April 12, 2017

Dear Undergraduate Researchers, Mentors, University Community and Guests:

NC State’s faculty and students strive to solve problems and create opportunities that impact the economic development of North Carolinians, the nation and the world. One annual hallmark of how our land-grant, research extensive university contributes to the greater good of North Carolina and beyond is through the mentored research conducted by our undergraduate students. This value-added undergraduate educational benefit will be showcased at the NC State University Undergraduate Research Symposium, from 10:30 a.m. to 2:00 p.m., on Wednesday, April 12, 2017 at the Talley Student Center Ballroom. Symposium participants will see firsthand how undergraduate students have created knowledge within their discipline and how, as young scholars, they have positioned themselves for advanced degrees and excellent employment opportunities.

We value the support of citizens (through tax dollars), corporate and government partners (through grants) and the support of donors which helps make possible our academic, research and extension initiatives that have made NC State a national research power. That faculty embrace the importance of motivating young researchers in scholarly, independent work is part of the mission we embrace and applaud. We owe a tremendous debt of gratitude to the mentors (both faculty and off-campus scholars within government agencies and industry) for the leadership and guidance they provide our students each year.

Research at NC State is defined as discovery-, inquiry- and creativity-based learning. So, scholarship can and does occur in the laboratory, field, library, studio, and other settings that promote exploration. Whether creating knowledge, investigating controversy, seeking truths, or expressing new visual or performing art forms, our mentors are challenging undergraduate students in promising intellectual work. The results of their labor can be seen firsthand at this hallmark symposium.

Join me in applauding our undergraduate students’ achievements and the mentors who have guided them so well. As in the past, the quality of the students’ work and the experiences of having done it are likely to change their lives forever. We are, indeed, delighted to showcase their work in this Annual Undergraduate Research Symposium.

Sincerely,

Dr. Mike Mullen
Vice Chancellor and Dean
Division of Academic and Student Affairs
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## Exhibit Presentations

### Session 1 - Student Exhibits

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Abstracts
By
Mentor’s College
College of Agriculture and Life Sciences
Poster Number: 109
Solving the CT and PT Domain Structures of Oxoglutarate Carboxylase

Serene Ahmad, Biochemistry, NC State University
Mentors and/or Co-Authors: Robert Rose

Oxoglutarate carboxylase (OGC) is a novel enzyme derived from thermophilic bacteria that fixes carbon dioxide from the environment and transfers it to 2-oxoglutarate, a key intermediate in the TCA cycle. OGC is active at 70°C and is practically inactive at room temperature. The goal is to modify OGC to increase its activity at ambient temperature for applications in biofuels. OGC is a homolog of the well-studied enzyme pyruvate carboxylase, which carboxylates pyruvate instead of oxoglutarate. While the crystal structure of pyruvate carboxylase has been solved, only the biotin carboxylase domain of the multi-domain OGC structure has been determined. The carboxyl transfer (CT) domain of OGC binds oxoglutarate and determines its substrate specificity. The pyruvate tetramerization (PT) domain mediates interactions between CT domains in the OGC complex. The purpose of this work is to clone, purify, and solve the crystal structures of the CT and PT domains of OGC in order to characterize its unique substrate specificity. The CT and PT domain constructs were subcloned into a pET24b vector from artificially constructed linkers using PCR, gel electrophoresis, and bacterial transformation. The CT and PT domains were successfully inserted into the vector as verified by sequence analysis. Future work will include protein purification and crystallization of these domains. Further knowledge of the biophysical characteristics and structure of these domains will allow for future manipulation of the OGC protein and its utilization to increase carbon fixation in plants.

Poster Number: 123
Investigating the Phenotypic Characteristics Resulting from MUM4 Loss of Function in Camelina Sativa Using CRISPR RNA-guided Cas9 Nuclease.

Avery Ashley, Genetics, NC State University
Mentors and/or Co-Authors: Sathya Jali

Camelina sativa is a flowering plant belonging to the family Brassicaceae that is being investigated as a potential biofuel source-crop. The generation of transgenic C. sativa varieties exhibiting increased seed yield and lipid content is being investigated as a way to increase the economic viability of the crop. The focus of this research is to investigate the phenotypic traits of C. sativa that result from a loss of function mutation in the MUCILAGE-MODIFIED-4 (MUM4) gene. MUM4 is expressed in the seed coat epidermis and encodes a UDP-L-rhamnose synthase which is involved in seed mucilage production. Mutation of MUM4 in arabidopsis has been shown to result in reduced mucilage production, structurally altered columnellae, and delayed germination. However, the effects of MUM4 loss of function in C. sativa have not previously been investigated MUM4 loss of function was achieved using a cas9 vector optimized for plant expression in tandem with sgRNA sequences designed to target the MUM4 sequence. The plants were transformed through vacuum infiltration with agrobacterium, and amplicon sequence data from the resulting transformants was used to generate homozygous mutant lines that were analyzed for any resulting phenotypic traits.

