth. Multidrug resistance protein 1 (MRP1) is a protein that pumps toxic products, including chemotherapy agents, out of cells and is over expressed in cancers and this tumor. We have previously shown mouse hemangioendothelioma endothelial cells (EOMA) injected subcutaneously into syngeneic (129P/3) mice as a valid model for generating EC tumors. Non-tumor murine aortic endothelial cells were used as controls. To analyze the effects NBE on MRP1 expression and function, immunohistochemistry, calcein exclusion test, and western blot were performed. Results indicated that EOMA cells treated with NBE significantly inhibit the activity of MRP1 because the cells accumulated nuclear oxidized glutathione (GSSG) leading to apoptotic EOMA cell death. Mice injected with EOMA cells treated with NBE produced smaller tumors with longer survival compared to the control group, untreated EOMA cell tumors. These findings are the first to report that a berry extract can interfere with MRP1 expression and function, resulting in apoptotic cell death from the accumulation of GSSG in the nucleus of EOMA cells. NBE inhibition of MRP1 should be examined further as a therapeutic treatment and considered as a possible application for other cancers with high activity of MRP1.

Student Presenter: Alan Coburn

Booth Number: 16

Research Mentor: Lauren Pintor

Project Title: Trade-offs between plant diversity and ecosystem function in restored and unrestored Lake Erie coastal wetlands

Abstract: Coastal wetlands along Lake Erie have been dramatically altered by humans since the mid-1900s, disrupting important natural ecosystem functions including habitat provision for fish and wildlife, flood mitigation, and nutrient retention. Restoration actions, such as the removal of dikes in coastal wetlands in the western Lake Erie basin, aim to restore these natural processes. However, while the goal of dike removal is to restore long-term ecosystem functioning, there may be short-term trade-offs between restoring ecosystem function and maintaining biodiversity. For example, higher-than-optimal water levels and longer inundation periods following hydrological reconnection may decrease wetland plant diversity. This phenomenon would presumably have a negative impact on nutrient retention and primary productivity, thus affecting higher trophic levels in the wetland ecosystem and water quality in Lake Erie (e.g. higher levels of nitrogen and phosphorus). Preliminary water quality data from 6 restored and 6 unrestored wetlands at the Ottawa National Wildlife Refuge indicates that total nitrogen and total phosphorus levels were lower in restored wetlands than in unrestored wetlands in 2016. Also, preliminary water level data indicates that water levels were higher in restored wetlands than in unrestored wetlands in 2016. Analysis of 2017 data is expected to show similar patterns. Therefore, pending final analyses, we expect that wetland plant diversity and productivity will be lower in restored wetlands than in unrestored wetlands.

Student Presenter: Megan Dailey

Booth Number: 17

Research Mentor: Cynthia Clopper

Project Title: Speech intelligibility in noise: Listener, talker, and stimulus factors

Abstract: Regional dialect can affect speech processing: Midland speech is more intelligible than Northern speech for listeners of both dialects (Clopper & Bradlow, 2008; Dailey & Clopper, 2017). Lexical, discourse, and social factors can also affect speech processing. Previous studies examining these factors in the context of talker regional dialect suggest that speech processing differences between talker dialects interact with other linguistic and contextual factors that inhibit speech processing (Jones, Dailey, & Clopper, 2016). The current study explores the possible interactions of these talker and stimulus factors with listener dialect. A speech intelligibility in noise task was conducted to determine Northern and Midland listeners' relative success in processing Northern and Midland speech. 67 Midland listeners and 63 Northern listeners transcribed short phrases mixed with speech-shaped noise. The phrases were extracted from short stories read by 8 Northern and 8 Midland speakers, and were balanced for target word frequency, phonological neighborhood density, semantic predictability, speech style (plain or clear lab speech), mention in a discourse (1st or 2nd), talker dialect, and talker gender, which are all known to facilitate or inhibit speech processing. Accuracy of the target words in the phrases was measured. A logistic mixed-effects regression model revealed that, consistent with previous findings, target word accuracy was lower when a combination of factors that inhibit speech processing interact: accuracy was lower for various combinations of Northern, male, plain, and 2nd mention words relative to Midland, female, clear, and 1st mention words. Additionally, target word accuracy was better for 2nd mention words as semantic predictability increased. Lastly, high frequency words showed greater target word accuracy than low frequency words. Taken together, these results suggest that factors related to phonetic reduction inhibit the intelligibility of words in phrasal context, but contextual and lexical factors allow listeners to recover highly-reduced tokens.

Student Presenter: Havovi Desai

Booth Number: 18

Research Mentor: Julian Thayer

Project Title: The Association of Resting Heart Rate Variability and False Memory

Abstract: Lower resting high frequency heart rate variability (HF-HRV) is associated with better cognitive control, including memory control. Previously we found greater resting HF-HRV was associated with fewer false memories. Lower HF-HRV is also associated with a greater negativity bias, and thus, the following study examined how the valence of memories (positive, negative, or neutral) may influence the link between HF-HRV and false memories. Using an electrocardiogram, HF-HRV was collected for 5-minutes during a resting-baseline period. Participants then completed a false memory paradigm. Participants were first shown a total of 6 word lists, each list containing 12 words (2 word lists per valence). Immediately following the presentation phase, participants completed the recognition phase, in which they were to indicate if they previously saw a word. To indicate false memories, false alarm rates were used, and are defined as the proportion of lure or false words incorrectly identified as true words. Results showed lower resting HF-HRV to be associated with a higher tendency to incorrectly identify both neutral ($r = -.349$, $p = .034$) and negative ($r = -.362$, $p = .029$) false memories; however a similar pattern was not observed for positive false memories ($r = .152$, $p = .220$). These results are in line with our lab's previous work, suggesting that those with lower resting HF-HRV have difficulties with correctly identifying false memory-words. Importantly, this pattern was found in negative and neutral, but not positive, memory-words. These data support the novel idea that resting HF-HRV may not predict control over positive memories. Over the 2017 summer semester, an additional 27 subjects participated in a second study that utilized 24 word lists (8 per valence); data collection is ongoing. Preliminary results from the current sample ($n = 27$) will be presented and discussed.

Student Presenter: Shivani Deshpande

Booth Number: 19

Research Mentor: Gail Besner

Project Title: Investigating New Injury Scores for the Diagnosis of Necrotizing Enterocolitis

Abstract: Introduction: Necrotizing enterocolitis (NEC) is the leading cause of death in preterm infants. The exact pathogenesis of NEC is unknown. Our lab uses a validated model of experimental NEC in rodents to determine the efficacy of novel potential clinical therapies for NEC. In this model, NEC is confirmed by histologic examination of the intestines after sacrifice, using an established intestinal injury grading system. The current project introduced two new injury scoring systems to our experimental NEC model, and determined the correlation between these new scores and the standardized histologic injury-based diagnosis of NEC.Methods: Rat pups were delivered preterm at E21.5 via C-section. Pups were gavage fed with a high calorie formula 5 times a day, and subjected to hypoxic and hypothermic stress 3 times a day. Feeds started at 0.1mL, and increased by increments of 0.1mL each day. The Macroscopic Injury Score (MIS) was determined at the time of sacrifice upon harvesting of the intestines. The Clinical Sickness Score (CSS) was determined once daily, and also recorded immediately prior to sacrifice. At 96 hours, remaining pups were sacrificed and their intestines collected for histologic grading. Results: With a large sample size of n=86 pups, there was a strong correlation between MIS and histologic injury score (correlation coefficient 0.9876). With a small sample size of n=10 pups, there was a suggestion of a positive correlation of CSS prior to sacrifice with histologic injury score (correlation coefficient 0.3882). CSS experiments are still ongoing. Conclusions: The Macroscopic Injury Score (MIS) correlates well with histologic injury grading, and may be a useful addition to our experimental NEC model. The Clinical Sickness Score (CSS) still needs optimization in order to determine its usefulness. MIS and CSS may represent a faster and useful adjunct to the histologic diagnosis of NEC in our experimental NEC model.

Student Presenter: Brittni Dixon

Booth Number:

Research Mentor: Hanna Primeau

Project Title: The Evolution of Merlin

Abstract: The goal of this research project is to discover how the image of Merlin has changed over the span of 30 years. Using different types of media, including the lesser known but growing field of fan art, my aim is to compile a time-line to represent Merlin's appearance over the years. Linking images to his profession and comparing Merlin's image to those of modern day popular wizards and warlocks. With the ever-growing popularity and the extensive history of the Arthurian legends, it is surprising how much we do not know about one of its biggest and key players. There are reports of him hailing from Wales, England, and even Scotland each version consisting of slight tweaks to his appearance. Merlin is known for his guidance to King Arthur using his wisdom to create the golden age of Camelot that alone is a reason for some to look up to him. Merlin over the years has been many things and in time will become many more. To date my research has provided me with several different images of Merlin. The bulk of my research has come from many books and surprisingly they almost describe him in the same way: with a long white hair and beard; others have shown a Merlin of middle age. Still the wise man known in the legends but nowhere near as old. It was interesting to find that during my research I found two different movies where the same man, Sam Neill, portrayed Merlin. Better known as the 'dinosaur man' from the Jurassic Park movies, Neill portrays the warlock in Merlin 1998 and then again in Merlin's Apprentice 2006 and though it is the same man in both movies the character Merlin is completely different, yet still the mischievous warlock known thought history.

Student Presenter: Amber Dock

Booth Number:

Research Mentor: Eric Johnson

Project Title: Shed Light on the Red and White: A Research Project on the American Intervention in Russia, 1918-1920

Abstract: The Ohio State University's Rare Books and Manuscripts Library houses a collection of photographs documenting the United States' little-known intervention in Siberia following the First World War, an operation referred to as the American Expeditionary Force Siberia. The set of photographs and postcards showcased on this website were part of private collections and only recently, and rather excitedly, acquired by the University for teaching, research, and outreach activities, and prior to my own work these collections had not yet been the subject of any scholarly efforts. Given the direct influence that American intervention in Siberia had on international relations for decades after, recognition of this operation should be more common. This project has granted me the opportunity to analyze and address an event aptly named The Unknown War and to present it in a way that is available to a wide audience, while also drawing on themes that prove relevant today, such as refugee crises and foreign political interventions. By providing context for as many items as possible, it is my goal that the reader will gain a much broader understanding of the Russian Civil War and the effect that US involvement had on foreign relations in the succeeding decades, particularly during the Cold War. It has always been a strong belief of mine that educational resources should cater to various types of learners. Not everyone is able to learn from large and difficult to read texts which, unfortunately, is the predominate form that historical narratives often take, particularly ones that rely on difficult to access primary historical materials or focus on little-known events and events relating to military history. I also hope that my work will provide the University Libraries with an example of how archival content can be presented effectively in a digitized format.

Student Presenter: Ashley Dundon

Booth Number: 22

Research Mentor: Ayaz Hyder

Project Title: Developing a Mathematical Model for the Opioid Epidemic in the State of Ohio

Abstract: The opioid epidemic is pervasive across the United States and, in particular, the state of Ohio. Though the state of Ohio has put forth recovery programs, overdoses continue to occur and increase. In order to combat this epidemic, it is important to understand the dynamics between overdose and recovery efforts put forth by the government and community. A mathematical model was developed to simulate these dynamics using data acquired from Summit County, Ohio. Using this model, parameters affecting the numbers of susceptible, overdosing, and recovering individuals in Summit County were determined. It is hypothesized that by adjusting these parameters, the epidemic could be shortened and the severity could be lessened. This model could also give emergency personnel information about when overdoses are most likely to occur and how many people are likely to overdose. Because the opioid epidemic is ubiquitous throughout all levels of society and is a widespread issue, adequate resources are not always available. This model could provide information that would allow for a more strategic and effective allocation of resources across communities. Though the opioid epidemic is a continuing problem, steps can be taken to reduce its impact. By identifying and understanding factors that influence the dynamics between overdose and recovery, more effective actions can be taken to mitigate the effects of the epidemic on the community.

Student Presenter: Anthony English

Booth Number: 23

Research Mentor: Daniel Wozniak

Project Title: Hydrogen Peroxide Susceptibility of Mucoid and Non-Mucoid Variants of Pseudomonas aeruginosa

Abstract: Psuedomonas aeruginosa (P.a.) is a Gram-negative opportunistic bacterium that causes serious acute and chronic infections in the hospital-setting. Cystic fibrosis (CF) is a genetic disorder caused by a mutation in the cystic fibrosis transmembrane regulator (CFTR) protein. Consequently, CF patients produce thick and sticky mucus that blocks the airways and creates an ideal environment for chronic bacterial lung infections, most commonly due to P. a. During infection, P.a. can acquire mutations allowing the bacterium to better adapt to the host lung. For example, mutation of the gene, mucA, results in overproduction of the bacterial polysaccharide, alginate, causing the colonizing "non-mucoid" bacteria to switch to a "mucoid" phenotype. Mucoid strains of P.a. are known to be less susceptible to antibiotics and the immune system compared to non-mucoid isolates. However, we recently showed that the mucoid isolate, FRD1, is more susceptible to hydrogen peroxide (a reactive oxygen species produced by immune cells) than an isogenic, non-mucoid variant, FRD2. Given the unexpected finding in the FRD strain background, we wanted to test whether this phenotype is conserved across multiple mucoid/non-mucoid isolates of P.a. As such we utilized a laboratory strain library that replicates mutations found in P.a. isolates derived from Danish CF patients over a period of 40 years. These clinical isolates and laboratory strains were tested for peroxide sensitivity. We found that lab isolates are less susceptible to peroxide compared to clinical isolates and that peroxide sensitivity is independent of mucoid status. One lab strain with a mutation in rpoN (bacterial transcription factor) showed decreased susceptibility to peroxide, suggesting, rpoN may be a negative regulator of an antioxidant (catalase) that provides protection from peroxide. These data support continued investigation of mucoid/non-mucoid P.a. susceptibility to innate immune factors, including peroxide, as we seek to understand the mechanisms of P.a. evasion of host-defenses.

Student Presenter: Luke Fannin

Booth Number: 24

Research Mentor: Scott McGraw

Project Title: Circumorbital variation in West African red colobus (Piliocolobus badius badius)

Abstract: Expansions of bone surrounding the cranial orbits are characteristic features of African red colobus monkeys (Genus: Piliocolobus). Previous work has demonstrated that variation in the circumorbital region of primates is unrelated to masticatory stresses, leading some to suggest that factors such as sexual selection may better explain variation in this feature. However, few studies have tested whether sexual differences underlie variability in circumorbital morphology within a single species. In this study we investigate patterns of circumorbital ridge variation within a population of West African red colobus (Piliocolobus badius badius) testing the null hypothesis that the feature is similarly variant in males and females and unrelated to size. Specific predictions include that the extent of ridging (1) increases with age and (2) is greater in males due to sexual selection. The sample consists of 82 crania collected by members of the TaÃ¯ Monkey Project from their study site in western Cote dâ€™Ivoire. We collected seven measurements from adult specimens, including two assessments of orbital ridging (superior and lateral) and five measures of cranial size. Adult age was assessed using a tripartite scheme of dental wear: low, moderate, and heavy. These data were used to create eight indices describing orbital ridge variation in males and females. One-way ANOVA reveals no relationship between circumorbital ridging width and dental wear (age). In every case and across all age (dental wear) categories, ridging was significantly greater in males than in females. Based on these results, we conclude: (1) circumorbital ridging is a sexually dimorphic trait and is more extensive in males, (2) the extent of ridging does not increase as adults age, and (3) other factors, notably sexual selection by females on male facial breadth, may underlie the variation of this feature.

Student Presenter: Finnick Vest

Booth Number: 25

Research Mentor: Joni Acuff

Project Title: Reflecting on Jamaican Art: Using Identity to Inspire Creativity

Abstract: The arts are vital to Jamaican life, and are deeply rooted in the oppressive history of the island, and how this history impacts the people. When Americans think about Jamaica they do not think of the importance of identity present in the culture; they do not think about how the influence of identity affects the art created there. Yet, the student artists I met at Edna Manley College of Visual and Performing Arts were creating powerful pieces, artwork that forced one to think outside of their experiences and stereotypes. The art was backed by a heavy understanding and reflection of identity and political movements. Michael Layne, an art educator, stressed the importance of identity and having students care about what they are making, truly connecting to the art. Artists are not created by mimicking step by step skills, but they are inspired by their own realities and a sense of independence and individuality. He explained how he only felt sheer joy creating comics, toys, and dollies out of found objects. Creativity came from his interest in the creations, he cherished these toys, while he did not care for his art assignments. Jamaican artists are using this personal connection in their art, which is what is making it successful. The artists at Edna Manley seem to do this with ease, a stark difference from the United States. An understanding of history and in turn, an apparent connection to one's identity is the difference. History and marginalized identities are of an utmost importance to artists in Jamaica. Using identity as a tool in inspiring young artists to create is vital, and leads to students being able to understand themselves and their society more, in a way that artists and art educators in Jamaica have seemed to master.