Poster Number: 13
Increasing Shelf-Life of North Carolina’s Chocolate Milk by Altering the Degree of Cocoa Powder Dutching

Kendall Barkley, Food Science NC State University
Mentors and/or Co-Authors: Gary Cartwright, Tyre Lanier

North Carolina dairies are experiencing decreased shelf-life (~2 days shorter) of chocolate milk (CM) products in comparison to unflavored milk (UM). This is hypothesized to be caused by added microbial load or some other growth factor contributed by the cocoa added to CM. If the cocoa receives a stronger ‘dutching’ (alkalinization) treatment, shelflife of CM could be extended due to a resulting decreased microbial load/growth factor in the cocoa, and/or by increased pH of the CM induced by the cocoa which will slow lactic acid bacteria growth. To test this hypothesis, pasteurized CM was created at a pilot scale utilizing cocoa powder dutched to three varying degrees, while controlling for other factors (milk source, processing environment, cocoa powder supplier, etc.). The resulting three CM treatments plus pasteurized UM were stored at 3°C for intervals of 1, 7, 14, 21 and 25 days. to determine the end of shelf-life as evidenced by growth in CFU/ml and any shifting in pH to unacceptable levels. Gram stains were performed at these same intervals for identification of microbes possibly involved in the spoilage process. If shelflife of CM can be increased to match that of UM the NC Dairy industry can realize increased profits from a longer-lasting product.
Effects of H3K27me3 on Gene Expression in Muscle Atrophy Model

Hadley Bryan, Genetics, NC State University

Mentors and/or Co-Authors: Christina Valerie Garcia

Myogenesis, the development of muscle cells, is regulated by many interconnected systems. One such system involves epigenetic modification of histone proteins. This results in alteration of expression patterns by remodeling chromatin structure without changing the DNA sequence. The histone modification studied in this experiment, trimethylation of histone 3 lysine 27 (H3K27me3), is a repressing mark made by the Polycomb complex (Asp et al 2011). Multiple proteins act to create a compact chromatin structure preventing binding of RNA polymerase and subsequent gene expression. While this histone modification’s ability to repress expression during muscle cell differentiation is well studied, its role during muscle atrophy is not. Previously, we compared the histone modifications present in undifferentiated, differentiated, and atrophying muscle cells as this could lead to therapies that alter gene expression in patients with cachexia. After finding patterns of fold enrichment in promoter regions modified by H3K27me3, the next step was to explore the effects of these modifications on gene expression. For these reasons, previous experiments were repeated in order to validate the fold enrichment patterns and gene expression was analyzed and compared to these fold enrichment trends. This will help determine if the histone modification is sufficient to cause changes in gene expression in undifferentiated, differentiated, and most importantly atrophied C2C12 cells.
Poster Number: 85
Functional characterization of the putative effector protein, MGG_09842, in the rice blast fungus, Magnaporthe oryzae.

Elizabeth Carter, Microbiology, NC State University

Mentors and/or Co-Authors: Yeonyee Oh

Fungi have evolved to cause devastating diseases of plants and animals that frequently result in huge economic losses and human suffering. The rice blast disease, caused by Magnaporthe oryzae, is the most destructive disease of rice worldwide. This disease also infects other agricultural cereals, such as barley. To understand the mechanism of pathogenicity and to develop an effective way to control this disease, we functionally characterized the putative effector protein, MGG_09842, using direct gene knock out. As a small secreted protein, MGG_09842 was highly expressed during fungal infection, and the protein expression was only detected under nutrient stress. A MGG_09842 knock out mutant was generated by performing fungal transformation using a hygromycin resistance gene-containing knock out construct. We tested the fungal growth, sporulation, and pathogenicity of the MGG_09842 knock out mutant and compared them to those of wild type and ectopic strains. Currently, we have not identified significant differences among these strains during vegetative growth, sporulation, and infection into barley plants. This suggests the MGG_09842 protein may not have an important role in fungal infection, or it may work as an avirulent factor to resistant host plants. We will continue to investigate the role of this protein, including cellular localization and pathogenicity in diverse rice varieties.

Poster Number: 11
Structural characterization of heat activated transcription coactivator MBF1c

Shannon Conroy, Biochemistry, NC State University

Mentors and/or Co-Authors: Colleen Doherty

Heat stress on plants plays a large role in crop yields and agricultural productivity. Due to global temperatures rising 1 degree Celsius in the past 30-40 years, there have been significant decreases in crop yields. For example, in rice, a 1 degree Celsius increase in nighttime temperatures has been shown to cause a 10% decrease in yield. With a rapidly growing population, understanding plant responses to heat stress is essential for supporting the food supply for future generations. Multiprotein bridging factor 1c (MBF1c) is a transcriptional coactivator that is involved in regulating gene expression levels in response to heat.

Overexpression of MBF1c in Arabidopsis results in an increased heat tolerance while MBF1c plant knockouts show heat sensitivity. MBF1c is known to interact with the TATA box binding protein (TBP), which is an important protein involved in initiating transcription. The interaction of MBF1c and TBP, as well as other binding factors is still not fully understood. Decoding MBF1c’s role in the transcription initiation complex will give us insight into its function as a transcriptional regulator in response to heat stress. I will be using X-ray crystallography to determine the structure of MBF1c.

Poster Number: 105
Evaluating off-site migration of arsenic from MSMA into sod farm pond systems

Sarah Dance, Environmental Science, NC State University

Mentors and/or Co-Authors: Matthew Polizzotto

Monosodium methanearsonate (MSMA) is a common organic arsenical herbicide used to control weeds on sod farms. Under certain environmental conditions, MSMA can be converted to highly toxic inorganic forms of arsenic (As). This research aims to examine and quantify arsenic accumulation in sod farm pond systems following MSMA use. Soil cores from sod fields, pond sediment cores, sediment pore water, and pond surface water samples were collected over time and evaluated for their arsenic concentrations. Samples from areas of MSMA use were compared to those from background areas where MSMA had not been sprayed. Soil field cores had elevated levels of As, especially right after spraying, at the surface but gradually decreased with depth. All surface water samples had As concentrations well below the drinking water As standard, but many pond pore water samples adjacent to sprayed fields had elevated levels of As. Some pond sediment cores showed elevated As concentrations, as compared to background cores, at the surface, whereas others showed normal As concentrations throughout their profiles. These results suggest that there has been no- to- minimal off-target As movement following MSMA use within the studied systems. Future work will evaluate As speciation, retention and concentration gradients.
Analysis of Fatty Acid Profiles in Eastern Box and Common Snapping Turtles for Wild and In-Human Care Environments

Khushboo Dass, Animal Science, NC State University
Mentors and/or Co-Authors: Kimberly Ange-van Heugten, Liz Koutsos, Jb Minter

The diets of wild animals are often more diverse and offer higher levels of nutrients than those of animals’ in-human care (zoos, rehabilitation facilities, etc.). Managing wild animals within human care facilities is often necessary, and we hypothesized that chelonian dietary differences within circulating fatty acid profiles would be reflected in wild vs human care data. The current study examined the effect of species and environment on fatty acids concentrations in two omnivorous species of native North Carolinian chelonians within two environments: Eastern Box Turtles, Terrapene Carolina Carolina, and Common Snapping Turtles, Chelydra serpentine, located in the wild and kept in-human care for up to 6 weeks. A drop of whole blood was collected on spot cards to analyze all 26 fatty acids in a total lipid fatty acid profile. This novel research indicated that snapping turtles have significantly (P<0.05) higher values of Linolenic acid, Dihomo-γ-Linolenic acid (DGLA), Tetradecanoinic acid, Docosatrienoic acid (DTA), Docosapentaenioic acid (DPA), Eicosadienoic acid, Erucic acid. Among all the wild animals, there tended (P<0.06) to be higher values for α-Linolenic acid, DGLA, Arachidonic acid, Eicosadienoic acid, Eicosatrienoic acid, DPA, and DTA. Docosanoinic acid, DTA, DPA, Eicosadienoic acid, and Nervonic acid showed significant (P<0.01) differences via species*environment interactions. This research may allow us to better formulate diets for chelonian kept in-human care. Additionally, fatty acids are used for many important body functions including proper immune system usage and therefore our research provides new biologically important data for the reptile diagnostic field.