Student Presenter: Luke Genutis

Booth Number: 26

Research Mentor: Albert de la Chapelle

Project Title: SMAD3 in the Context of Thyroid Cancer Predisposition

Abstract: Thyroid cancer is one of the most common endocrine malignancies, yet the mechanisms for its predisposition remain elusive. Genome wide association studies (GWAS) have proved to be a good way to uncover candidate loci for human cancers. GWAS measures association between genotype and affected phenotype by using large cohorts of affected patients and controls to find causative variants or genes. A recent GWAS revealed two SNPs (rs2289261 and rs56062135) at the 15q22 locus that showed a strong association with thyroid cancer risk. These SNPs are in separate introns of the SMAD family member 3 (SMAD3) gene, a member of the Transforming Growth Factor – β (TGF-β) signaling pathway. TGF-β mutations, including SMAD3 mutations, have been implicated in other cancers. In this study, we hope to uncover the significance of SMAD3 in thyroid cancer. First, we found a 25.6kb linkage disequilibrium (LD) block in SMAD3. We discovered 6 single nucleotide polymorphisms (SNPs) in this LD block are predicted to be functional variants in the RegulomeDB database. Luciferase reporter assays were performed with plasmids containing the different alleles of these SNPs and an empty vector to measure differences in luciferase activity between different alleles. As a result, we've found two SNPs, rs17293632 and rs4562997, are functional variants within the LD block of SMAD3. We also performed an siRNA-mediated knockdown of SMAD3 in the TPC-1 thyroid cancer cell line, and used a gene expression array to find dysregulated downstream gene targets of SMAD3. This analysis yielded a list of 116 candidate gene targets of SMAD3 in TPC-1 with a fold change larger than 1.5. These results demonstrate how variants in SMAD3 can alter its transcriptional levels in thyroid cancer cells. We've also uncovered the downstream targets of SMAD3 in the TPC-1 cell line, which gives insight into the functions of SMAD3 in thyroid cancer.

Student Presenter: Benjamin Green

Booth Number: 27

Research Mentor: Melissa Davis

Project Title: Evaluating Anxiety and Depression in Transgender Patients at The Ohio State University Transgender Primary Care Clinic

Abstract: The transgender community has extremely high rates of mental health diagnoses compared to its cisgender counterpart, particularly for depression and anxiety. This disparity is due to increased risk factors faced by transgender people. In short, these include discrimination, abuse, and isolation. Little research has been done to evaluate mental health outcomes of this increasingly underserved patient population. Within the last 10 years, many medical societies have produced clinical guidelines for treating gender dysphoria with cross-gender hormone therapy (CGHT). However, treatment of transgender individuals remains controversial. This is because many of these clinical guidelines for the treatment of gender dysphoria are based on expert opinion rather than clinical data regarding mental health outcomes. Thus, it remains unclear how CGHT affects mental health outcomes in transgender patients. This study aims to evaluate the existence of a relationship between CGHT and the attenuation of depression and anxiety in transgender patients. The data for the study will be collected from patients who were seen within the first two years of the Ohio State University Transgender Primary Care Clinic (OSUTPCC). The study is collecting vital data that is absent on transgender patients here in the Midwest (most data localized to coastal urban centers). Benefits include providing OSUTPCC with a better understanding of how well it is addressing the mental health needs of its patients, as well as providing further insight into the greater question of what impact, if any, hormone therapy has regarding mental health outcomes.

Student Presenter: Chanhee Ha

Booth Number: 28

Research Mentor: Hanna Cho

Project Title: Characterization of the Effects of Cyanophages on Cyanobacteria Microcystis aeruginosa for Potential Biological Control of HABs

Abstract: Cyanobacteria are responsible for the toxins produced by Harmful Algal Blooms (HABs), whose environmental risks are extremely hazardous to humans, wildlife, and the ecosystem. Cyanophage act as viruses on host cyanobacteria and can deter or improve their growth; in turn, affecting the growth of HABs (Watkins 2014). Whereas this general phage-bacteria relationship is understood, detailed characteristics about the lytic cycle are still not completely understood. Further understanding of morphological change over time is beneficial to target HAB causing cyanobacteria with cyanophages at specific time frames. So far, extensive research the phage-bacteria relationship has mainly been performed on saltwater cyanobacteria because of its higher economic impact; however, freshwater cyanobacteria must be investigated for its ecological impact, such as clean drinking water. Microcystis aeruginosa (M. aeruginosa) was reported to show cases of cell lysis and phage growth (Yoshida et. al 2006), which was also confirmed through our preliminary Atomic Force Microscopy (AFM) measurements on M. aeruginosa from Lake Erie in collaboration with the Department of Environmental Health Science in the College of Public Health (Jiang, Lee et. al 2016). Air, liquid, and viscoelastic AFM techniques were used to further characterize the phage bacteria relationship. Air measurements showed a degradation of the bacteria when introduced to phage within 6 hours. Viscoelastic AM-FM mode showed a decrease in Young's modulus of the bacterial membrane over the span of one month. A similar trend is expected during liquid measurements, which are currently in progress. IR Spectroscopy will also be used to examine any chemical change when the bacteria is exposed to phage. Measurements showing a chemical lysis of the bacteria are expected. Through further lytic characterization, a biocontrol can potentially be developed to deter growth of freshwater HABs in the future, helping the environment and providing clean drinking water for humans.

Student Presenter: Jacob Harris

Booth Number: 29

Research Mentor: Daniel Wozniak

Project Title: Evolution of P. aeruginosa rugose small-colony variants during chronic wound infections

Abstract: The delayed healing of chronic wounds is attributed to the presence of bacterial biofilms. Pseudomonas aeruginosa is a common causative organism of these infections. P. aeruginosa also commonly causes chronic pulmonary infections in Cystic Fibrosis (CF) patients. Within the CF lung environment P. aeruginosa evolves, by acquiring stable genetic mutations, to produce variant sub-populations that are more fit in the infection. This process is known as pathoadaptation. However, little is known about the occurrence or role of pathoadaptation during chronic wound infections. To determine if P. aeruginosa pathoadapts within a chronic wound, we utilized a porcine burn wound model. Wounds were infected with wild-type P. aeruginosa and homogenized punch biopsies were plated and screened for P. aeruginosa colony morphology variants. We recovered rugose small colony variants (RSCVs) at a frequency of 1% of the total P. aeruginosa burden. RSCVs isolated from chronic wounds displayed similar phenotypes to RSCVs isolated from sputum samples of CF patients. These include, overproduction of exopolysaccharides, increased biofilm and reduced metabolic activity. An additional porcine burn wound infection was performed using a P. aeruginosa mutant defective in biofilm formation. Small-colony variants (SCV) were isolated from homogenized porcine tissue at a similar frequency to the wild-type infection. These SCVs showed a reduced metabolic activity compare to the parent, however did not display increased biofilm formation as was observed for the variants evolved during the wild-type infection. This suggests that these variants possess phenotypes, other than increased biofilm, that would be advantageous in a chronic wound. We have preliminary evidence that factors within the wound environment drive the evolution of P. aeruginosa variants. We are currently investigating the fitness advantages the pathoadapted variants display over the parent strain. This will lead to an understanding of the impact these evolved variants may play in a wound environment.

Student Presenter: Browning Haynes

Booth Number: 30

Research Mentor: Julie Medas

Project Title: Code Pink Criteria Revised: Can Increased Efficiency and Quality Outcomes Coexist?

Abstract: In the mid-1980's, the MetroHealth System (MHS) Division of Neonatology developed a Regional Code Pink Program which identified risk factors that required neonatal resuscitation in the delivery room. The Code Pink protocol was recently revised so it excluded risk factors that predicted minimal to no intervention. The objective of this study was to determine if the recent change in criteria maintained patient outcomes while lowering the number of Code Pink calls. This study is a retrospective chart review of all deliveries between May and November 2016. A REDCap electronic database instrument was created for data collection. During the study period, a total of 1,617 deliveries occurred. Electronic medical records, Labor and Delivery and Neonatal Intensive Care Unit Log Books were analyzed for demographic information, delivery details, type of resuscitation, and post-resuscitation outcomes. Statistical analysis was performed utilizing SPSS software. During the 6-month study period, a total of 890 Code Pinks out of 1,617 deliveries were initiated. After the criteria revisions, the number of Code Pink calls significantly decreased from 64.2% to 45.8% of all deliveries. It can be inferred there was less disruption of the NICU staff, increasing the time for patient care in the unit. Additionally, the number of deliveries requiring airway and extensive resuscitation was lower in the post-revision group. The revision, therefore, did not result in more newborns requiring more than minimal intervention after birth. Finally, there is no significant difference in post-resuscitation outcomes from before to after the criteria revision indicating that patient outcomes were maintained. In an ever-changing healthcare arena, all efforts must be made to ensure health care delivery is evidence-based, safe, effective, and cost-efficient. Future studies can look into the indirect benefits of the protocol change including improved patient satisfaction and efficient spending.

Student Presenter: Jade Hettick

Booth Number: 31

Research Mentor: Chanhee Lee

Project Title: Effects of Lipidol Ultra on rumen fermentation and feed digestibility: in vitro

Abstract: Lysophospholipid is hydrolyzed phospholipids and has been studied in pigs and poultry as a feed additive where improved production and feed efficiency were reported. Phospholipids extracted from soy were hydrolyzed to produce lysophospholipids (LPL; Lipidol Ultra®, Easybio inc., Seoul, Korea) where 70% of phospholipids were lysophospholipids. We hypothesized that LPL can have beneficial effects on feed digestibility and utilization efficiency. The experiment was conducted in vitro. Rumen fluid was collected from two cannulated beef steers (350 kg of BW) fed a typical growing diet (about 65% corn silage; 14% CP on a DM basis). Buffer solution was prepared prior to collecting rumen fluid and flushed with O2-free CO2 for about 2 h to remove O2 in buffer. The rumen fluid was mixed with the buffer in a 1:3 ratio and buffered rumen fluid was then distributed into 125-mL serum bottles (total 60ml) containing substrates under a stream of O2-free CO2 gas. After inoculation, bottles were immediately sealed with a 14-mm butyl rubber stopper plus aluminum crimp cap. The bottles were placed in a shaking incubator at 39°C. Substrates (1 g) prepared in the incubation serum bottles were as follows: 1) Mon, a basal diet containing monensin (Rumensin 90; Elanco; dosage rate, 350 mg monensin/head/day), 2) Cont, the basal diet; LLPL, the basal diet containing 0.025% LPL (DM basis), MLPL, the basal diet containing 0.050% LPL (DM basis); HLPL, the basal diet containing 0.075% LPL (DM basis). The incubation was conducted at 3, 6, 12, 24, and 48 hours. At each time point, samples were collected from individual bottles and analyses are in progress. Methane production, total protozoa, gas pressure, VFA concentrations, ammonia concentrations, digestibility of DM, and NDF will be determined. Since this study was in vitro, an in vivo study will be conducted.

Student Presenter: Daniel Hribar

Booth Number: 32

Research Mentor: Kari St.Laurent

Project Title: Assessing blue carbon stock across wetland environmental gradients in Delaware

Abstract: Coastal wetlands offer numerous ecosystem services, including the ability to trap and store carbon, and are today increasingly susceptible to human and climate-related stressors. Consequently, interest has expanded in tidal wetland potential to help offset carbon emissions through sequestration and vertical sediment accretion collectively referred to as "blue carbon". There is an ongoing need to quantify the accumulation and standing stock of carbon within these systems and to assess how environmental gradients, especially salinity, affect the variability of stocks within marshes of an intrastate region. This question was investigated through collection of sediment cores covering a salinity gradient of 0-35 ppt across the two sites comprising the Delaware National Estuarine Research Reserve. Cores were segmented into halves, dried at 105^{o}C for 24 hours and homogenized. Bulk carbon was measured in triplicate using loss on ignition, the methodology of which was also tested to determine ideal time and temperature parameters. Results suggest that organic carbon density varies spatially and may be correlated with covariates including sediment bulk density, vegetation type, and/or salinity fluctuation. This work will improve existing knowledge of Delaware-specific carbon stocks and identify whether salinity is a useful proxy for carbon storage extrapolation over un-sampled areas, further informing scientists, policymakers, and land-managers on the manifold benefits of tidal wetlands in the context of restoration and greenhouse gas sequestration potential. Determination of carbon stock and accumulation rates in Delaware marshes adds to the growing understanding of the role of such wetlands across North America and their prospective carbon storage characteristics.

Student Presenter: Kristen Hsu

Booth Number: 33

Research Mentor: Ludovica Butto

Project Title: Investigation of bone marrow-derived macrophage responses to bacterial ligands in ileitis-prone SAMP1/YitFc mouse model

Abstract: Crohn's disease (CD) is one of the two dominant phenotypes of inflammatory bowel disease (IBD) characterized by chronic, remitting and relapsing inflammation of gut intestinal segments. Although the cause of the disease is still unknown, an exaggerated immune response to commensal bacteria in individuals with a genetic predisposition has been postulated as a key mechanism. Macrophages play a pivotal role in the host immunity and they can be classified into two functionally polarized states: pro-inflammatory and anti-inflammatory macrophages, secreting TNF and IL-10, respectively. A growing body of literature reports that the lamina propria of the inflamed intestine in patients with CD is massively infiltrated by macrophages secreting TNF. The central hypothesis of this work is that macrophages from inflamed mice exhibit an exacerbated response to bacterial stimuli compared to those from healthy mice. To test this, bone marrow-derived macrophages (BMMs) from ileitis-prone SAMP1/YitFc (SAMP) mice prior to disease onset and with established disease, 10 and 30 weeks old, respectively, and from littermate controls, were elicited with bacterial ligands, i.e. lipopolysaccharide (LPS) and peptidoglycan (PGN). BMM secreted proteins, i.e. TNF and IL-10, were measured by ELISA. BMMs from inflamed SAMP mice secreted higher TNF levels upon PGN stimulation compared to those from control mice (1785±109.1 vs 1222±197.8, n=5, P = 0.0334, Unpaired t-Test). In contrast, there was no difference when BMMs from either mouse strains at 30 weeks old were stimulated with LPS, and when BMMs from either mouse strains at 10 weeks old were elicited with LPS and PGN. Additionally, we observed no differences in IL-10 levels between BMMs from all mouse strains upon stimulation with both bacterial ligands. Our findings show an exacerbated pro-inflammatory response upon PGN stimulation by BMMs from inflamed SAMP mice, suggesting an impaired regulation of innate immune responses, which can contribute to disease pathogenesis.

Student Presenter: Jane Hulse

Booth Number: 34

Research Mentor: Sean Liu

Project Title: Analysis of effect of fermentation of nutritional quality of navy bean flour

Abstract: Beans are a global staple in both diets and economies as they are a good source of protein, calories, and micronutrients as well as being easy and relatively cheap to produce. However, in addition of their myriad of merits, beans also contain various antinutritional properties that adversely affect the digestibility, nutritional value, and acceptability of the pulses. For example, alpha-amylase is an antinutrient that causes malabsorption of starches by inhibiting the digestive enzyme that breaks down starch into simple sugars. Additionally, the sugars Raffinose, Verbascose, and Stachyose are antinutritional in that they cannot be digested and can cause bloating or flatulence. Fortunately, there are processing techniques, such as fermentation, that can reduce and/or eliminate any antinutrients the beans contain. The purpose of this study was to examine the effects of fermentation on the content of alpha-amylase inhibitors and soluble sugars in naturally fermented navy bean flour. Navy bean flour samples, having flour-to-water ratios of 1:1 and 1:1.5, were fermented at 32°C in an incubator for three days. After the fermenting process, the samples were freeze-dried for use in testing for alpha-amylase inhibitors and soluble sugars. It was found that Sucrose, Raffinose, Verbascose, and Stachyose were absent in fermented samples along with decreased Glucose and Fructose and increased lactic acid content, which was noted through pH measurements at intervals throughout the fermentation process. Testing for alpha-amylase inhibitors found that the inhibitors were inactivated in the fermented samples compared to raw samples, as was predicted. Overall, results of the tests were that both the alpha-amylase inhibitors and soluble sugars were at significantly lower levels in the fermented navy bean samples than they were for the raw navy bean samples. These results further support fermentation as a processing method that makes beans a more viable food source.

Student Presenter: Allyson Huttinger

Booth Number: 35

Research Mentor: Shahid Nimjee

Project Title: Thrombolytic Efficacy of Von Willebrand Factor Aptamer in Large Animal Model of Carotid Occlusion

Abstract: Background: Occlusive arterial thrombi, leading to stroke and myocardial infarction, contribute to ~13 million deaths annually. Recombinant tissue plasminogen activator (rTPA) is the current standard of care for ischemic stroke treatment; however, <10% of patients are eligible for rTPA and recanalization is only ~30%. Furthermore, a significant number of patients treated with rTPA experience restenosis and symptomatic hemorrhage, resulting in loss of initial neurological improvement and increased mortality. Our murine data in a FeCl3-induced carotid artery occlusion model demonstrated aptamer inhibition of von Willebrand Factor (VWF) significantly restored blood flow after occlusion. Hypothesis: VWF aptamer treatment will result in greater recanalization after canine carotid artery occlusion compared to rTPA. Methods: Adult male and female beagles were anesthetized, intubated and the right carotid artery exposed. A Transonic Doppler probe was used to monitor blood flow throughout the procedure. Occlusion was induced with FeCl3 patch for 15 minutes, stabilized for 45 minutes, then treated with intravenous infusion of vehicle (n=7), rTPA (n=5), or VWF aptamer (n=5). Angiography and platelet reactivity (PFA-100, Siemens Diagnostics) were performed prior to injury, at occlusion and 120 minutes after occlusion to assess patency and platelet activity. Statistical analysis was performed using multiple t tests. Results: VWF aptamer significantly increased reperfusion compared to rTPA and vehicle-treated animals 85 minutes after infusion (p<0.05). Platelet reactivity was significantly reduced immediately after treatment and sustained for 60 minutes after aptamer infusion (p<0.0001) compared to rTPA or vehicle. Angiography indicated a trend toward increasing recanalization with aptamer (20.6% ± 13.1) compared to rTPA (0.0%±0.16) and vehicle (0.0%±0.00). Conclusions: Aptamer inhibition of VWF resulted in significantly greater recanalization in both murine and canine thrombosis models. These results, in addition to future studies to assess the hemorrhagic burden comparison between rTPA and VWF aptamer, may provide a superior alternative to current ischemic stroke therapy.

Student Presenter: Caroline Jipa

Booth Number: 36

Research Mentor: Michael Poirier

Project Title: The Pioneer Factor Reb1 Coordinates Nucleosome Unwrapping with Multiple Binding Events

Abstract: In eukaryotic cells, DNA is packaged into chromatin. The base unit of chromatin is the Nucleosome, 147 basepairs of DNA wrapped around a protein octamer core. Nucleosomes limit the binding site's accessibility for transcription factors and other DNA binding proteins. Pioneer factors are a group of transcription factors that can bind to regions inaccessible to other ligands, making them essential for activating genes. This study focuses on Reb1, a pioneer factor from S. Cerevisiae, involved in establishing nucleosome depleted regions and installing the histone variant H2A.Z on the 5' ends of genes. However the mechanisms of how Reb1 accesses its sites in condensed chromatin are unclear. Therefore by studying Reb1, we aim to learn how pioneer factors in general function to initiate gene expression. In our study, we used EMSA and ensemble FRET experiments. We found through EMSA that Reb1 has similar affinities to naked DNA and Nucleosomes. This reflects its pioneering ability, as nucleosome binding sites are typically less accessible. To probe Reb1's effect on nucleosome structure, we moved the binding site in 5 base pair increments through the entry-exit region and monitored the Reb1 induced ΔFRET between the cy3 labeled DNA and cy5 octamer. We showed that Reb1 binds to transiently exposed binding sites on unwrapped nucleosomal DNA without evicting histones. Furthermore the change in FRET is not due to octamer eviction or H2A C-terminal tail distortion. Additionally, inserting a binding site into the dyad region increases Reb1 affinity 3-fold. EMSA experiments also show three distinct shifts. This suggests that multiple Reb1 binding events coordinate nucleosome unwrapping. For many of the binding sites, ΔFRET occurs at concentrations where EMSA's indicate multiple Reb1 proteins binding. Our findings show that Reb1 alone does not disassemble nucleosomes and Reb1 may achieve its pioneering role through multiple binding events to one nucleosome.

Student Presenter: Michael Johnson

Booth Number: 37

Research Mentor: Katelyn Fry

Project Title: Development of a System for the Early Detection of CP in At-Risk Infants

Abstract: Medical robotics is a growing field that has a wide range of potential to both increase the effectiveness of therapeutic techniques and provide early indication of diseases and disorders. Current clinician evaluation of persons with motor disorders tends to be more qualitative than quantitative, usually based on a subjective estimate of the patient's motor ability from observation. In this work, we aim to develop a system to observe infant kicking and to obtain a quantifiable metric for the early indication of motor disorders, specifically Cerebral Palsy (CP). This system will maximize observation time by taking testing outside of the clinic and into the home. To accomplish this, we use MetaWear-C IMU sensors placed on the infant's leg segments to collect accelerometer and gyroscope data. An application was designed to connect to the sensors via Bluetooth and record IMU to files stored on the device conducting the test. At this stage of the project, this data is analyzed by a machine-learning algorithm that perceives whether or not kicking is occurring, but will further be used to categorize a child's kicking pattern as likely or not to develop CP. The project aims to contribute to physical therapy and rehabilitation of at-risk infants through detecting and rewarding appropriate, therapeutic behavior.

Student Presenter: Parviz Kanga

Booth Number: 38

Research Mentor: Fabienne McClanahan

Project Title: Influence of the microenvironment on resistance to Ibrutinib treatment in Chronic Lymphocytic Leukemia- an in vitro study

Abstract: Introduction:

Chronic Lymphocytic Leukemia (CLL) is a B-cell malignancy and the most common but incurable adult leukemia. Treatment with Ibrutinib has significantly improved patient survival. Ibrutinib irreversibly binds to Bruton's tyrosine kinase (BTK), a signal transduction kinase which is overactive in CLL and promotes tumor survival. While treatment significantly reduces tumor load, complete remission is rare. We hypothesize that CLL cells seek "refuge" in protective lymphoid environments which provide stimuli that lead to differential cellular responses to Ibrutinib. Our aim is to explore Ibrutinib-BTK binding across spleen (SP), peripheral blood (PB), and bone marrow (BM) samples from leukemic mice. Methods/ Results: First we compared BTK protein expression in B-cells among organs by immunoblot. Interestingly, there was a trend to higher BTK expression in SP and BM compared to PB. We next determined if BTK in CLL cells from PB, BM, and SP had different affinities for Ibrutinib binding using an occupancy assay. CLL cells were isolated from leukemic mice (n=6) and treated for one hour with Ibrutinib or DMSO vehicle. Lysates were prepared and labelled with a competitive probe to detect unbound BTK following drug exposure. Output was measured using an electrochemiluminescence immunoassay. Compared to vehicle, Ibrutinib treated cells had greatly reduced free BTK in SP and PB. The levels of free BTK in BM remained virtually unchanged. Conclusion/ next steps: Our in vitro data suggests insufficient drug binding to BTK in BM cells. This is derived on a small sample number and should be confirmed in additional samples, as well as in vivo. Altogether, this is highly relevant for patients, as CLL cells in the BM may persist during therapy, preventing complete remission.

Student Presenter: Chase Kayrouz

Booth Number: 39

Research Mentor: Renita Horton

Project Title: Manufacturing an On-stage Incubator for Live Cell Imaging

Abstract: The ability to perform live cell imaging can be critical to a number of research applications. For mammalian cell lines, this requires the maintenance of a humidified environment held at 37oC. Although a number of microscope incubation systems exist with these capabilities, the cost associated with such an instrument can range upwards of $20,000. We propose to design, build and test a low-cost (<$500) incubation system that can be easily integrated into most microscope platforms. The proposed system will consist of a 3D-printable shell, transparent top and bottom plates, and ports through which material can flow for microfluidic experiments. The slide, petri dish, or microfluidic device will be housed within the bottom platform. Temperature and humidity will be controlled by flowing conditioned air through the device. A microcontroller will adjust the temperature of the perfused air according to feedback from a thermocouple inside the incubator. To achieve this, we will first use CAD software to model the device and perform a heat-transfer simulation. Then the device will be assembled and tested for its ability to fit properly on different microscopes, maintain temperature, and provide optical clarity. The final validation step will be to determine whether results from previous cell culture studies can be replicated within the new platform. If successful, this device will provide a low-cost, reliable system for real-time imaging during cell culture studies.

Student Presenter: Gretchen Klingler

Booth Number: 40

Research Mentor: Jeffrey Cohen

Project Title: More Than Babel:

Abstract: The President's executive order regarding immigrants and refugees entering the United States from seven Muslim majority countries has been questioned heavily for the last 6 months. However, resettled families already in the United States continue to face a steady and increasing stream of xenophobic and anti-Islamic rhetoric. My work is centered specifically on Iraqi women as they confront life and establish themselves in the U.S. Building upon my experiences as a translator during my time in Iraq, I have a unique opportunity to interview in both English and the Iraqi dialect of Arabic. My background knowledge and understanding of Iraqi culture facilitates my research and helps me build bridges with my informants. I have developed my project around my contacts in the Iraqi communities located in California Bay Area (San Francisco/Monterey), and Columbus and Dayton, Ohio. The research is framed within the theory of Feminist Anthropology, and Parin Dossa's work with Iranian women in Canada (Politics and Poetics of Migration: Narratives of Iranian Women from the Diaspora (2004, Canadian Scholars Press)) guides my ethnographic study. I discern how women's narratives differ in relation to their experiences and how their experiences fit into the larger social realities of settlement. How Iraqi women respond to their new and changing environment is at the center of my project. Are Iraqi women looking forward to the future? Are they taking new precautions as they adapt to increasing Islamophobia? Do they hope to return to more culturally traditional roles or do they look to embrace new opportunities and express their agency in new ways? More than storytellers managing their own lives, my discussion of how Iraqi women narrate their experiences in response to xenophobia will reflect their changing roles as women in their communities, and the process of assimilation and settlement in the U.S.

Student Presenter: Victoria Kocsuta

Booth Number: 41

Research Mentor: John Gunn

Project Title: PmrA-Regulated sRNAs and their Effect on the Pathogenicity of Francisella

Abstract: Francisella tularensis is a Gram-negative, nonmotile, intracellular pathogen that is the causative agent of tularemia. Because of its virulence properties and ease of dissemination, F. tularensis is classified as a tier 1 (Class A) bioterrorism agent by the CDC. F. tularensis is classified by several subspecies that include tulanensis, holarctica, mediasiatica, and novicida. While most bacterial species contain many regulators including two-component systems (TCS) that regulate gene expression via a sensor kinase and a cytoplasmic response regulator, Francisella encodes a dearth of regulatory elements and lacks any classic TCS. However, PmrA is an orphan response regulator in F. tularensis that directly regulates the Francisella Pathogenicity Island (FPI) and affects intramacrophage growth and survival. Small RNAs (sRNAs) are important regulators of gene expression and protein production in prokaryotes and eukaryotes, and are also believed to play a role in gene expression in Francisella, especially given the lack of protein regulatory factors. The purpose of this study is to explore the role of sRNAs in regulating the virulence of Francisella, focusing on those regulated by PmrA. RNAseq was performed to identify sRNAs in F. novicida and an isogenic pmrA mutant. This data was used in conjunction with IntaRNA software to identify potential targets of the sRNAs. Based on interesting potential targets, sRNA 543 was selected as the focus of study. Constructs were created to both delete and overexpress sRNA 543. These strains will be tested in intramacrophage survival assays to observe the effect of sRNA 543 on virulence. This work will lead to a better understanding of how this bioterror agent responds to its environment and could lead to new therapeutic strategies to limit infection by F. tulanensis.

Student Presenter: Dinushi Kulasekere

Booth Number: 42

Research Mentor: Bruce Weinberg

Project Title: The Impact of Severity Scoring Systems on Treatment, Costs, and Outcomes in New Zealand

Abstract: Background: Spinal injury is a significant issue in New Zealand. Spinal injuries are usually classified using scales with scoring guidelines. Discontinuities around guideline thresholds in healthcare are an under-studied topic and may provide insight into the effects of using these scales. Aim: This project focuses on the effects of discontinuities in severity ranking scales, particularly regarding injury severity classification systems used to classify spinal trauma. The goal of this project is to provide evidence to either support or dispute the usage of these types of scales in the medical field, based on their impact and effectiveness, to increase the quality of patient care internationally. Methods: A regression discontinuity approach, looking at the variables of hospital cost, patient lengths of stay, patient re-admission rates, and treatment decisions will be conducted. These variables will be compared to score categories to determine if the usage of injury scaling systems creates inefficiencies in expenditure, treatment, and patient outcome for people at the margin of a classification level. Results: This project is currently in progress, but anticipated results include an increase in cost related to score usage, with a minor effect on treatment decisions and minimal impacts on patient outcome. Importance: Understanding this topic could influence the quality of care for patients in regards to the general usage of health-related classification systems in the medical field, including within the field of cancer research. The Gleason Score is a classification scale utilized for prostate cancer cases, which uses a similar computation method to the Injury Severity Score. This project will also showcase the benefit of using econometric techniques in research evaluating clinical care, highlighting an effective way of determining methods to achieve greater efficiency and outcomes in health care.

Student Presenter: Amanda Kyle

Booth Number: 43

Research Mentor: Michael Ibba

Project Title: Phenylalanyl-tRNA synthetase regulated quality control is linked to stress responses in Saccharomyces cerevisiae

Abstract: Compared to other essential cellular processes, translation is substantially more error-prone, with an error rate of approximately 1 in 10^4 codons. In translation, aminoacyl-tRNA synthetases (aaRSs) are enzymes responsible for binding amino acids to cognate tRNAs. Since certain amino acids are structurally similar, aaRSs have editing processes to prevent the misincorporation of amino acids into proteins. Recently, it has been shown that phenylalanyl-tRNA synthetase (PheRS) quality control is important in the regulation of the general amino acid control (GAAC) pathway in Saccharomyces cerevisiae. To further explore how quality control affects S. cerevisiae, a PheRS editing deficient mutant was compared to a wild-type (WT) strain using phenotypic microarrays in many growth conditions. Conditions where differences in growth were observed were assigned to genes with previously established relationships to those chemicals. Many of these genes were associated with the target of rapamycin (TOR) and GAAC pathways. Interestingly, when grown in media supplemented with caffeine, the PheRS editing deficient mutant grew at a faster rate than the WT strain. There is evidence linking mutations in the TOR pathway to differential growth in caffeine. To explore the relationship between PheRS quality control and the TOR pathway, growth of TOR deletion and TOR deletion PheRS editing deficient mutants were compared in a chronological lifespan assay. It has been previously documented that TOR deletion yeast mutants have prolonged chronological lifespans. However, we observed that the TOR deletion in the PheRS editing deficient mutant had a decreased effect on chronological lifespan when compared to the TOR deletion strain. This evidence suggests a relationship between aaRS regulated quality control and stress responses in S. cerevisiae. Since translation is a more error-prone cellular process and there is evidence that mistranslation may be advantageous, it is important to understand how lacking quality control affects the cell.

Student Presenter: Kathryn Lane

Booth Number: 44

Research Mentor: Randee Hunter

Project Title: Quantifying variation of aBMD assessment techniques on ex-vivo tibiae

Abstract: A dual x-ray absorptiometry (DXA) scan is a prevalent clinical instrument providing areal bone mineral density (aBMD) measurements utilized by clinicians in diagnosing osteoporosis and bone quality. Quantifying bone quality across various skeletal elements is important in understanding fracture risk. Although ex-vivo tibiae have been assessed using aBMD, there is no reference population to which data can be compared. While previous studies have mentioned using rice when scanning ex-vivo bones to obtain more accurate aBMD values, the variation between scans using rice and those not using rice has not been quantified. Therefore, the purpose of this study is to quantify the extent of variation in aBMD values along the length of ex vivo tibiae under two acquisition parameters: with rice as a soft tissue surrogate and without rice. Twenty ex-vivo tibiae obtained from post mortem human subjects (PMHS) ranging from 54 to 75 years of age were scanned on the GE Lunar Prodigy using the left forearm protocol with customized regions of interest (ROIs) (n= 8 to 9 per tibia). All other parameters remained constant between scans. A total of 40 scans were produced, resulting in aBMDs from each scenario for each ROI spanning the length of the tibia. To quantify the effect of scanning ex-vivo tibiae with rice versus without rice, aBMD raw values (g/cm2) for each ROI were compared via percent variance. Results ranged from -0.096% to 27.73%, with the epiphyses generally demonstrating higher amounts of variation. A paired samples t-test also confirmed statistically significant variation in epiphyseal aBMDs (p<0.05). These results indicate that due to substantial variance in aBMD values between acquisition parameters, it is imperative to standardize the methods by which ex vivo bones are scanned for comparable results.

Student Presenter: Julian Lee

Booth Number: 45

Research Mentor: Dmitri Kudryashov

Project Title: Investigating the Calcium-Sensitive Nature of the EF-domain of T-Plastin

Abstract: Plastins are a conserved family of proteins that assist in cellular functions such as motility and cell division by bundling actin filaments. There are three human isoforms of plastin: I-Plastin expressed primarily in the intestinal, inner ear, and kidney epithelia, L-Plastin expressed in leukocytes, and T-Plastin ubiquitously expressed in solid tissues. All three isoforms are calcium-dependent, becoming significantly less efficient at bundling actin when Ca2+ ions are present. This is due to a calcium-sensitive region known as the EF-domain located at the N-terminus of each plastin isoform. L-Plastin and T-Plastin are of particular interest as they are overexpressed in cancer cells, mediate the cytoarchitectural plasticity of cancer cells, and promote metastasis. The structure of the EF-domain of L-Plastin is known, but researching the structure of the same domain on T-Plastin would still glean useful information, as the two structures could be cross-examined in order to discern their distinct roles in controlling cytoarcitectural plasticity, and subsequently the role of these isoforms in cancer cell metastasis. The purpose of this study is to characterize the calcium-dependent regulation of plastin bundling activity using biochemical and structural techniques to investigate the calcium-binding regulatory domain of L- and T-plastin. To this end both crystallography and NMR techniques are being explored to determine the structure of the T-plastin regulatory domain. Several constructs of varying lengths have been purified to produce a stable protein. Having found a stable construct, current work has been to express and purify a 15N-labeled version of the protein for NMR. Generation of a T-plastin regulatory domain structure will allow comparison with the known L-plastin structure and help to identify unique L- and T-plastin properties that contribute to cancer cell metastasis.

Student Presenter: Junchao Lin

Booth Number: 46

Research Mentor: ChunNing Lau

Project Title: Fabrication of graphene devices suitable for quantum hall effect measurement

Abstract: Quantum Hall (QH) effect can be observed in 2D systems. Landau level splittings and phase transitions can be observed in graphene hall bar devices at low temperature and under large magnetic field. These require high-quality graphene devices. Landau levels splitting can be observed under small applied magnetic field if quality of graphene device is good enough. Many factors such as the flatness, impurity concentration, contact quality, etc. can affect the quality of graphene device. The most important part of device fabrication is making stacks. Stack is a sandwich-like structure with graphene encapsulated by thin layers of boron nitride (BN). We use exfoliation method to get graphene and BN flakes then use transfer microscope to stack them layer by layer till stacks are formed. Large flat few-layer graphene and even larger flat BN are chosen to assemble stacks. Graphene is characterized by Raman microscopy to identify the layer number. I encountered many problems during transfering. Some of my flakes are broken during the transferring, while some cannot be picked up. In these cases, I have to change the pickup temperature or change the flakes I want to use. In addition, stack assembling is time-consuming, patience is required. So far, I succeeded with a few stacks though their qualities are not good enough and improvements are needed. After high-quality stacks can be made, my next step will be conducting fabrication including e-beam lithography and ICP etching to define geometries and depositing electrodes to make contacts. Any measurement to see quantum hall effect is the ultimate goal.