Development of Extreme Food Makeover Challenge Video Tutorial for Nutrition Educator Training

Abigail Denny, Applied Nutrition, NC State University
Mentors and/or Co-Authors Natalie Cooke

Nutrition education is an important part of helping teens build a healthy life. Cooking Matters is a national, hands-on cooking and nutrition education program. Within the Cooking Matters for Teens curriculum is an Extreme Food Makeover Challenge (EFMC) that uses friendly competition to encourage teens to make their favorite dishes healthier. This curriculum is used in NTR 420: Applied Nutrition Education to teach college students to be nutrition educators in the community. NTR 420 is a service-learning course that includes a pre-service-learning training during the first half of the semester to enhance students’ skills and self-efficacy as nutrition educators. Students then teach the 6-week long Cooking Matters class in the community. Our research goal was to develop a new video training module for the pre-service-learning training to guide students to implement the EFMC in their lessons. We used discussion with former students and videos of past classes to determine best practices and compile tips for future teachers. The training module was created with week-by-week videos and compiled into a YouTube playlist for easy access for the students. At the end of each video is a list of key points for the students to remember when implementing the EFMC in the community. Students used the module to prepare lesson plans, and at the end of the semester, we will determine the impact of the module through community observations and end of semester in-class focus groups. Feedback will be used to make edits to the original module for future use.

The Impact of Initial Bacillus subtitles Concentration on the Shelf life and Microbiological Quality of Milk.

Savana Everhart, Food Science, NC State University
Mentors and/or Co-Authors: Tyre Lanier, Gary Cartwright

The shelf life of milk can be traced back to the farm as a result of the milking process taking place in an open environment that could potentially be the home to many microorganisms. Pasteurization kills most of these microorganisms; however, sporeformers are vegetative cells that can sporulate to survive pasteurization. Bacillus subtilis is a very prevalent spore former in milk that produces fairly robust spores. Studying the survival of these spores will give an insight to the potential for spores of this species to contribute to the end of milk shelf life. Known concentrations of these spores will be inoculated into milk to perform this analysis. Industry imitated pasteurization of the inoculated milk will provide data on the effective lethality on spores of this species. The inoculated milk will then be held under typical refrigeration temperatures, 7°C, and the shelf life will be determined once it exceeds the microbial shelf life threshold. Results from this study will provide a better understanding to this prevalent organism’s ability to contribute to end of shelf life.
Considering research of this organism's contribution to shelf life has not be extensively studied in milk, this research will fill in knowledge gaps in literature about milk shelf life.

Poster Number: 9
Optimal Bacterial Concentration for Raw and Pasteurized Human Milk Samples for Lysozyme Assay
Jenna Freda, Biology, NC State University
Mentors and/or Co-Authors: April Fogleman
Donated human milk is ideal for preterm infants or infants whose mothers cannot produce their own milk. Donated milk is pasteurized and screened for pathogens before it is given to infants to ensure the safety and to reduce the bacterial load of the milk. Often times, this milk is not used right away and stored in milk banks until needed. It is important to study the effects of processing variables and different storage conditions on the components of human milk to determine the optimal storage conditions and the nutrient activity of the milk over time. An important bioactive immune component to monitor after pasteurization is lysozyme, which catalyzes destruction of cell walls of certain bacteria. Lysozyme can be studied through the 96-well turbidity assay method, which measures the changes in turbidity of a microbial suspension of *micrococcus lysodeikticus* to determine the concentration of lysozyme in the sample. As the lysozyme lyses the bacterial cell wall, the turbidity will decrease, which can be quantified by measuring the change over time. The lysozyme assay for raw milk and pasteurized milk are performed with different bacterial concentrations. While it is preferable to run the assay with only raw samples or only pasteurized samples, in reality, samples that need to be analyzed for lysozyme in a lab setting or in a milk bank may prompt analysis of both raw and pasteurized at once. The objective of this project is to find an optimal bacterial concentration of *micrococcus lysodeikticus* for both raw and pasteurized samples.