Student Presenter: Dale Lingo

Booth Number: 47

Research Mentor: Stephen Osmani

Project Title: Investigating the localization and dynamics of novel microtubule-associated proteins in intercellular trafficking in Aspergillus nidulans cells.

Abstract: All eukaryotic cells require an intercellular transport system to move cargo like organelles, vesicles, and proteins over large distances. This transport occurs on long tracks called microtubules (MTs) and is governed by a set of rules that is not well understood. MTs are polar cables that are anchored at the MT-organizing centers at their minus ends and grow at their plus-ends. Our lab uses the filamentous fungus A. nidulans to study the role of MT-associated proteins in subcellular travel. We are currently investigating the localization and dynamics of three novel proteins, AN1156, AN3906, and AN10946, that move bi-directionally on MTs and interact with each other. The focus of my research was to investigate specifically the role of AN3906 and AN10946 in regulating the dynamics of AN1156. I used the kymograph tool and derived the rate of movement of AN1156 foci in wildtype cells. I found that the rate of movement of AN1156 towards the plus-end of MTs is similar to that towards the minus-end of MTs. Furthermore, the rate of movement of AN1156 is comparable to that of AN3906 and AN10946 in both directions. My ongoing analyses are targeted towards computing the rates of movement of AN1156 in the absence of AN3906 and AN10946 and compare them to rates in wildtype. Overall, my research is aimed to provide a more quantitative understanding of the movement of novel dynamic proteins, ultimately providing a more thorough insight into the rules governing intracellular transport.

Student Presenter: Nicholas Lipari

Booth Number: 48

Research Mentor: Noel Paul

Project Title: Search for the Acetylenic Receptor

Abstract: This investigation aims to identify a macrocyclic structure that serves as a host for an acetylene functional group. Macrocycles that present an array of hydrogen bond donors (O-H or N-H substituents) with different spatial relationships have been synthesized based on literature precedent, and these compounds were evaluated for their ability to engage in non-covalent interactions with the compact, cylindrical electron density of several arylalkynes. 1H NMR titration studies were performed in deuterated chloroform, and the chemical shift values of each hydrogen in the system were evaluated for changes in shielding effects in the mixtures relative to the pure starting materials in solution. At the onset of this study, calix[4]pyrrole, p-tert-butylcalix[6]arene, p-tert-butylcalix[8]arene, alpha-cyclodextrin, and beta-cyclodextrin were chosen as the macrocyclic hosts, and 1-ethynyl-4-fluorobenzene and 4-ethynylanisole were investigated as guest molecules. In these NMR studies, shifts in the chemical shift values of distinctive hydrogens were observed, but the degree of change ($\Delta\delta \sim 0.01$ ppm) was small compared to previous reports by other researchers in the field. Molecular modeling studies have been explored to optimize the search for a suitable macrocyclic target. Investigation of this yet-to-be described intermolecular interaction will continue with the synthesis of new macromolecular hosts, and implementation of more diverse NMR studies (such as the screening of other NMR solvents, and use of variable temperature NMR experiments.) Successful identification of a strongly associating alkyne-host pair would impact the areas of macromolecular self-assembly, molecular electronics, and nanomaterials where robust, orthogonal intermolecular relationships are critical to construct molecular-scale functional architectures.

Student Presenter: Vella Liu

Booth Number: 49

Research Mentor: Michael Bois

Project Title: Access μ-nephelometer accuracy

Abstract: BD KiestraTM ID/AST Module expands the BD Kiestra platform, automating the processes for picking colonies designated by the user and preparing a common inoculum suspension for spotting onto the Bruker MALDI (Matrix-Assisted Laser Desorption Ionization) Biotyper target plate. BD KiestraTM ID/AST Module effectively reduces turn-around-time (TAT) and human errors. Within BD KiestraTM ID/AST Module, the μ-nephelometer is a crucial component, since it provides an estimated McFarland (McF) value for the small volume of suspension prepared by the ID/AST Module. The accuracy of the μ-nephelometer is critical for the preparation of suspensions with the appropriate density for ID and AST testing. More importantly, only a precise and accurate μ-nephelometer can provide reproducible McF values, which determine sample concentration on a MALDI target plate, and result in consistent minimal inhibitory concentrations (MICs). The purpose of this study was to assess the accuracy of the μ-nephelometer.

Student Presenter: James London

Booth Number: 50

Research Mentor: Richard Fishel

Project Title: Fluorescent labeling of human MLH1-PMS2 for single molecule studies

Abstract: DNA polymerase and damage to nucleotides regularly generate mismatched nucleotides within the DNA. The DNA mismatch repair (MMR) system is a highly conserved pathway that recognizes and repairs these mismatches. Defects in the human MMR genes can result in sporadic and hereditary cancers such as Lynch syndrome. To understand this fundamental and medically relevant pathway bulk studies have previously been used which have begun to reveal the mechanism of MMR. However, bulk studies are extremely limited. Single molecule imaging studies offer an opportunity to understand the fundamental mechanism of the MMR pathway by observing the individual proteins as they search, identify and repair DNA mismatches. Such single molecule imaging studies require each observed protein to be specifically labeled with a fluorescent molecule. We have been developing a specific fluorophore labeling technology in which a TEV protease is located on the N-terminus. TEV cleavage will leave a cysteine to which a pre-synthesised fluorescently labeled peptide can be linked by thioester-mediated chemical ligation. In this study the human protein complex MLH1-PMS2 will be labeled on the N-terminus of PMS2 using this method. We have constructed a DNA that codes for a fusion protein containing maltose binding protein (MBP), a polyhistidine-tag, and a TEV protease site onto the N-terminus of PMS2. The MBP-His6-TEV-PMS2 complex and MLH1 will be co-expressed in insect cells. The MLH1-PMS2(MBP-His6-TEV) complex will be cleaved with TEV protease and separated from uncleaved products with the aid of MBP and the polyhistidine-tag. The purified MLH1-PMS2 protein containing the N-terminal cysteine will then by ligated to the fluorescently labeled peptide and activity will be assessed utilizing single molecule analysis. Progress in these cloning, labeling, purification and analysis steps will be reported.

Student Presenter: Leslie Luna

Booth Number: 51

Research Mentor: Joni Acuff

Project Title: Comparing Cultural Identity in the United States and Jamaica

Abstract: After in-person observation of Jamaica, I noticed a strong difference in the way that cultural identity is shaped within American and Jamaican minds. Through the final art exhibits of the students at Edna Manley College of the Visual and Performing Arts (EMCVPA), I evaluated several pieces of artwork that displayed a search of one's cultural-identity. I also evaluated famous Jamaican artist's whose artwork is displayed at the National Gallery of Jamaica. This research project shares the ways in which my travel experience to Kingston, Jamaica has broadened my understanding of cultural identity, nationality, and self-identity through art. The research question that led this collaborative study was the following: In what ways can being immersed in Jamaican arts and culture impact someone's cultural identity? I collected data as a student-researcher during the entire study abroad experience. I engaged with artists, contemporary art, educators, cultural leaders, and art and cultural sites. Methods for data collection include observations, note taking, readings of notable Jamaican cultural scholars, and photographs. Since each person's self-identity is individualized to themselves, the perspectives in this research are a collective of different perspectives, including Jamaican and American individuals.

Student Presenter: Seth Lyon

Booth Number: 52

Research Mentor: Venkat Gopalan

Project Title: A mutant of T7 RNA polymerase enhances percent incorporation of 5'-modified guanosine analogs in RNA

Abstract: RNAs perform an array of functions in all life (e.g., catalysis, chromatin remodeling, structural scaffolds for large assemblies). Understanding this versatility of RNAs requires knowledge of their structure-function relationships. Probing RNA structure often requires spectroscopic methods, which in turn necessitates strategies for post-synthetic, site-specific incorporation of chemical probes into target RNAs. One method to achieve this goal is through in vitro transcription (IVT) of RNAs by T7 RNA polymerase (RNAP) and a GTP-initiating class III Φ6.5 promoter. In addition to GTP, T7 RNAP can incorporate 5'-modified guanosine analogs (G-analog) during transcriptional priming. Because the nucleoside/nucleotide monophosphate G-analog cannot be used in elongation, it can only serve as the initiator. By using a 4-fold excess of the G-analog:GTP in the IVT, others have successfully biased the polymerase to initiate with the G-analog. We have now rigorously examined the extent of this bias with 5'-deoxy-5'-azidoguanosine (Az-G) or thienoguanosine (Th-G) as the modifiers, and determined that there is an unexpected maximum threshold of ~50% for the incorporation of Az-G and Th-G into full-length pre-tRNAs even at high [G-analog]:[GTP] ratios. The ceiling that we observed for initiation of pre-tRNAs with 5'-modified guanosine analogs likely reflects a preponderance of 5'-G-analog-containing abortive transcripts, which are less likely when GTP serves as the initiator. In support of our hypothesis, we found that the use of a mutant P266L T7 RNAP, which displays decreased abortive transcription, enhanced percent incorporation of Az-G and Th-G into pre-tRNAs to ~80%. Furthermore, we have demonstrated that a one-pot multi-enzyme (OPME) approach, which consists of transcription by T7 RNAP P266L and a post-transcriptional clean-up by a polyphosphatase and an exonuclease, increased percent incorporation of Az-G and Th-G to ~95%. Our results should motivate the optimization of the OPME strategy because it offers a facile method to routinely yield nearly 100% 5'-chemically modified RNAs.

Student Presenter: Bailey Lytle

Booth Number: 53

Research Mentor: Joni Acuff

Project Title: The Impact of colonization and slavery on art in Jamaica

Abstract: This research looks at the artworks of students at the Edna Manley College of Visual and Performing Arts and the effects of Jamaica's history of colonization and slavery, today manifesting itself as mental slavery. This research looks into the importance of art as a way to work through one's personal journey with mental slavery and the depth of that artwork that results from that journey. While it remains unknown whether art can help every person who is affected by mental slavery, from my research it appears that it is helpful to those who have created works specifically around that topic. The purpose of this research is to examine the feelings Jamaican artists have about mental slavery previous to and after creating works that explore their personal journey. Through the process of viewing the artworks, speaking to the artists, and accompanied with the writings of Rex Nettleford and Verene Shepherd I was able to see a clear connection to using art to work through the effects of mental slavery. While there is still a lot more research that can be done to see the connection between artmaking and the journey an artist may have to overcome mental slavery. This research could include whether or not we see this connection with self-taught artists or artists from different generations? Overall this research is important because we can see art is a good vehicle for working through our internalized issues as a way to overcome them. This research has inspired lesson plans that could be used in the classroom, what personal issues do the students need to work through, something they can express through their art. Along with that, this research educated me and likely most of the group on the importance of the art world in Jamaica and the manifestation of mental slavery.

Student Presenter: Jian Mae Mah

Booth Number: 54

Research Mentor: Rachelle Adams

Project Title: Investigating the Behavioral Repertoire of Mandibular Gland Compounds on Apterstigma dentigerum

Abstract: Social insects have evolved elaborate chemical communication systems that support sophisticated social structuring among nestmates. A variety of compounds influence behaviors such as trail following, brood tending, and alarm. This remains true for the fungus-growing ants (Tribe: Attini), of which over 250 species farm fungi for food. Outside of the leaf-cutting ants, there is limited research on alarm communication among the attines. We have therefore investigated the behavioral responses of Apterostigma dentigerum to four mandibular gland compounds (3-octanol, 1-octen-3-ol, 3-octanone, and nonanal) and whole mandibular gland extracts. We aim to determine if this shy species will exhibit alarm responses similar to other attines or if its behavioral repertoire is unique to its genus. Ants were exposed to two concentrations of each compound (high = 0.1199g/cm3 and low = 0.1007g/cm3) in 10Âµl liquid of solvent and compound (n=18). Compounds were pipetted into 60mm arenas and the ant behaviors were scored (1 ant per petri dish). The activity level was assessed and specific behaviors characterized and counted. Three of the four compounds showed that the higher the concentration, the greater the effect on the ants. However, the opposite was true for 3-octanone. This result hints at the biological relevance of 3-octanone, a common and well-known alarm pheromone in Myrmicine ants. The responses of the ants to the alarm compounds mainly include standing motionless and playing dead, which is also found in other ant species with smaller physical attributes (e.g., Zacryptocerus varians, Cyphomymrex spp.). This defies typical defense behavior of increased locomotion in ants when alarmed. Our work is the first to describe alarm response in Apterostigma ants and we hope to prompt other studies of this kind for a broader comparative view of the alarm compounds and defensive strategies across the attine ants.

Student Presenter: Joshua Mangels

Booth Number:

Research Mentor: Richard Fishel

Project Title: Optimization of Expression and Determination of Spectra of Single Molecule Imaging Protein Constructs

Abstract: DNA mismatch repair (MMR) is an important process for maintaining genome integrity. Defective MMR is the cause of the hereditary cancer predisposition Lynch Syndrome, as well as 10-40% of related cancers. MMR removes mismatched DNA bases and replaces them with the correct sequence, drastically reducing the number of polymerase misincorporation errors passed on during replication. This process involves the formation of complexes on DNA between conserved proteins such as MutS and MutL in Escherichia coli or MSH2-MSH6 and MLH1-PMS2 in humans. An understanding of these interactions in vitro and in vivo is crucial for understanding MMR. One method to study such interactions is single molecule fluorescence microscopy where MMR proteins are covalently linked to a fluorescent chemical or protein. The fluorescence spectrum of such proteins must be understood for effective use. My first project seeks to study MMR by establishing the far-red fluorescence spectrum of miRFP670 in vitro. Ultimately, miRFP670 will be fused to a number of MMR proteins and visualized in vivo. Multiple bacterial cell types were induced under varying conditions to produce miRFP670 until high expression and solubility were achieved. Expression was quantified using polyacrylamide gel electrophoresis (PAGE). Once induction was optimized, the protein was purified. An emission spectrum for purified miRFP670 was obtained using a spectrofluorimeter. In my second project, a plasmid containing E.coli MutS and another fluorescent protein, mEos3.2, was constructed to determine its fluorescent characteristics. This was achieved using overlap polymerase chain reaction (PCR), restriction digestion, and ligation into the bacterial expression vector pET-29a. Additional fusion protein constructs, with previously studied fluorescent proteins, will be created including MutL-PSmOrange and ß-clamp-miRFP670. A better understanding of MMR protein complexes can lead to a more complete appreciation of their role in Lynch Syndrome—possibly leading to outcomes such as earlier diagnoses and improved treatment options.

Student Presenter: Siobhan McDermott

Booth Number: 56

Research Mentor: Janice Kiecolt-Glaser

Project Title: The effect of depression and cancer treatment on physical fitness among breast cancer survivors.

Abstract: Depression presents a prevalent problem to breast cancer survivors and is associated with decreased physical activity during a period when exercise appears to ensure promising recurrence and mortality rates. However, it remains unknown whether depressive symptoms are related to decreases in objectively-measured physical fitness throughout survivorship. Furthermore, while certain cancer treatments appear to negatively affect physical fitness, it remains unknown whether treatment type affects depression-related declines in survivorsâ€™ fitness level. The current study will assess whether changes in depressive symptoms from pre to post-adjuvant treatment correspond with physical fitness changes, and whether treatment type received (e.g., chemo, radiation, hormone, none) moderates this relationship. Data collection is ongoing; preliminary analyses assessed relationships between depressive symptoms and fitness prior to adjuvant therapy. Participants were breast cancer survivors stages I-IIIA (N=111) enrolled in a parent study assessing heart disease risk factors. A self-report measure (CESD-R) assessed depressive symptoms and a cycle ergometer test measured physical fitness using VO2 max results and minutes spent cycling. Pre-treatment depressive symptoms were not associated with fitness (b = -0.04, SE = 0.07, p = .558) or test duration (b = 0.02, SE = 0.03, p = .489) controlling for BMI, education, race, surgery type, cancer stage, and smoking. Accounting for physical activity level did not significantly change results (b = -0.03, SE = 0.07, p = .684), (b = 0.03, SE = 0.03, p = .335). Further follow-up analyses will investigate the link between depressive symptoms and physical fitness changes to determine whether treatment type affects results. All currently enrolled participants will undergo breast cancer surgery, 37.2% of participants will have chemotherapy, 77.0% hormone therapy, and 48.7% radiation. Understanding the interaction between depression, treatment type, and fitness may ultimately identify patients most at risk for physical fitness declines across survivorship, and who would benefit most from interventions.

Student Presenter: Mary McGrath

Booth Number: 57

Research Mentor: Paul Stoodley

Project Title: Antibiotic-loaded calcium sulfate mediated killing of Pseudomonas aeruginosa and Staphylococcus aureus biofilms grown on orthopaedic implant materials

Abstract: Biofilms are communities of microorganisms that colonize surfaces and are critical in the pathogenesis of periprosthetic joint infections (PJIs). Localized, sustained antibiotic delivery, loaded in dissolvable mineral bone cement, is used in high concentrations to treat PJIs. However, the ability of this antibiotic delivery to reduce biofilms remains unknown. The purpose of the present study is to determine the efficacy of high-purity calcium sulfate antibiotic beads of tobramycin and vancomycin in eradicating mature Pseudomonas aeruginosa and Staphylococcus aureus biofilms on solid orthopaedic surfaces. Bioluminescent strains S. aureus and P. aeruginosa were used to monitor the growth and loss of activity after exposure to antibiotics. Biofilms were grown on stainless steel, UHMWPE, and hydroxyapatite coupons for three days, placed in petri dishes, and overlaid with thin layers of Tryptic Soy Agar. Four vancomycin or tobramycin -loaded beads were placed adjacent to coupons containing biofilms of S. aureus or P. aeruginosa, respectively. IVIS imaging was performed for six days and CFU counts before, 24 hours after, and 120 hours after antibiotic exposure were taken. Biofilms grown on coupons overlaid with agar without antibiotic bead exposure were used as controls. The loss of bioluminescence was evident after 24 hours of antibiotic treatment of biofilms in both strains for all materials. Moreover, biofilms from the coupons without beads quickly spread across the agar. After 120 hours, evidence of some biofilm reactivation was found in both IVIS images and CFU counts for the coupons adjacent to antibiotic-loaded beads. These results show that biofilms on orthopaedic implant materials are susceptible to reduction when in contact with antibiotic-loaded beads. However, optimal packing densities of beads and proximity to orthopaedic surfaces must be determined. In conclusion, biofilm bacteria can be reduced by antibiotic-loaded beads, but high, local concentrations of antibiotics may require sustained exposure to effectively treat PJIs.

Student Presenter: Robert McKay

Booth Number: 58

Research Mentor: Nandini Trivedi

Project Title: Anomalous Transport in Type-II Weyl Semimetals

Abstract: The discovery of topological insulators [1] and Weyl semimetals has introduced a new paradigm in condensed matter physics [2, 3, 4]. The signatures of topological semimetals are: (a) gapless bulk excitations with linearly dispersing fermions [5]; and (b) topologically robust gapless â€œFermi arcsâ€ on the surface that terminate on the projections of Weyl nodes [6]. Weyl semimetals possess monopoles of curvature [4] in momentum space, which can lead to anomalous transverse transport of electrons in the absence of an external magnetic field. This research project focuses on anomalous transport in type-II Weyl semimetals, which exhibit tilted energy cones of the energy band [7, 8], as opposed to type-I Weyl semimetals whose band cones are untilted. In this study, the semiclassical Boltzmann formulation of transport from regular semimetals is extended to type-II Weyl semimetals. We find that the topological nature of the tilted electronic band structure strongly influences thermomagnetic transport. We also study the effects of Berry curvature [9], a topological property that occurs from wavefunctions traveling in momentum space, and how its behavior emulates a magnetic field to allow for anomalous transverse transport. We find that the tilt of the energy bands in type-II Weyl semimetals has a broad impact on transport. Particularly, the amount of tilt will affect how the distribution of filled energy states interacts with the Berry curvature of a Weyl semimetal. Furthermore, we discover that the Hall and Nernst transport coefficients have a non-monotonic dependence on temperature, which is attributed to the chemical potential changing as a function of temperature. These results open the door for experimental verification with Professor Jos Heremans and his research group and provide a basis for the effect of tuning the tilt of a Weyl semimetal through strain. Type-II Weyl semimetals also show promise as a potential device which utilizes transverse transport without need of a magnetic field.

Student Presenter: Errienna Mckenzie

Booth Number: 59

Research Mentor: Jesse Kwiek

Project Title: The Use of Traditional Medicine in the Treatment of Malaria in Immunocompromised Individuals

Abstract: The practice of traditional medicine is a vital component of the culture in Tanzania. While the recent governmental regulation of the profession escalated its legitimacy, traditional healers have played a crucial role in the foundation of an integrated healthcare system. The objective of this study is to understand how healers diagnose patients and establish treatment plans, more specifically as it relates to Malaria. Historically, the derivation of chemicals from plants has led to breakthrough discoveries in the pharmaceutical field. While the natural products prescribed by the healers in Tanzania aren't tested for their medicinal qualities and instead monitored to insure they don't cause adverse effects. I hoped to learn whether there was a prevailing treatment used amongst the healers as this could point to legitimate medicinal benefits. Here we show through interviews of traditional healers there is a recurring preferred treatment for Malaria in immunocompromised individuals. During the interviews of three traditional healers from different regions of Tanzania, I learned that they confirmed their diagnosis of Malaria by evaluating the symptoms of their patients and presented a treatment plan considering the patients' demographic information. To combat the common symptoms of vomiting, diarrhea and fever, an herbal tea was prescribed. The remedy consisted of heating water and leaves from the Mvele Vele tree then straining the leaves before oral consumption. Observing the commonalities in treatment for this disease illustrates the possibility this remedy may have an actual medicinal effect since it is widely prescribed by the healers. From a small sample, it can be deduced that the usefulness of traditional healers in the treatment of immunocompromised individuals requires more in-depth research. The chemical structure of the natural products used to treat Malaria could be isolated and analyzed. This information could then be expounded upon dependent on the findings.

Student Presenter: Tim McManus

Booth Number: 60

Research Mentor: David Dean

Project Title: Cytotoxicity of a novel Magnesium Alloy for Resorbable Bone Fixation Devices

Abstract: Skeletal fixation devices are vulnerable to complications such as stress shielding, stress concentrations, or sensitization of surrounding tissue, which can result in device failure1. Resorbable magnesium skeletal fixation devices are being investigated as an alternative because of magnesium's similar Young's modulus to bone, its biocompatibility, and its biodegradability. However, the rapid degradation rate of pure magnesium makes it necessary to alloy the metal. Our novel Mg alloy, Mg 1.2-Zn 0.5-Ca, is expected to successfully slow the degradation rate to the 6-9 month post-implantation window that is needed while maintaining its biocompatibility and strength during bone healing. We report here on an in-vitro investigation of the potential cytotoxicity of our Mg alloy. We tested fluid aspirated from coupons of our Mg alloy versus pure Magnesium coupons for the effects of the aspirate on L929 murine fibroblast cell numbers after 24 and 72 hours using a PrestoBlue Metabolic Assay. The aspirated extracts were formed by soaking Mg alloy coupons in complete media (0.2g/mL media) for 72 hours. The aspirates were then diluted into four groups (1x, 2.5x, 6x and 10x)2. Also included in the study were two "pre-treated" Mg alloy groups that were soaked in fetal bovine serum (FBS) for one week or four weeks, respectively, to investigate cytotoxicity over time. The experiment resulted in no statistically significant cytotoxicity difference between pure magnesium and the alloyed samples at corresponding dilution points. Pre-treated (i.e., soaking in FBS) samples reported, on average, a trend toward better viability as pretreatment time increased. These preliminary data are promising in showing that our Mg alloy can support cell viability of over 70% at dilution rates of 6x or higher. Our next study will determine whether additional, previously published, heat and micro arc oxidation pretreatments can further reduce the cytotoxicity of our Mg alloy.3,4

Student Presenter: Nathalie Milbrandt

Booth Number: 61

Research Mentor: Patrick Woodward

Project Title: Synthesis, Crystal Structures, and Magnetic Properties of Iridate Double Perovskites

Abstract: Transition metal oxides containing 5d ions have exhibited many exotic magnetic properties, the underlying mechanism of which has not yet been fully understood. Many of the unique characteristics of 5d transition metal oxides are thought to be dependent on the strong spin orbit coupling and the extended nature of the 5d orbitals. Double perovskites provide a great platform to study the magnetic interactions among 5d transition metal ions because they are amenable to various types of element substitutions. Octahedrally coordinated transition metal ions with a 5d4 configuration should possess a nonmagnetic J=0 state, due to the effects of strong spin orbit coupling, however, recent studies by different groups have shown that there exists nontrivial magnetic moments in some compounds. By synthesizing new double perovskites containing iridium in the 5d4 electron configuration, the exotic magnetic properties can be explored. Solid state synthesis has been performed on targeting stoichiometry of Ba2LuIrO6 and SrLaMIrO6 (M= Zn, Mg, and Ni). The crystal structures of the products have been studied using X-ray powder diffraction. The Ba2LuIrO6 crystallizes in a cubic double perovskite structure, and all the other iridates crystallize in a monoclinic double perovskite structure. Preliminary magnetic data shows that Ba2LuIrO6 is paramagnetic and SrLaNiIrO6 is likely antiferromagnetic. Further magnetic data and heat capacity data are needed for these as well as the other iridates to determine and verify their magnetic properties. This study is expected to expand our knowledge of the interesting magnetic phenomena presented by 5d transition metal oxides in different crystal structures and with different B site cations.

Student Presenter: Margaret Moodispaw

Booth Number: 62

Research Mentor: Sally Miller

Project Title: Tracking Bacterial Spot, Xanthomonas gardneri, Infection of Tomato Fruit

Abstract: Bacterial diseases are a problem for crops worldwide. Bacterial pathogens spread quickly, are not easily managed, and disease severity can vary, depending on the developmental stage of the plant. Specifically, the genus Xanthomonas encompasses 27 species that collectively can infect more than 400 different plant hosts. Bacterial spot is a devastating disease in the United States, and it is usually associated with four different species of Xanthomonas (X. euvesicatoria, X. vesicatoria, X. perforans, and X. gardneri). In Northeast Ohio, Xanthomonas gardneri is common. Bacterial spot is most commonly a seed-borne disease but can also be transmitted by water splashing and mechanically. However, little is known about how the seeds become infected. The goal of this study is to determine if broken trichomes on tomato fruits can be a point of entry for the bacterial pathogens, in our study Xanthomonas gardneri. Also, the colonization and movement of the pathogen was tracked over time to evaluate the eventual infection of the seeds. This study was conducted by inoculating with a transformed bioluminescent strain of Xanthomonas gardneri tomato fruits of three different sizes (small, medium and large) and different trichomes density. To track the bacterial population during the infection process we utilized an in vivo Imaging System (IVIS). Also, seeds from infected fruits will be extracted and assessed for the presence of the pathogen. IVIS imagining will be used to determine if the seedlings are infected. Preliminary results indicate that small fruits can be infected and the bacterium is present in the locular cavities and, thus, on the seed coat. Future data will be generated for the other two classes of fruits (medium and large). These results will help to understand how the seeds become infected and, consequently, spread the disease.

Student Presenter: Jessica Mormol

Booth Number: 63

Research Mentor: Nilay Shah

Project Title: PBX1Interaction with the Nucleosome Remodeling and Deacetylase (NuRD) Complex to Promote Differentiation in Neuroblastoma

Abstract: Neuroblastoma, a childhood cancer of the sympathetic nervous system, presents disparately in patients. In patients <18 months of age at diagnosis, the cancer may spontaneously differentiate or involute. In contrast, in older patients, the cancer is very aggressive and leads to death despite current therapies, including the use of the differentiating agent 13-cis retinoic acid. We previously reported that the cofactor protein PBX1 is a biomarker of differentiation and can directly promote benign differentiation, but the mechanism of this activity is unclear. The nucleosome remodeling and deacetylase (NuRD) complex modifies chromatin and the epigenetic profile, in part through histone deacetylation by its component proteins HDAC1 and HDAC2. The NuRD complex has been identified as a driver of differentiation in neuroblastoma, in conjunction with the tumor suppressor CHD5. In other cells, PBX1 has been shown to bind and redirect HDAC 1/2. We hypothesize that PBX1 directly interacts with the NuRD complex, through CHD5 and HDAC1/2, to affect histone acetylation and promote spontaneous and retinoid-induced neuronal differentiation in neuroblastoma. To test this hypothesis we pursued the following aims: 1) demonstration of the interaction and localization between PBX1 and CHD5-NuRD complex components using proximity ligation assay (PLA) and co-immunoprecipitation, and 2) determination of the effects of 13-cis retinoic acid on PBX1-CHD5-NuRD complex interaction and localization. We demonstrated by PLA that PBX1 co-localizes and interacts with NuRD complex components PBX1 and NuRD complex components CHD5 and HDAC1 in situ in neuroblastoma cell lines. When the cells are treated with 13-cis retinoic acid, these interacting proteins have increased localization to the nucleus. By co-immunoprecipation, we confirmed the interaction of PBX1 with CHD5 and NuRD complex components. This is the first report of PBX1 interaction with the NuRD complex, elucidating the mechanisms of spontaneous and retinoid-induced differentiation in neuroblastoma, which will allow improvement of therapy.

Student Presenter: Andrew Mularo

Booth Number: 64

Research Mentor: Rachelle Adams

Project Title: Effects of Leaf Litter on Predatory Arachnid Abundance in a Tropical Ecosystem

Abstract: Arachnids are classified as common predators found in most terrestrial ecosystems and are constantly shaped by factors within their environment. Many studies outside of the tropics have suggested that arachnid abundance and diversity are influenced by leaf litter depth and composition. The objective of the study was to determine if certain arthropod groups were influenced by leaf litter depth and arachnid abundance. Several one square meter quadrants were established in Soberina National Park in the Colon Province of Panama, and leaf litter depth and potential prey items were measured and compared to the abundance of arachnids present. In the first analysis, leaf litter depth had a significant positive effect on the density of pseudoscorpions, which may suggest that pseudoscorpions are more dependent on habitat structure that other arachnids, and could be more sensitive to alterations in leaf litter composition and chemistry. For the second analysis, we found that arachnid abundance was positively correlated with the number of beetles. Additional insect orders are being analyzed and will similarly be compared to arachnid abundance, and the trophic relationships among the arachnid and insect communities will be assessed. As arachnids are widely considered to be generalist predators that occupy a variety of habitats, these specific relationships between arachnids and their environment can help make more informed research and conservation decisions on the ecology of neo-tropical forests.

Student Presenter: Karan Naik

Booth Number: 65

Research Mentor: Sameek Roychowdhury

Project Title: Mutation in mTOR Confers Resistance in BRAF V600E Positive Lung Cancer

Abstract: Understanding the genetic footprint of cancer has led to improvements in diagnostic and treatment strategies for patients with cancer. These include a more precise molecular/genetic classification of cancer, improved prognostication, and enhanced ability to match a patient with molecularly targeted therapy. However, many patients who demonstrate an initial clinical response will go on to develop secondary resistance mutations resulting in halted therapeutic response followed by clinical progression. Therefore, it is important to identify and characterize the genetic/molecular drivers of acquired resistance in order to develop successful treatment strategies that may overcome such resistance. Here, we report the study of a patient with metastatic lung adenocarcinoma, which is a type of non-small cell lung cancer. Her cancer tested positive for the BRAF V600E mutation, a known oncogenic driver of melanoma and thyroid malignancies but occurring with much less frequency in human lung cancers (<5%). The patient went on to receive treatment that consisted of dual AKT and BRAF inhibition, which resulted in clinically stable disease. Ultimately, her disease demonstrated radiographic progression, and genomics testing revealed a de novo MTOR L1460P mutation. Based on this, we hypothesize that MTOR L1460P is the genetic driver of acquired resistance having arisen in the context of PI3K-AKT inhibition. To test this hypothesis, we aimed to characterize the functional consequences of having MTOR L1460P in the presence of constitutive BRAF activation. Using cell-based assays, we assessed the effects of MTOR L1460P on cellular proliferation and sensitivity to treatment with an AKT inhibitor or with AKT/BRAF inhibitors in combination. We also evaluated cell proliferation and viability when MTOR wildtype and mutant cells were treated with the MTOR inhibitor everolimus. In summary, our results may reveal crosstalk between PI3K-AKT-MTOR and RAS-RAF-MEK signaling pathways to be an important mechanism leading to acquired resistance to molecularly targeted therapies.

Student Presenter: Christina Negray

Booth Number: 66

Research Mentor: Ning Quan

Project Title: Stimulation of neuronal IL-1 decreases kainic acid induced seizure severity

Abstract: Epilepsy is a neurological disorder characterized by reoccurring seizures. Seizures are caused by abnormal hyperactivity of glutamatergic neurons ultimately leading to a neurotoxic environment, neuronal death, and an increase in proinflammatory cytokines, such as interleukin 1β (IL-1β). Previous studies reported IL-1β prolongs seizure activity; however, the mechanism of this phenomenon is unknown. We have recently discovered IL-1R1, the cognate receptor for IL-1 signaling expressed on glutamatergic neurons in the dentate gyrus, suggesting neuronal IL-1R1 plays a critical role during epileptogenesis. Therefore, we examined the role of neuronal IL-1R1 in a chemically induced model of epilepsy. Seizures were induced following intracerebroventricular (ICV) injections of kainic acid to determine if seizure severity differs between wildtype (WT), interleukin 1 receptor deficient (R1r/r), and neuronal IL-1R1 restore (VGLUTCre-IL-1R1) animals. Severity scores did not differ between WT, R1r/r, and VGLUTCre-IL-1R1 animals, however, pretreatment with chronic IL-1β overexpression in VGLUTCre-IL-1R1, but not R1r/r, resulted in decreased severity scores. Preliminary data also suggests lack of IL-1R1 leads to sporadic, intermittent seizures. These results suggest IL-1R1 signaling on glutamatergic neurons may alleviate seizure severity and provide neuronal regulation during seizures.