Poster Number: 32
An Evaluation of Food Safety Risk Behaviors During Consumer Pork Preparation in the Home
Eleanor Frederick, Food Science, NC State University
Mentors and/or Co-Authors: Benjamin Chapman, Tyre Lanier
Risky handling of raw pork, such as improper hand washing and insufficient surface decontamination, can increase consumer risk of contracting *Toxoplasma gondii* and developing toxoplasmosis, which can be fatal to individuals who are highly susceptible to foodborne illness. The purpose of this research is to observe food preparation behaviors surrounding consumer preparation of pork in the home and create a standardized method of behavioral coding for future researchers to use. The research group will observe the handling and preparation behaviors of five different primary meal preparers in their homes with a pork product that will be provided by the group. Researchers have developed a standardized codebook and participated in an inter rater reliability test with a target Cohen’s kappa of 0.9 to begin data collection. Notational analysis will be used to determine the most common risk behaviors associated with preparation of raw pork. The researchers will recruit for study participants using flyers posted in public libraries and parks. Exclusion criteria for participants will include pregnant, elderly, children, and immunocompromised individuals. Participants will not be aware that their handling procedures of raw pork are being observed until a post-event debriefing session. As part of the debriefing, a survey will be administered to determine previous knowledge of food safety practices and perception of risks. Data on actions (both risk reducing and increasing) will be analyzed using descriptive statistics. Quantitative and qualitative data generated from post-observation debrief will be analyzed using content analysis and pairwise comparisons with existing public datasets.

Poster Number: 51
Distinguishing between two aspartic enzymes, with similar - but different - nucleotide sequences, present during oocyte growth in teleost fishes.
Shelby Gandee, Zoology, NC State University
Mentors and/or Co-Authors: Benjamin Reading, Scott Salger
Egg yolk precursors called "vitellogenins" are taken up from the blood by growing oocytes in the ovaries of female fish and then processed into yolk proteins by aspartic proteases called "cathepsins". Selective degradation of yolk proteins into free amino acids by cathepsins contribute to an osmolyte pool, which drives hydration for egg buoyancy and additionally provides diffusible nutrients critical for early embryonic nutrition. Three complementary DNA (cDNA) sequences encoding cathepsin D (catD) or cathepsin D-like enzymes were sequenced from striped bass (*Morone saxatilis*) ovary. One of these (contig09415) was full-length and the other two (contig07987 and contig02885) were partial length encoding the carboxy- or

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amino-terminal ends of the protein(s), respectively. The partial proteins encoded by contig07987 and contig02885 shared 37.0% and 61.6% amino acid identity with contig09415, respectively, thus there appears to be multiple variants of catD-like enzymes expressed in striped bass. Contig07987 and contig09415 shared a high degree of sequence identity with catD sequences from other fish species, whereas contig02885 had greater identity with a different type of aspartic protease called “napsin”. A protein dendrogram based on ClustalW alignment of known catD and napsin sequences from several fish species also indicates at least two major groupings of aspartic proteases. Therefore, at least two forms of aspartic proteases (catD and napsin) are expressed in striped bass ovary and may be involved in yolk processing of fishes. Further research will be directed at understanding how these genes are expressed in the ovary and if their expression correlates to egg fertility.

Poster Number: 70
**Understanding Pollen Tube Formation Through the Interactions of LUREs and MDIS-1,2**

*Savan Gandhi, Biochemistry, NC State University*

**Mentors and/or Co-Authors:** Guozhou Xu, Sayan Chakraborty

In flowering plants, during fertilization, the sperm containing pollen grains make contact with the stigma of the female plant. Once the pollen grain attaches to the stigma, a pollen tube is formed to transport the sperm to fertilize the eggs in the ovules of the female plant. The mechanism of pollen tube formation is still an unknown phenomena. There seems to be a general consensus that the cysteine rich peptides LUREs produced by the synergid cells of the ovule and its cognate receptor protein kinases: Male Discoverer 1 (MDIS-1), Male Discoverer 2 (MDIS-2), MDIS-1 Interacting Receptor (MIK-1) and MDIS-2 Interacting Receptor (MIK-2) play crucial roles in this process. Our objective is to determine the biophysical and chemical interactions between LUREs and its receptors to guide the formation and development of the pollen tube. The structures of the proteins alone and in complex with the ligand Lure will elaborate their interaction mechanism and shed light to its downstream signaling processes. We expressed LUREs, MIK1, 2 and MDIS1, 2 in BaculoVirus mediated Insect cells that are purified by Nickel and gel filtration chromatography. We have obtained relatively pure, soluble, and homogeneous proteins and crystallization trials are in progress. The structural elucidation of these proteins and protein complexes will give insight to their functions and allow us to further understand the mechanism of sexual reproduction in flowering plants.