Student Presenter: Alex Northrop

Booth Number: 67

Research Mentor: Byron Orlando Albuja EcheverrÃ-a

Project Title: Perceptions of Health and Its Influence on the Use of the National Healthcare System in Cotacachi, Ecuador

Abstract: The definitions of health may impact the goals and thus, the actions of critical components of healthcare systems. Despite the crucial impact definitions of health may have on the provision of health care, how differing viewpoints of this concept may manifest in a local context has not been extensively explored. The investigation examines how healthcare providers of the Ministry of Public Health (MSP) and indigenous users of this system define health in the canton of Cotacachi, Ecuador. Further analysis of how these perspectives influence the use of the current healthcare system in the canton was performed. The study was conducted through three focus groups of men and women in the rural indigenous communities of Morochos, San Pedro and La Calera in Cotacachi. The groups contained 7 to 10 people between the ages of 24 and 64. Additionally, individual interviews with the health care providers, primarily of mestizo descent, through the hospital of Asdrúbal de la Torre of the MSP in the urban center of Cotacachi were conducted (n=8). All information obtained was qualitative and analyzed using grounded theory. The results revealed notable differences in the definitions of health given by paid hospital staff and the indigenous communities. 83% of the healthcare providers within the hospital described health as an “equilibrium” and held views that aligned with the Manual of Comprehensive Care (MAIS), a document developed by the MSP which promotes a biopsychosocial approach to health. Interestingly, all of the indigenous community focus groups displayed a strong tendency to view health in a biomedical context. Two of the three indigenous community focus groups (66%) identified food as the base of all health. These data suggest that the strong mistrust of the system by indigenous communities may be influenced by discrepancies in healthcare officials’ and community members’ conceptions of health.

Student Presenter: Margaret Otto

Booth Number: 68

Research Mentor: Andrea Grottoli

Project Title: Evaluation of temperature and pH dissipation from a point source on a simulated coral reef

Abstract: Corals are a vital component of tropical marine ecosystems. Coral reefs provide shelter for nearly one third of all marine life, yet cover less than two percent of the ocean floor. However, corals are highly susceptible to elevated temperature conditions and declines in pH (both of which are occurring on a global scale), which can lead to a thermal stress response known as bleaching, declines in health, and increased mortality rates. To date, no long-term coral bleaching studies have been performed in situ due to the logistical complexity of such a study. Introducing heated, acidified seawater onto a reef presents permitting challenges due to the potential that such an introduction could damage large areas of healthy reef. In open ocean environments, an injection of acidified, heated water into the ocean would mix and dissipate to background levels almost immediately. However, it is unknown whether reefs would behave similarly due to their shallower environment, diurnal and lunar flow regimes, and presence of living biota and sediments. To simulate the potential dissipation rate of heated water on a reef, a scale model was constructed in the laboratory. Tests were run at a range of simulated reef flow rates, positions of point source water, and point source injection temperatures. A colored dye was used to visualize the dissipation of the water and video was used to capture the dissipation. Preliminary results suggest that the point source water would impact an area of reef no greater than one cubic meter. This would be sufficient to conduct an in situ experiment without impacting the larger reef area. It is our hope that these results will help us secure a permit to conduct a long-term in situ bleaching experiment at the Hawaii Institute of Marine Biology. A computer simulation of the scenarios is in progress.

Student Presenter: Cara Palusak

Booth Number: 69

Research Mentor: Susan Cole

Project Title: Regulation of Oscillatory Hes1 Expression by Alternative Polyadenylation in Brain Cancers

Abstract: During development of the brain, neural cells begin in a quiescent stage of non-division, which then progresses to rapid proliferation without differentiation, and finally differentiation into oligodendrocytes, neurons, or glia. This process is tightly controlled by the Notch pathway which regulates cell-to-cell communication. One specific Notch target gene, Hes1, exhibits oscillatory expression regulated by a negative feedback loop with a period of 2-3 hours in mice during neural proliferation. The arrest of these oscillations is seen to result in differentiation. One mechanism known to regulate Hes1 oscillations is the microRNA, miR-9. The current model suggests that low levels of miR-9 binding to the Hes1 mRNA 3' untranslated region (UTR) signals mRNA degradation and allows the negative feedback loop to occur. When miR-9 is present in high levels, it immediately binds to all Hes1 mRNA causing rapid degradation, arrest of the oscillations, and differentiation to occur. These differentiated cells continue to express this high level of miR-9 preventing further Hes1 oscillations for the life of the cell. It is observed, however, that in gliomas and other brain cancers, the differentiated cells return to the proliferative state. I am proposing this occurs due to Hes1 escaping regulation by miR-9 allowing the Notch pathway to promote re-initiation of oscillations and de-differentiation of the neurons. The regulation of transcript stability is controlled by the 3'UTR and Hes1 is known to have two polyadenylation sites, where miR-9 binds to a consensus sequence on only the long transcript. Therefore, tests can be done by mutating the 3'UTRs to force the expression of either the long or short isoform and using Luciferase assays to test the stability of each isoform with and without exogenous miR-9. I am currently working on these assays and expect to have results before the forum.

Student Presenter: Julia Parker

Booth Number: 70

Research Mentor: Woo-Young Ahn

Project Title: Predicting Impulsivity in Healthy Adults Using Machine Learning Models in Resting State Functional Magnetic Imaging Scans

Abstract: This study will build a model for predicting impulsivity levels by using machine learning methods applied to resting state functional magnetic imaging (rsfMRI) scans, which record activity in the brain while participants are completing no tasks. Impulsivity is a genetically-linked personality traits associated with a wide range of psychological dysfunction. Usually, impulsivity is measured using the self-report Barratt Impulsiveness Scale (BIS). Machine learning is a way to build models that can make predictions about new data. This technique is ideal for measuring impulsivity, as it is suited to analyses on multidimensional variables. Using resting data compiled from various brain imaging studies, this project utilizes machine learning measures to predict scores on the BIS. To our knowledge, past research has not yet addressed the utility of rsfMRI data in predicting impulsivity scores. The scans used in this study come from the Brain Genomics Superstruct Project, a collection of healthy participantsâ€™ rsfMRI scans. A total of 892 brain scans and their associated BIS scores are used in this projectâ€™s analysis. Graph theory measures will quantify the correlations between different areas of the brain. Thus far, the data has been pre-processed using Matlab coding and the brain atlas has been applied. This model will serve as an effective marker of psychological dysfunction and will be suitable for use in clinical practices to predict impulsivity scores in new, healthy participants. Additionally, the results of the graph theory analyses may reveal useful data for future studies relating to neural correlates of impulsivity.

Student Presenter: Andrew Parra

Booth Number: 71

Research Mentor: Kazimierz Slomczynski

Project Title: Class, Trust, and Political Participation in Poland

Abstract: With the rise of populism and the success of the Brexit movement, there has been concern in Europe about the collapse of the EU. Poland, and EU country since 2004, has undergone enormous change in the past 30 years, including the rise of the populist, Catholic nationalist PiS party; some scholars have used Poland as an example of the erosion of trust in institutions and a growing divide between elites and the masses. This project examines how the intersection of class and political trust affected the rate of political participation. My main hypothesis was that people of privileged class would participate more, while high trusting individuals would engage in voting, while low trusting individuals would engage in alternative political participation. For the project, data was taken from the 2013 Polish Panel Survey (POLPAN). Polpan is a panel survey taken every five years since 1988, and contains information on age, class, health, opinions on the state of the country, and feelings towards both the national government and the EU. My main dependent variable is political participation: voting, protest, and petitions. My main independent variables are trust in three political institutions; the parliament, the judiciary, and political parties, and then class based on the Erickson Goldthorpe Portocarero schema. My control variables were gender, age, and interest in politics. I found empirical support for my main hypothesis with regards to voting, but trust and class were not strong indicators of other forms of political participation.

Student Presenter: Ian Pelfrey

Booth Number: 72

Research Mentor: Ryan Yoder

Project Title: Computational Simulations of Re-alkylation Reactions of Aged-Acetylcholinesterase with Quinone Methide Precursors

Abstract: Organophosphorus compounds (OPs) such as sarin, soman, and tabun are toxic nerve agents used in chemical warfare. These OPs covalently bond with Serine-203 (Ser203), a catalytic residue in the enzyme acetylcholinesterase (AChE), preventing hydrolysis of the neurotransmitter acetylcholine into acetate and choline. Once exposed to an OP compound, the inhibited AChE will undergo an irreversible process known as aging, where the OP-AChE complex will dealkylate and form a stable phosphonate anion on the serine residue, permanently inactivating the enzyme. Without functioning AChE, acetylcholine accumulates in the central nervous system causing seizures vomiting and often death. Currently, there are no known therapeutic methods to reverse this aging process to regain enzymatic activity. However, inhibited AChE can be restored to the active AChE before the onset of the aging process by treatment with pharmaceuticals containing an oxime functional group. The goal of this project is to discover a compound that will re-alkylate the phosphonate anion on Ser203 in aged-AChE, which can then be restored to the active AChE by oxime treatment. Literature shows that quinone methides (QMs) are capable of alkylating phosphodiesters, which are structurally similar to the phosphonylated Ser203 residue in the aged-AChE active site. Through computational methods, potential docking poses in AChE of a variety of quinone methide precursors (QMPs) were analyzed in silico. These QMPs were chosen as derivatives of a lead compound, a substituted 3-hydroxypyridine. Snapshots of an aged AChE were used for our docking calculations where the QMPs were allowed to interact with the enzyme active site. Molecular dynamics simulations permitted us to determine how the interaction between the ligand and enzyme changed over time. Statistical analysis of the results from these computational studies provided insight into structural characteristics of the most effective QMPs, which our colleagues can then combine and synthesize to make the most promising compounds for in vitro analysis with the goal of eventually creating a therapeutic agent.

Student Presenter: Shannon Phillips

Booth Number: 73

Research Mentor: Jesse Kwiek

Project Title: Incentive-Based HIV Interventions â€“ Iringa, Tanzania

Abstract: In Tanzania women are disproportionally affected by HIV. In 2011, HIV prevalence among women was 6.2% compared to 3.8% of men, according to the Tanzania HIV/AIDS and Malaria Indicator Survey; this is due, in part, to a lack of economic opportunity. Incentive-based interventions, which distribute monetary supplements contingent upon preventative health-related behavior, have the potential to reduce their risk for HIV. Incentive-based interventions are a relatively new HIV prevention strategy, and the best way to implement these interventions is currently unknown. The goal of this project was to use personal interviews and existing literature to explore multiple perspectives of incentive-based HIV programs implemented in Iringa. Two local programs were studied, Sauti (voice, in Swahili) and TAHEA (Tanzania Home Economics Association). Sauti, an NGO USDAID-funded organization that promotes HIV testing, counseling, and linkage to appropriate HIV services, has recently partnered with TAHEA, a local professional organization, to organize and promote community savings and loans groups. These groups comprise of 20-25 young women who each contribute to a group fund, which is then used to provide loans to group members. Through a series of interviews, a few common themes/challenges emerged that better describe incentive-based HIV interventions in Iringa which can improve how they are implemented in the future. Among the eleven group members who were interviewed, most had success with starting a small business and have become financially independent. The women interviewed also benefited from the social support created from these groups. The major complaint among the interviewees was the need for the government or a financial institution to help contribute to their funds. These findings align with other studies to further provide evidence that incentive-based interventions are a promising strategy in a holistic approach to HIV prevention.

Student Presenter: Audrey Phipps

Booth Number: 74

Research Mentor: Carlos Castro

Project Title: DNA Origami Nanostructure Stability and Retention of Daunorubicin

Abstract: DNA nanotechnology has demonstrated that chemotherapeutics can be integrated into DNA origami nanostructures, which can circumvent drug resistance mechanisms and enter the cell via endocytosis.(1) DNA origami is a self-assembly process in which a long “scaffold” strand of DNA “folds” into a 3D nanostructure via synthetic DNA oligonucleotides, or “staples”, pinching together different sections of the scaffold.(2) Before DNA origami can be used in clinical trials, we need a better understanding of DNA origami stability. We performed stability analysis of various DNA origami nanostructures in physiological conditions and investigated their ability to retain chemotherapeutics such as daunorubicin. DNA nanostructures with varying design parameters such as surface area, cross section, and lattice type were selected to observe structure degradation in environments of varying salt (MgCl2) and fetal bovine serum (FBS) concentrations. We quantified stability through gel electrophoresis and qualitatively through electron microscopy. We used a UV spectrophotometer to measure daunorubicin concentration in DNA nanostructures at different time points at physiological temperatures to determine base pair binding ratio and TEM imaging to observe intercalation. Preliminary results indicate that most nanostructures degrade between 3 nM and 1 nM MgCl2 concentration and nanostructures with a square lattice are stable at all FBS concentrations. This suggests high stability in cell conditions. Initial results for daunorubicin experiments with a 24-hour incubation period suggest that using 10 nM of nanostructure with 250 uM daunorubicin yields the highest base pair binding ratios. We anticipate that nanostructures with larger cross sections and greater surface area will better retain the drug. A long-term objective is to apply the information gathered from stability and drug retention experiments to designing an optimal drug delivery nanostructure to test in vivo.

Student Presenter: Devante Potter

Booth Number: 75

Research Mentor: Mark Foster

Project Title: Yin and Yang mutants to study pre-synaptic Cre-loxP complex

Abstract: Cre recombinase is a site-specific DNA recombinase derived from bacteriophage P1, that is commonly used in biomedical research to recombine DNA molecules in a highly controlled manner, without the use of other cellular cofactors. To recombine its specific loxP DNA sequences, two pairs of Cre molecules assemble as a dimer of homodimers onto two loxP sites. Which are then brought together via protein-protein interactions to form a tetrameric “synapse” (Cre2-loxP)2. X-ray crystallographic studies have shown that the recombination pathway follows through this tetrameric synapse and a DNA four-way Holliday junction intermediate. However, little is understood about the intermediates leading to assembly of the recombination complex. I seek to engineer two Cre mutants (termed “Yin” and “Yang”), totaling ten point mutations, that are incapable of forming the synaptic tetramer, but can assemble as a heterodimer on loxP, allowing formation of the assembly intermediate Cre2-loxP. Structural studies of these pre-synaptic complexes will lend insight to the study of dimer formation, DNA bending, and the thermodynamic contribution of each protomer to the binding of the asymmetric binding element between loxP sites. To engineer CreYin and CreYang, I am using site directed mutagenesis by performing polymerase chain reactions (PCR) with complementary mutagenic DNA primers and a plasmid encoding the Cre gene as the starting template; at each step, the resulting mutagenized plasmid serves as the template for the next PCR reaction. Following completion of the construction of the genes encoding the Yin-Yang pair, the proteins will be expressed recombinately in E. coli, purified and their complex on loxP will be characterized by electrophoretic mobility shift assays (EMSA). Thus far, I have succeeded in engineering CreYin through site directed mutagenesis and the protein has been purified and expressed. Site directed mutagenesis to construct CreYang is in progress.

Student Presenter: Justin Richards

Booth Number: 76

Research Mentor: Devina Purmessur

Project Title: Tryptase/PAR2 interactions in the Pathogenesis of Discogenic Back Pain

Abstract: Intervertebral disc (IVD) degeneration is a cause of lower back pain, and immune cells may significantly impact this IVD degeneration. Mast cells are present in degenerative human IVD tissue, and demonstrate potential importance to degeneration of the IVD. Mast cells release preformed granules containing factors combatting diseases or allergens. Uniquely, mast cells produce tryptase which is known to activate Proteinase Activated Receptor 2 (PAR2), expediting degradation of human osteoarthritic cartilage. We hypothesize that tryptase will upregulate PAR2 degradative in IVD tissue. Aim 1: Human IVD tissue samples (autopsy; N=8, surgical; N=5) were stained using immunohistochemistry, then quantified for percent positive expression of PAR2. Aim 2: Human IVD autopsy samples (N=4) were seeded in 2% agarose at 4.0x10^6 cells/mL. The gels were cultured 24 hours in 10% Fetal Bovine Serum (FBS) media in normoxia (20%), and 24 hours in 2.5% FBS media and hypoxia (5%) at 0, 0.01, 0.1, or 1 g/mL of recombinant human tryptase (rhTryptase). Media was collected for a VEGFA ELISA, Â¾ of each gel was dissolved in trizol for qRT-PCR, and Â¼ of each gel was quantified for percent viability. Aim 3: Human autopsy samples (AF and NP; N=4) will be seeded and cultured exactly as described in aim 2 with Basal, 1g/mL rhTryptase, 1g/mL rhTryptase + PAR2 antagonist (10M), and PAR2 agonist (10M) constituting experimental groups. Takedown will follow aim 2 methods. PAR2 expression was documented in all samples (Fig. 1) and upregulation of degradative factors in experimental groups is expected.The expected results suggest possible therapeutic application of immunological modulation to treat discogenic back pain.

Student Presenter: Abigail Robbertz

Booth Number: 77

Research Mentor: Barbara Andersen

Project Title: Identifying anxiety and depression in patients with Chronic Lymphocytic Leukemia (CLL): An examination of American Society of Clinical Oncology guidelines, cancer specific factors and CLL specific factors

Abstract: Introduction: The National Comprehensive Cancer Network (NCCN) requires all Comprehensive Cancer Centers to screen patients for distress. With this guideline, distressed individuals may be identified who need proper support and treatment for anxiety and depression. However, there is little research on the factors associated with anxiety and depression in cancer patients, especially in individuals with hematological cancers, such as chronic lymphocytic leukemia (CLL). CLL, the most common type of adult leukemia in the US, presents with abnormal B-lymphocytes in blood, lymph nodes and bone marrow. Unfortunately, 13-40% of cancer patients experience symptoms of depression and 10-30% experience symptoms of anxiety. Methods: This study collected screening data for depression and anxiety in patients with CLL in three clinical trials at a Comprehensive Cancer Center in the Midwestern United States. Assessments include data on American Society of Clinical Oncology risk factors, cancer specific factors and CLL specific factors. This study is designed to evaluate which factors are associated with depression and anxiety. Results: Specifically, we hypothesize that those with recurrent, advanced or progressive cancer, chronic illness, who are single, unemployed/low SES and are female will have higher levels of depression/anxiety. We also hypothesize higher cancer specific stress, less social contacts and support, more adverse life events and those who are older will be associated with greater depression and anxiety. Finally, we predict depression and anxiety will be correlated with higher absolute lymphocyte counts, patients who have not received treatment, and have more fatigue. Conclusion: Screening all cancer patients for distress is a new, important criterion to provide innovative treatment for cancer patients. Determining which factors are correlated with depression and anxiety will improve preventative measures and enable the use of supportive care for cancer patients with greatest risk.