**Keywords:** LURE, Pollen tube, signaling, crystallization

Poster Number: 72
**LRR-RLK Signaling Involved in Pollen Tube Formation through Pollen Receptor Kinases**

*Jerrin Gause, Biochemistry, NC State University*

**Mentors and/or Co-Authors:** Guozhou Xu

Sexual reproduction in flowering plants require the formation of a pollen tube to initiate fertilization. Pollen tubes serve as a pathway for sperm to reach the female flowering organ to fertilize the egg. Cysteine rich AtLURE1 peptides which is expressed in synergid cells act as chemoattractants and play an important role in pollen tube formation. Recently, it has been discovered that Pollen Receptor Kinases (PRKs) specifically PRK6 and PRK3 perceive the AtLURE1 peptides and are involved in the cellular signaling process that leads to the pollen tube formation. PRKs fall under the category of Leucine Rich Repeats Receptor Like Kinases (LRR-RLKs) that form the largest receptor like kinase family in *Arabidopsis thaliana*. The purpose of this research is to characterize the structural mechanism of AtLURE1-PRKs (PRK3,PRK6) interaction, downstream signaling cascade and how it helps in the pollen tube formation. So far, we have successfully expressed and purified the extracellular domains of the PRK3,6 and AtLURE1 peptide in baculo-virus mediated insect system and crystallization trials are in progress. This research will not only broaden our overall understanding of pollen tube formation, but also about LRR-RLKs and their involvement in different cellular processes in plant body.

Poster Number: 109
**Paenibacillus larvae phage-host interactions examined by PCR**

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**Mentors and/or Co-Authors:** Eric Miller, Adam Groth

*Paenibacillus larvae* is the causative agent of American Foul Brood (AFB), a serious bacterial disease affecting honeybees. Multiple bacteriophages that infect this bacterium have been isolated; however, their interactions with the host are not well characterized. The goals of this work are to evaluate the kinetics of phage infection and, ultimately, to determine the expression pattern of phage and bacterial genes during the infection

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cycle. This will lead to a better understanding of virus-host interactions. *P. larvae* strain ATCC 9545 and *P. larvae* NW6 (a wild-type strain isolated from North Wilkesboro, NC) was used with bacteriophages Sitara (infests strain 9545) and Mock2 (infests strains 9545 and NW6). The time frame in which the phage bind to their host is determined by quantifying the amount of free phage remaining in solution, and identifying whether phage DNA is present within the bacteria, after infection. To measure the presence of phage DNA in the bacterial cells, PCR is performed on pelleted cells from an infected culture using phage-specific primers. Primer pairs amplifying three distributed regions of the Sitara genome have been designed for this detection. These findings will improve our understanding of phage-host interactions, and may augment the use of bacteriophages to treat this disease in the future.

**Poster Number: 79**

**Effect of culture medium on growth and gene expression in the plant pathogen Mycosphaerella fijiensis**

Andrew Green, Plant Biology, NC State University  
**Mentors and/or Co-Authors:** Margaret Daub, Elizabeth Thomas

The purpose of this research was to determine if the nutrient composition of culture media will influence gene expression or growth rate in cultures of *Mycosphaerella fijiensis*, fungal pathogen of bananas. Currently, researchers in the lab are studying clusters of polyketide synthase (PKS) genes in the *M. fijiensis* genome that code to produce polyketide metabolites that may be essential for infection of banana by *M. fijiensis*. The PKS family of genes are found throughout the Mycosphaerellaceae family and recognized as important for infection. Previous work in the lab identified eight potentially significant PKS gene clusters, with three, called 7-1, 8-2, and 10-2, of interest because they are expressed during colonization and disease development. These genes have been difficult to study because they have not been observed to be expressed in *in vitro* culture. This project tested several types of media to determine if medium composition would induce PKS gene expression. The effect of light was also tested by growing cultures in both complete darkness and under 12 hours of light. By RT-PCR analysis, I identified culture conditions that induced expression of the 10-2 and 8-2 clusters, however cluster 7-1 was not expressed under any condition tested. The study also found that cultures of *M. fijiensis* grow more rapidly if exposed to light and on media containing malt and yeast extract. The results of this work are being used to evaluate the utility of gene silencing strategies to suppress the production of these compounds as a possible mechanism of disease control.