Student Presenter: Julia Rose

Booth Number: 78

Research Mentor: Monique Pairis-Garcia

Project Title: Behavioral and production effects of environmental enrichment on fast-growing broiler chickens

Abstract: In order to promote natural behavior in livestock species as a means to improve welfare, physical enrichment has been implemented in commercial poultry facilities. However, to date, there is limited research validating the quality of commonly used enrichment items such as straw bales on the behavior and performance of broiler chickens. The objective of this study was to quantify the behavioral and production effects of straw bale enrichment on commercial broilers. A total of 104 “Ross 708” broilers were enrolled on the trial and randomly assigned to one of two treatments; Control (C, standard pen with litter, 2.790m2), Enriched (E, standard pen with litter, 2.790m2 and straw bale 0.279m2). Day one old chicks were allocated to one of eight pens (C: n=4; E: n=4) with 13 chicks per pen (C: 0.215m2/bird; E: 0.193m2/bird) and housed until five weeks of age. Behavior was collected using live observation with five minute scan samples, four hours per day for three days a week. In addition, weight, feather quality, and foot pad lesions were scored weekly. Feed conversion rates and total feed consumed were calculated weekly. Birds in the E treatment group demonstrated decreased sitting behavior compared to birds in the C treatment (P<0.05). Feeding, drinking, and active behaviors were not affected by treatment (P>0.05). This research suggests bird behavior is influenced by the addition of straw bales as a source of enrichment during the early weeks of production.

Student Presenter: Sunder Sai

Booth Number: 79

Research Mentor: Paul Bellair

Project Title: The Relationship Between Responsible Drinking Policies and Football Game-Day Misconduct at The Ohio State University: a Preliminary Study

Abstract: Studies have shown crime, misconduct, and incidents tend to increase within and around stadiums during football games, particularly, alcohol-related misconducts (Reese and Schnepel 2008, Merlo et al. 2010, Kalist and Lee 2014). Ohio Stadium, home to The Ohio State University (OSU) Buckeyes college football team, hosts 7-8 annual home football games each fall. Minimal research has been presented observing trends regarding incidents during OSU's home football games. Furthermore, the causes for these potential trends remain unknown. It is hypothesized that responsible drinking policies, which are reflected through stadium-wide alcohol sales and a no-bag policy, are associated with a reduction of game day misconduct. Incident statistics from OSU's Department of Public Safety were examined for the 2012, 2013, 2014, 2015, and 2016 OSU home football game seasons. Alcohol arrests and citations inside and outside the stadium along with stadium ejections were compared across these seasons. Additionally, game time, attendance, points scored, and game-day temperatures were observed as potential variables influencing game-day incidents. Preliminary findings show a decrease in total alcohol incidents, total arrests, and total ejections in the last three seasons. Within each season, incidents were highest for evening games that started at 6 p.m. or later. The findings also suggest that attendance, points scored, and temperature did not appear to have a significant relationship to the number of game-day incidents. When evening games were taken out of the data, the decreasing trend in incidents still remained. This study provides initial findings showing a decrease in overall game-day incidents over three years, which may be due to responsible drinking policies. Stadium-wide alcohol sales may give guests opportunities to drink more moderately inside the stadium. Bag policy could also prevent guests from bringing alcohol into the stadium. Causality cannot be established, however. More research will be conducted for future games evaluating trends.

Student Presenter: Alex Seibel

Booth Number: 80

Research Mentor: Jonathan Song

Project Title: CXCL12 Isoform-Specific Effects on Vessel Behavior and Function

Abstract: CXCL12 (SDF-1) is a stromal-derived cytokine that promotes angiogenesis (vessel growth) and vascular permeability (vessel leakage) in CXCR4-expressing endothelial cells, making it an important signaling molecule for cancer research. Previous studies have focused on CXCL12's α-isoform, but it was hypothesized that β and γ isoforms would impact targeted cells differently due to distinct biochemical properties. This study compared CXCL12's isoform-specific (α, β, or γ) effects on blood vessel sprouting and apparent vascular permeability. The vessel microenvironment was modeled using a 3-channel microfluidic device composed of poly(dimethylsiloxane) (PDMS). Human Umbilical Vein Endothelial Cells (HUVECs) were seeded into the outer channels, forming monolayers against a 3-D Type 1 collagen matrix in the central channel. HUVECs were cultured with media containing recombinant CXCL12 (α, β, or γ, 100 ng/ml). For sprouting experiments, devices were imaged and analyzed for sprouting area and morphological features. Permeability assays were run independently by tracking dye diffusion across the cell monolayer using time-lapse imaging and analyzing intensity change over time. Results indicate that CXCL12 isoforms elicit noticeably different sprouting responses from HUVECs. While all CXCL12 isoforms promoted sprouting area compared to control, the sprouting response followed an α > β > γ order. Morphologically, the number of individual HUVECs that detached from primary multicellular sprouts gave an α > β > γ result as well. Both findings follow the rank order for binding affinities of CXCL12 isoforms to CXCR4 (α > β > γ), confirming the CXCL12-CXCR4 mechanism's importance in sprouting behavior. Vascular permeability studies are ongoing, but a similar trend is expected. It is interesting whether changing components of the extracellular matrix could reverse or diminish the α > β > γ trend for sprouting or permeability. Fully understanding specific biological responses conferred by each CXCL12 isoform will be beneficial when designing targeted therapies against CXCR4-mediated signaling.

Student Presenter: Bhavya Shah

Booth Number: 81

Research Mentor: Kuan-Hsuan Shen

Project Title: Effects of Morphology on dynamics of Block Copolymer Systems

Abstract: A block copolymer that consists of two types of monomers – A and B, arranged such that that there is a chain of each monomer and those two chains are grafted together to form a copolymer chain. These diblock copolymer structures can phase separate (at microscopic level) into different types of structures/morphologies – spherical, cylindrical, lamellae and gyroid, depending on various factors. We perform MD simulations on these different structures to understand the dynamics of the chains and of the other small, added penetrants. We analyze these simulations and see how the penetrants can improve the designs of the chains for transport applications. For these simulations, we use a simple coarse grain bead-spring polymer model. We expect the diffusion and the dynamics to be correlated to the morphology, so we compare the cylindrical and lamellar morphologies for their diffusion constants in the directions parallel to the pathways as well as in other directions. The cylindrical morphology has only one parallel direction and the lamellar morphology has two parallel directions of travel. Hence, to understand the causes and effects of these particular diffusion constants, we aim to find the bond vector correlation functions for A-A bonds near the ends of the chain and near the middle of the polymer for each of the morphologies. The spherical and gyroid morphologies have very small regions of existence and hence, need to have more constraining factors to be useful for simulations. Through the research my main goal is to calculate diffusion of penetrants in these morphologies by understanding various factors that affect and relate to the morphologies.

Student Presenter: Sarah Solomon

Booth Number: 82

Research Mentor: Andrea Grottoli

Project Title: Coral lipid class composition following repeat bleaching

Abstract: Increasing sea surface temperatures, a result of anthropogenic global change, is causing an increase in the frequency and severity of mass coral bleaching events. When heat stressed, corals expel their photosynthetic algal endosymbionts that provide them with fixed carbon to meet metabolic energy requirements. In the absence of endosymbionts, corals with high levels of stored energy reserves (lipids, carbohydrates, and protein) and corals that acquire energy through heterotrophy are known to have increased survival and resilience potential. To evaluate how lipid management can infer resilience, I measured changes in lipid class composition in repeatedly bleached and non-bleached corals of three species across several recovery time points over two years. Phospholipid concentrations in Orbicella faveolata decreased by about half, which might correspond to cell loss associated with severe bleaching in this species following single bleaching.Â However, this response was mitigated in the second year and cholesterol concentrations increased, which could be a response to increased incorporation of heterotrophic food into tissue building. Porites astreoides maintained low concentrations of cholesterol across both years. These initial findings suggest that these two species manage their lipid reserves differently under heat stress. The effects of single bleaching events were not indicative of lipid class composition following repeat bleaching. I am measuring more lipid classes (tri- di- & mono-acylglyceride, free fatty acid, glycerol and wax ester) to have a comprehensive record of coral lipid management. Further investigation of structural and storage lipid management will reveal resilient strategies and improve our knowledge of how corals recover following annual bleaching events.

Student Presenter: Zhixin Song

Booth Number: 83

Research Mentor: Ratnasingham Sooryakumar

Project Title: Collective Dynamics of Micro-swimmers

Abstract: Bacteria live in a very different world from us. For such small spatial dimension, the inertia of their motion is small compare to the viscous forces due to the environment. This leads to a whole new world of physics different from daily life, and hence unintuitive. We have observed that a magnetic strain of bacteria AMB-1 forms belt-like clusters near surfaces when placed in an oxygen concentration gradient. However, bacteria swimming in these clusters appear to undergo net linear translations along the belt when subjected to external magnetic fields that presse in-plane with the surface. In order to explain this unusual phenomenon, we have devised a mathematical model that can explain this phenomenon if there is a velocity difference of individual swimmers at each side of the belt. Firstly, we are able to make a gradually increased oxygen gradient along a micron-sized channel by letting one end open ensuring a consistent oxygen supply from outside atmosphere. After the bacteria belt is formed, we call the region closer to the opening the â€œoxic regionâ€ which contains more oxygen compare to the â€œanoxic regionâ€ on the opposite side. During the experiment, a number of videos were recorded at each side of the belt. Secondly, we use an image processing software called Fiji, with which we tracked thousands of bacteria. Finally, a MATLAB program is used to convert the tracking result into velocity histograms. After analyzing 30 groups of datasets, we were able to get velocity distributions in two regions. A Kolmogorov-Simonov test with 99.99% confidence level confirmed the velocity distribution in the oxic and anoxic side are significantly different. This experiment not only helps us understand the mechanics of collective swimming in micron scale but also offers the possibility of bio-micro hydrodynamic applications such as magnetically controllable mixing and pumping.

Student Presenter: Anastasia Soulas

Booth Number: 84

Research Mentor: Sung Ok Yoon

Project Title: Role of ProNGF-p75 signaling in loss of bladder function after spinal cord injury

Abstract: Loss of bladder control is a challenging outcome facing spinal cord injured patients. The NGF signaling mechanism has been a focus for treating various urological conditions, such as overactive bladder and interstitial cystitis (IC)/painful bladder syndromes (PBS) because it contributes to bladder hyperactivity. Particularly, an increase in NGF levels was reported in urine after spinal cord injury (SCI) and in overactive bladder and IC/PBS, prompting attempts to block NGF signaling as a way to improve bladder control. Research has led to mixed results; the reason for which is unclear, but we postulated that it may be proNGF rather than mature NGF signaling that is involved. We have reported that proNGF is released after injury in the CNS. Thus, we wished to test whether blocking proNGF binding to p75 with an orally bioavailable, small molecule inhibitor, LM11A-31, previously determined to improve motor coordination after SCI, will favorably influence bladder control after SCI in female mice. We report here that daily oral administration of LM11A-31 for 28 days beginning 4 hrs after initial SCI resulted in significant improvement in bladder function. The hyperreflexia was attenuated with normal bladder pressure, acquiring automatic micturition weeks earlier than the control. To understand the underlying mechanism, we analyzed synaptic changes in the L6 and S1 spinal cord segments that project afferent and efferent projections to the bladder. We found that LM11A-31 administration led to a reduction in c-fos positive cells, suggesting that the drug lowered the bladder filling indicative of lowered bladder pressure. We also observed an increase in excitatory synaptic input to the spinal cord with LM11A-31 treatment onto tyrosine hydroxylase+ fibers in the dorsal commisure for the spinal cord. We interpret these results as suggesting that proNGF-p75 signaling plays a role in disrupting bladder reflex circuit after SCI.

Student Presenter: Brianna Sowers

Booth Number: 85

Research Mentor: Nathalie Maitre

Project Title: Development of an infant-specific toy kit for research in rehabilitation of arm and hand function

Abstract: Introduction: Cerebral palsy (CP) is the most common movement disorder in children. Two effective and well-studied interventions to improve upper extremity function in children with hemiparetic CP are constraint-induced moment therapy (CIMT) and bimanual therapy (BIMT). While researchers and therapists have identified toys for these interventions in older children, none existed for infants under 2 years. Our goal was to develop infant-specific toy sets to facilitate goal-directed tasks and developmental progression during effective rehabilitation. Methods: This project was part of the APPLES study, â€œA Positive Parent-focused training for upper Limb Experience with Sensory-motor feedback studyâ€. This NIH-funded randomized controlled trial uses BIMT and CIMT to train reach and improve sensorimotor function in 72 infants with hemiparetic CP (9-24 months corrected age). Four categories of toys were identified based on their intended task: 1) bimanual toys, 2) unimanual toys for sensory therapy, 3) unimanual toys for reach-training, and 4) toys used for distraction during study assessments. Initial selection was from published literature, then modified based on child size, developmental abilities and task. Three treatment fidelity sessions in 4 weeks allowed refinement of the toys based on scored examiner and parent feedback. Results: Based on parent treatment fidelity and infant performance on standardized tests, we developed four sets of toys with 3-5 toys in each set, allowing for 4 developmental/ability stages. Results indicated that the initial selection of primarily auditory and visual characteristics was insufficient to maintain infant interest and textural elements were added. Additionally, a full range of weights within object categories was developed (e.g. balls from 0.25 to 1.5 kg) to allow for increasing effort. Conclusions: We developed infant-specific toy sets easily used by parents during BIMT and CIMT. Because our study follows infants to 36 months, the next project will address the developmental needs and cognitive abilities of toddlers.

Student Presenter: Katherine Sprudzs

Booth Number:

Research Mentor: Harmony Bench

Project Title: The Obscuring of Lester Horton Repertory

Abstract: When choreographer Lester Horton (1906-1953) passed away, he left control of his entire artistic oeuvre in the hands of Frank Eng, a former Daily News reporter who had become the managing director of Horton's company, as well as his romantic partner. Despite the efforts of former members of the Lester Horton Dance Theater to restage his work, including attempts by notable choreographer Alvin Ailey, Horton repertory is little known and infrequently performed. Analyzing archival resources housed at the Library of Congress including programs, newspaper clippings, interviews, and correspondence, I ask how approaches to preserving a choreographer's legacy can actually render it obsolete. I contend that Frank Eng's possessive and protective hold over the repertory contributed significantly to its eventual obscurity. I further argue that in comparing the physically inherited rights former Horton dancers held and the rights Frank Eng inherited legally, scholars can gain important insights into the complexity of preserving and passing on dances. This presentation will contribute to a crucial area of investigation in dance studies that considers the friction between dancers' rights and ownership of repertory stored in their bodies, and the intellectual property rights of creators and their estates to control the production and staging of choreographic work. This project was developed with guidance from Dr. Harmony Bench and is supported by an Undergraduate Research and Creative Inquiry fellowship.

Student Presenter: Julianne Stamer

Booth Number: 87

Research Mentor: Mark Hubbe

Project Title: The Influence of Biology and Culture on Sexual Dimorphism in Carious Lesions in Pre-History

Abstract: The global transition from hunter-gatherer to agricultural subsistence captures a profound biocultural transition in human history, and resulted in significant changes to different aspects of human life-style, including the increased susceptibility to different pathologies, like dental carious lesions. Global skeletal series show that females have more caries than males. Biological (dental morphology, oral fauna, age, and sex) and cultural (diet, social/socioeconomic factors, technology, personal preference) variation can explain this difference. However, the amount of influence these factors have in caries prevalence between sexes is unknown. Here, we attempt to understand the impact and importance of these factors on caries prevalence by sex. We have gathered data from 67 skeletal series published in International Journal of Osteoarchaeology, the Backbone of History, Current Anthropology, and American Journal of Physical Anthropology. Only studies providing information about female and male caries were included, and percentage of teeth affected with a carious lesion and of individuals with at least one carious lesion were compiled. In total, these papers examined 67,734 teeth recovered from 4,374 individuals. Caries frequencies for males were plotted against the frequencies for females, and their relationship was analyzed using linear regressions. The results show a strong association between male and female, with females usually showing higher prevalence of caries. However, this relationship only explains 31% of the variation, indicating that factors other than biological sex have an important role in the different caries prevalences observed. This supports the idea that caries have a complex etiology, and that differences between sexes cannot be easily attributed to either biological or cultural factors alone.