**Poster Number: 90**

**Tracking 19th century late blight from archival documents using text analytic tools**

Rachael Guenter, Chemical Engineering, NC State University  
**Mentors and/or Co-Authors:** Jean Ristaino, Laura Tateosian

In the year 1845, Ireland was struck by an unforeseen disaster. A plant disease that killed the potatoes led to mass starvation throughout the country for seven long years. The cause of the potato destruction was due to the plant pathogen *Phytophthora infestans*, causal agent of late blight. Currently, there are several theories about the origin of the pathogen and how the disease spread globally to cause outbreaks. U.S. agricultural reports from the mid-1800s contain extensive discussions of crop yields and failures, seed export and import, and weather conditions, along with location names. The reports contain some tables, but the vast majority of key geospatial information pertaining to the disease is found within voluminous unstructured (natural language) descriptions. The length of the texts prohibits manual inspection, so we used natural language processing tools to automate text mining. Specifically, we used text analytics tools from the Natural Language ToolKit (NLTK) with place name and geographic coordinate extraction from Berico’s CLAVIN geoparser. These were coupled to mine the relationships between locations and instances of potato disease. NLTK also exploited key characteristics and frequencies found in the text to create connections between geographic locations and an interactive Web mapping tool, GazeGIS, was used to visualize and explore geographic findings. Relevant information is being extracted on early descriptions of the disease, its severity, cause, locations of outbreaks, as well as methods of control. At the current time, collocations and maps are being analyzed for trends and information about 19th century late blight.

**Poster Number: 75**

**Phospholipid Extraction from Cocoa Butter for Replacement of Soy Lecithin in Dark Chocolate**

Micaela Hayes, Food Science, NC State University  
**Mentors and/or Co-Authors:** Gabriel Harris
The emulsifier, soy lecithin, commonly found in chocolate bars deters consumers who are looking for soy-free and clean-label products. Creating an ingredient made of phospholipids naturally found in cocoa butter to replace the emulsifying function of soy lecithin has been deemed feasible because of their similar functionality. A 100% ethanol extraction method separated a crude mixture of phospholipids from cocoa butter. The presence of phospholipids was confirmed by TLC and spectrophotometric analyses. Chocolate manufacturers are most interested in an emulsifiers ability to reduce viscosity and yield stress during the conching phase to reduce the mechanical effort needed during processing. Thus, functionality of the cocoa butter extract was assessed by measuring viscosity and yield stress of liquid chocolate made of cocoa powder, cocoa butter, sugar, and cocoa butter extract. The results were compared to the viscosity and yield stress of two control liquid chocolate mixtures: one with soy lecithin, and another with no emulsifier. It is anticipated that there will be no significant difference between the experimental and control chocolate bars. Upon successful use of cocoa butter extract, manufacturers will be able to process chocolate of the desired viscosity and yield stress, and consumers will be provided a cleaner label and soy-free chocolate bar.

Poster Number: 60
Improving the Self-Efficacy of Instructors Conducting Cooking Matters for Teens and Kids Pop-up Tours
Nora Holmes, Applied Nutrition, NC State University
Mentors and/or Co-Authors: Natalie Cooke
Community-based nutrition intervention programs provide children with skill sets to make healthy decisions and sustain a healthy lifestyle. Due to a deficit in grocery store literacy programs, a pop-up grocery store tour was developed by Cooking Matters, a national nutrition education program, to bring the grocery store to the classroom to educate community participants about making healthy grocery store purchases on a budget. The purpose of this project was to adapt the pop-up tour, which was designed for adults, so it could be used with children and teens. Assessment of previous nutrition education literature coupled with feedback from nutrition educators and former pop-up tour instructors were combined to determine age-appropriate modifications to the curriculum. Two supplemental instructor guides, one for kids and one for teens, were developed. The pop-up tour for kids instructor guide focuses on teaching kids how to help their guardians select healthy food when grocery shopping. The teen instructor guide focuses on encouraging teens to select healthy foods while on a budget. Both guides emphasize selecting foods low in fat, sugar, and sodium, while also selecting whole grains. An accompanying training video was developed. Students in NTR 420: Applied Nutrition Education course utilized these resources to create a lesson plan. Students tested the lesson through an in-class mock lesson before implementing in the community. Once students implement their lesson in the community, the effectiveness will be determined through community observations and in-class focus groups. Feedback will be used to determine future modifications before sharing with community partners.

Poster Number: 104
Can you Outsmart the Rain?
Ethan Jordan, Ag Business, NC State University
Mentors and/or Co-Authors: Julianne Treme
Rainfall has been a growing concern in agricultural production. Farmers have begun using irrigation systems to ensure a steady amount of water is available for agricultural crops. This study examines whether the irrigation system installed on a North Carolina family farm guards against drought and contributes to an upward yield trend. The data began in 2005, a point at which the farm was 100 percent under irrigation. Regression analysis was used to determine the factors that affected the yield of the soybeans. The results suggest that the irrigation system is effectively supplying the crops with an adequate water supply during periods of inadequate rainfall.