Student Presenter: Joseph Sudar

Booth Number: 88

Research Mentor: Marcos Sotomayor

Project Title: Molecular Mechanisms of Sound Amplification and Perception in the Inner Ear

Abstract: Hearing is a fundamental sense for living organisms. Simply put, hearing is the ability to interpret sound, but there are many different processes allowing one to hear. The key to hearing is within the cochlea located in the inner ear. Running along the length of the cochlea is the organ of Corti, containing the Basilar membrane, inner, and outer hair cells. With sound waves traveling through the Basilar membrane, and the outer hair cells providing amplification, the vibrations disrupt the hair bundles and tip links at the top of the inner hair cells, triggering electrical signals that are interpreted by the brain as sound. The amplification process of the outer hair cells is key to the hearing process, though how this occurs is unknown. Prestin is a motor protein responsible for size changes of the outer hair cells. How Prestin causes the cells to change size is not clear. To investigate the molecular mechanisms of Prestin-mediated amplification I used coarse-grained molecular dynamics (MD) simulations and different homology models of the protein. The purpose of this was to observe the size changes of Prestin that would be responsible for the size change of the outer hair cell. MD simulations were run using the software NAMD under different conditions including the application of membrane potentials at Â±1.0V and Â±0.5V. Difficulties arose while running these simulations, and it was concluded that models need to incorporate polarizability to better represent physiological conditions. Systems were also created with Prestin to include its extended C and N-termini. The purpose of this was to determine the function of these domains. In addition, I started experimental work on the crystallization of tip link fragments essential for hearing. The above work will be continued to understand how Prestin mediates sound amplification and how tip links mediate sound perception.

Student Presenter: Jenna Tabbaa

Booth Number: 89

Research Mentor: Chirstopher Callam

Project Title: Synthesis and Evaluation of Pyridine Based Quinone Methide Precursors for Aged Acetylcholine Esterase Reactivation

Abstract: Organophosphorus compounds (OPs) such as tabun, sarin and soman are used as chemical warfare nerve agents. The advancements of chemical warfare agents used for military tactics exceed the research to inhibit the effects of the nerve gases. The demand to study OP nerve agents is crucial because of the damaging effects to people, the commercial availability, and even the stockpiles in countries. Exposure to OPs affects the central nervous system and causes a buildup of acetylcholine in the body by inhibiting acetylcholinesterase (AChE). The AChE is initially inhibited followed by an aging process. There are known therapeutic oximes for inhibited AChE, pyridinium oxime; however, there are no known treatments for aged AChE. We are developing a library quinone methide precursors (QMPs) to be used as potential re-alkylators. These QMPs can be used to potentially re-alkylate the aged OP-AChE complex to its inhibited AChE form to be reactivated with a pyridinium oxime. This research is vital to enhance the pharmaceutical measures and further inspire more research done to medically counteract the aging process. Several frameworks were synthesized through synthetic routes including nucleophilic substitution, reductive amination, and Mannich reactions. We will present the synthesis of a small library of pyridine QMP frameworks and the screening of these compounds as re-alkylators and re-activators of both the inhibited and aged AChE (electric eel and human).

Student Presenter: Anne Taylor

Booth Number: 90

Research Mentor: Min Zhou

Project Title: A higher density of mitochondrial networks in astrocytes compared to neurons indicates critical astrocytic role in brain metabolism

Abstract: The importance of mitochondria as the cell's major source of energy has been well established, as these organelles are critical in the production of ATP from glucose, via the tricarboxylic acid cycle. This study is particularly interested in the mitochondrial networks in the brain, as the brain consumes much of the body's daily glucose intake. More specifically, we have examined the mitochondrial makeup in the brain's two major cells types: neurons and glial cells, with astrocytes making up the majority of glial cells. Currently in the field, the role of neurons has been extensively studied, while the metabolic role of astrocytes remains largely unknown. Previous studies have claimed that astrocytes contain very few mitochondria, giving the impression of a negligible metabolic role. However, more recent studies have contradicted this idea, as they have shown that astrocytes do in fact contain mitochondrial networks. Despite this new research, the present consensus is that neurons consume more energy, and thus contain more mitochondria than astrocytes. This present study challenges this notion, as it shows for the first time that astrocytes contain a higher volume density of mitochondria compared to neurons. This was achieved by using an innovative EM technique, termed serial blockface scanning electron micrography (SBFSEM), which makes reconstruction of the structural details of mitochondria possible. In addition to reconstructing these extensive mitochondrial networks, we were also able to calculate the relative size and number of individual mitochondria for comparison between neurons and astrocytes. Furthermore, SBFSEM has allowed us to examine the unique cristae packing of individual mitochondria, important in the function of the TCA cycle and electron transport chain. Our findings suggest that astrocytes produce and consume more energy than previously recognized, and calls for further investigation of the specific functions of astrocytes requiring such high amounts of energy.

Student Presenter: Altan Turkoglu

Booth Number: 91

Research Mentor: Pearlly / Ralf Yan / Bundschuh

Project Title: Uncovering Papillary Thyroid Cancer Associated Epigenetic Factors Through a Systems Biology Approach

Abstract: Single-nucleotide polymorphisms, loci where nucleotides change between individuals, are often associated with different phenotypical characteristics. DNA methylation, a method of epigenetic control for gene expression, may alter the activity at a segment of DNA through the addition of a methyl group, usually repressing gene transcription. DNA methylation in humans primarily occurs in the context of a cytosine followed by a guanine, or CpG. Single-base resolution methylation in a genome can be determined using reduced representation bisulfite sequencing (RRBS), where unmethylated cytosine bases are converted to uracil and then thymine upon PCR amplification. Papillary thyroid cancer (PTC), the most common thyroid cancer, is most often sporadic, with only 5-10% familial attribution (He, et al. 2015). It is, however, conceivable that the effect of genetic alteration may still be indirectly associated with PTC tumorigenesis. Of 24 PTC-attributed SNPs found from previous studies, four papillary thyroid cancer-associated SNPs were selected based on RRBS sequenced read coverage level for further investigation. The relationships between cancer-associated SNPs and CpG sites in surrounding genes and transcription factor binding sites were determined for 24 paired tumor and normal samples. Based on overlap between SNP allele and methylation status, CpGs associated with the given SNP were found. Briefly, Methylkit (an Rscript) is used to identify methylation statuses for RRBS sequencing data. A 100 kilo-base region surrounding the SNP site was then investigated for CpGs located in genes and transcription factor binding sites, using Bismark and FIMO, respectively. Of these, the final association was determined using a t-test. Using this methodology, we hope to find associations between SNPs and DNA methylation loci. Associating methylation with already known cancer linkages may prove to be a powerful boon in uncovering further cancer related genes and transcription factors.

Student Presenter: Ronald Turner

Booth Number: 92

Research Mentor: Jan Schwab

Project Title: Neurological Deficits Caused by Tissue Hypoxia after Spinal Cord Injury

Abstract: The injured spinal cord is susceptible to inflammation, which constricts the vasculature that supplies the cord with oxygen. This insufficient oxygen supply to neuronal tissue, known as hypoxia, could be detrimental to the neuronal tissue depending on the extent of this hypoxia. Oxygen is necessary for proper energy production. In an injured cord that requires more energy for repair, an energy insufficiency could lead to the functional deficits experienced by spinal cord injury patients. In contrast to earlier studies analyzing hypoxia after acute spinal cord injury, we will investigate chronic SCI, given the fact that chronic inflammation has been also demonstrated to cause tissue hypoxia. In this study, we performed a severe contusion (250 kdyne) at T8 in the rat spinal cord. To detect the degree and localization of hypoxia in the spinal cord, we injected a molecular probe called pimonidazole intraperitoneal 4h prior to sacrificing the animal. A second measure of oxygen tension in the cord will be completed through the use of EPR Oximetry technology for verification. By injecting paramagnetic lithium phthalocyanine crystals into the cord, we obtained weekly readings of oxygen tension in the injured spinal cord. The exact effect of hypoxia in the spinal cord after spinal cord injury is still unknown, and this experiment will further the understanding of the degree of hypoxia that develops in the cord after injury. We hypothesize that hypoxia develops in the spinal cord at the lesion and caudal to the lesion after spinal cord injury and persists into chronic timepoints. We will use rodents in which the injured cord will be harvested one month after injury for IHC analysis. This research will lead to a better understanding of SCI hypoxia.

Student Presenter: RAMAN VILKHU

Booth Number: 93

Research Mentor: ASIMINA KIOURTI

Project Title: Scalable Power Generation for Wearable Electronics Using Fabric Electrochemistry

Abstract: We introduce a new class of electrochemical fabrics which, when moistened by a conductive bodily liquid (sweat, wound exudate, etc.), generate DC voltages and current levels capable of powering wearable electronics. Contrary to conventional power generation techniques, the proposed electrochemical fabrics are fully flexible, feel and behave like regular clothing, do not include any heavy or rigid components, and provide DC power via moistening by readily available conductive liquids. Generation of DC power is achieved via an electrochemical process that enables the transfer of electrons from Zinc to Silver-printed electrodes (anodes and cathodes), using the conductive liquid as an electrolyte. Flexible inter-connections between several of the aforementioned 'printed' battery cells are also proposed for scaling the generated DC power, per the application requirements. As a proof-of-concept, we demonstrate that voltage and current levels as high as 1.4 V and 10 μA, respectively, can be generated via 'printed' battery cells connected in series. Notably, this combination has been shown to turn 'ON' a digital thermometer's display. Overall, the proposed technology is expected to be of utmost significance for powering electronics in military, healthcare (e.g. electroceuticals), entertainment, arts, sports, and emergency applications, among others.

Student Presenter: Connor Wagner

Booth Number: 94

Research Mentor: Jeff Kuret

Project Title: Toward a More Robust gene expression signature for Alzheimerâ€™s Disease Neurodegeneration

Abstract: There continues to be a need for basic science insight into the Alzheimerâ€™s disease phenotype. One approach to this end involves analysis of gene expression in late-onset Alzheimer's disease (the most prevalent form of AD) relative to non-demented control cases. Previous studies have leveraged this strategy to identify a broad array of biological processes altered in disease. We hypothesize that the approach can be refined by disaggregating expression data on the basis of regional severity, and by better controlling for the variables of sex, age, post-mortem interval, and RNA integrity. Here we test this hypothesis using publicly-available data sets derived from authentic human tissue specimens. Preliminary results identified expression changes in genes related to the glutamatergic neurotransmitter system, including NPTX2 and RhBG, and clarified the relationship between these emerging biomarkers and AD neurodegeneration. Certain neuron populations were also identified as being selectively vulnerable to AD pathogenesis. The results indicate that novel insight into AD neurodegeneration phenotype can be generated by prioritizing expression differences on the basis of regional severity.

Student Presenter: Maggie Wingo

Booth Number: 95

Research Mentor: Jeffrey Parvin

Project Title: Examining Protein Interaction Differences and Phosphorylation in DNA Repair Deficient BRCA1

Abstract: BRCA1, a tumor suppressor protein, is a key factor in DNA repair. Mutated BRCA1 is linked to breast and ovarian cancer predisposition. Using the homology-directed repair (HDR) assay, where DNA repair deficiency has correlated to clinically pathogenic mutations, several mutations were identified in a region of the BRCA1 BRCT domain for which no known protein interactions could explain the loss of function. We hypothesize that there is a novel protein interaction occurring at this region which is lost in the BRCA1 mutants examined. To examine the role of protein interactions in this area of the BRCT domain, BRCA1 A1708V L1786A G1788A (BRCA1 TM) was constructed. The known deleterious amino acid mutations at location 1786 and 1788 (L1786P and G1788V) were changed to alanine to examine whether the repair deficiencies observed in this region were due to more significant protein structure changes. BRCA1 TM repair proficiency was completely eliminated in HDR, further supporting the hypothesis that repair loss is due to protein interaction differences. A BRCA1 fusion protein will be constructed with the biotin ligase BirA for use in the BioID method. BirA-BRCA1 fusion proteins should biotinylate proteins that interact with BRCA1, allowing identification of protein binding differences between wild-type and mutants via mass spectrometry. Wild-type BRCA1 is also known to be phosphorylated after DNA damage. We find that deleterious BRCA1 BRCT mutants do not phosphorylate following DNA damage, leading us to test the hypothesis that all BRCA1 mutants do not phosphorylate post-DNA damage. The phosphorylation of BRCA1 M18T and C61G, mutants located in the BRCA1 RING domain, was examined following X-ray irradiation and results show they are not phosphorylated. This indicates that the lack of phosphorylation appears to be characteristic of all deleterious BRCA1 mutants. This research can help better understand the DNA repair function of BRCA1.

Student Presenter: Maxwell Wisne

Booth Number: 96

Research Mentor: Jack Brangham

Project Title: Spintronics In Epitaxially Growth Y3Fe5O12 (YIG) and Bi2Se3

Abstract: Spintronics, as opposed to electronics, integrates electron spin in addition to the standard electron charge in transistors and memory devices. Manipulating spin requires less energy, can be run at high frequencies, and will lead to novel technologies that can combine memory and logic into a single component. My research aims to investigate how materials with novel spin characteristics behave when they come in contact with magnets in order to ultimately introduce them into spin-based computer hardware. Through a method called epitaxy, where we match the lattice of our deposited material to our crystalline substrate layer-by-layer, we achieve pristine crystal quality and uniformity. Our current project investigates Bi2Se3 grown by molecular beam epitaxy (MBE). Bi2Se3 was recently characterized as a topological insulator; it has an insulating bulk while its surface states are conducting. In order to better understand how this material behaves when placed in contact with YIG – a ferrimagnet with known spin properties – we must first calibrate the growth process. A thickness series of 11 samples ranging from 2 nanometers to 100 nanometers was growth in our MBE chamber. Resistance and x-ray diffraction measurements were taken to verify that the samples were indeed topologically insulating with high crystal quality. The resistivity reading indicated our films were partially topologically insulating, in agreement with reported literature, while the x-ray diffraction confirmed higher crystal quality. These measurements confirm high sample quality and we are ready to grow Bi2Se3 on YIG. Although research is still ongoing, the next step of the project will have ferromagnetic resonance spin pumping measurements performed on the Bi2Se3/YIG bilayer samples with varying Bi2Se3 thickness. The end goal of the project is to come away with a better understanding of how Bi2Se3 interacts with magnets to better estimate its eventual viability in computer technology.

Student Presenter: Emma Wittman

Booth Number: 97

Research Mentor: Devina Purmessur

Project Title: The Effects of L-Lactate on the Microenvironment of the Intervertebral Disc

Abstract: Degenerative disc disease affects >80% of the world's population1, yet current treatments fail to target the underlying disease mechanisms. The intervertebral disc (IVD) is avascular, a nutrient poor environment, and relies on anaerobic glycolysis for nutrition with L-lactate being the main bi-product. L-lactate is passively transported by monocarboxylate transporters (MCTs) throughout the cells3 with MCT1 responsible for L-lactate intake and MCT4 responsible for efflux.2 GPR81 is an L-lactate receptor shown to promote angiogenesis through the release of pro-angiogenic mediator amphiregulin (AREG). Upregulation of AREG increases angiogenesis, a symptom of DDD. Aim 1 of this study is to determine differences in gene regulation of MCT1, MCT4, GPR81, and AREG in response to varying concentrations of L-lactate in nucleus pulposus (NP) and annulus fibrosis (AF) cells. Aim 2 is to determine protein expression of MCT1, MCT4, and GPR81 in healthy and diseased human NP tissue. Bovine tail NP and AF cells were seeded in 3D agarose constructs and treated with varying L-lactate concentrations followed by post-culture qRT-PCR (n=4) and viability (n=6) assays. The viability assay revealed all constructs had >70% viability. QRT-PCR revealed no significant difference in MCT1, MCT4, GPR81 and AREG gene expression. Immunohistochemistry (IHC) was completed on surgical (diseased) and autopsy (healthy) NP tissue to evaluate protein expression of MCT1, GPR81 and MCT4 (autopsy: n=5,7,7 surgical: n=6,7,7 respectively) and showed a significant increase in MCT4 in the surgical tissue (P<0.05), but no significant difference in protein expression of MCT 1 and GPR81. The large variability of the qRT-PCR data may be due to the small n, which is currently being expanded in attempt to decrease variability. The significant difference of MCT4 in NP autopsy and surgical samples suggests upregulation of MCT4 in DDD cells. Since MCT4 is upregulated in these cells, it is a possible target to limit L-lactate efflux.

Student Presenter: Wenbo Zhan

Booth Number: 98

Research Mentor: Kelly Luo

Project Title: Creating 2D material stack structure with transfer methods

Abstract: The study of spintronics is one of the most active field in condensed matter physics. 2D materials like graphene and MoS2 are superior materials widely used in this field. Graphene provides an environment that brings long spin lifetime and long spin diffusion distance. Meanwhile, MoS2 can generate spin polarization easily under polarized light. Although they each have great spin properties, they also have limits. Finding a method to combine their properties to make good use of their advantages while avoid their disadvantages is important in spintronics study. To achieve this, in Dr. Kawakami's lab, one of t important methods that we use is piling up layers of different 2D materials. This kind of stack structure of 2D materials is named Van der Waals heterostructures, because the weak Van de Waals' forces between the atomic layers keep the stacks together. In such a stack structure, the properties of different 2D materials combine and end up having complex functionalities as a whole, which is crucial for the next generation spintronics materials. Transfer is the technique of making such Van der Waals heterostructures. It is a tool thatutilize polymer viscosity to pick up a flake of 2D materialsat the size of several micronsand drop it on top of another micron-size 2D materials with precise position and angle alignment. There are three different types of transfer methods I have learned about – the bulk cleaning method, the polycarbonate (PC) method, and the polymer based dry transfer method. The purpose of bulk cleaning method is to clean up bulk crystals around the 2D flake on the wafer using a propylene carbonate (PPC) film. The PC method uses a PC film to pick up and drop desired 2D flakes. The polymer based dry transfer method is derived from the PC method and is specially used to create hexagonal-Boron Nitride(h-BN) encapsulated stacks, such as h-BN/graphene/h-BN heterostructure, for the study of high-molibity graphene spin transport. The above three transfer methods arethe key processes to fabricate samples for spintronic study in Dr. Kawakami's group.