Poster Number: 56
Determining the Chromosome Number and Genome Size of Selected Isolates of Bemisia tabaci
Suzanna Kafer, Biochemistry, NC State University
Mentors and/or Co-Authors: Jose Ascencio-Ibanez
Bemisia tabaci, commonly known as the whitefly, is an agricultural pest that is the vector for many viruses that affect crops worldwide. There are many biotypes of B. tabaci, but there is no easy way to identify particular biotypes, because little is known about the demarcation of each biotype. The goal of this
investigation was to determine the genome size of select isolates of B. tabaci, in order to learn more about the demarcation of species. To analyze the genome size, salivary glands were removed from B. tabaci nymphs to determine the size of the isolates’ genomes using microscopy. A dissection method was developed using Drosophila melanogaster larvae, and then the method was applied to whitefly nymphs. Three salivary glands were retrieved from the whitefly nymphs that were dissected. Salivary glands were stained using propidium iodide and viewed under a light microscope, but the smallest structures identified were nuclei, and no chromosomes were seen. There are future plans to use flow cytometry to determine genome size of isolates.

Poster Number: 58
Impacts of natural transformation on dissemination of antimicrobial resistance in Campylobacter spp.
Jack Kittrell, Biological Sciences, NC State University
Mentors and/or Co-Authors: Sophia Kathariou
Campylobacter is a leading bacterial foodborne pathogen, infecting millions annually. Infections are typically caused by two species, Campylobacter jejuni and Campylobacter coli, found in poultry, cattle, and pigs. Certain strains are resistant to multiple antimicrobials, including quinolones, gentamicin, and erythromycin. Campylobacter develops these resistances through mutation or acquisition of resistance genes via horizontal gene transfer. Antimicrobial-resistant Campylobacter has been named a high priority for both the WHO and the CDC. The dissemination potential of antimicrobial resistance (AMR) among Campylobacter strains via transformation (update of naked DNA) was investigated. DNA from two multidrug-resistant Campylobacter strains was used as donor for a panel of seven recipient strains. Donor DNA was extracted into solution using Qiagen DNeasy protocols. Recipient colonies were mixed with 5 µL of DNA solution and incubated for 24 hours. Recipients were inoculated onto nalidixic acid (quinolone), gentamicin, and erythromycin plates. After 48 hours incubation, the plates were observed for growth. Of the seven tested recipients, five (two from turkeys, one bovine, and two reference strains) transformed readily to quinolone, gentamicin and erythromycin resistance. Transformation occurred more readily for quinolone resistance, followed by gentamicin and erythromycin. Some recipients exhibited pronounced lysis upon transformation, with zones of clearing on the antibiotic plates. Genome sequencing of these strains is being pursued to analyze phages or other determinants contributing to this lysis. These findings have important implications for AMR dissemination in Campylobacter. Antimicrobial-resistant strains create significant challenges in animal agriculture and compromise effective treatment of human campylobacteriosis, thus increasing overall disease burden.

Poster Number: 122
Elucidating the Release of Arsenic from Cambodian Sediments into Aquifers
Markus Koeneke, Environmental Technology and Management, NC State University
Mentors and/or Co-Authors: Matthew Polizzotto
Arsenic (As) is a naturally occurring contaminant in Cambodia that has been contaminating well-water sources and poisoning millions of people. Typical studies look into the biotic factors that cause the arsenic to be released from aquifer sediments to groundwater. However, abiotic release of As from sediments, though little studied, could also play a key role in As contamination of well water. The goal of this research is to quantitatively compare organic-carbon mediated abiotic and biotic release of arsenic from sediments to groundwater. Batch anaerobic incubation experiments under abiotic and biotic conditions are being conducted using Cambodian aquifer sediments, four different organic carbon sources, and six different carbon concentrations. Dissolved arsenic concentrations in the treatments are being measured over time through 112 days of incubations. Carbon mass balance is being assessed by measuring the sediment carbon and total and inorganic carbon for the solution. Collectively, these results are expected to show how different carbon sources, different carbon concentrations, and how abiotic and biotic factors impact the release of arsenic from Cambodian sediments into aquifers.

Poster Number: 115
Adapter to Transform a Paintball Gun into a Particle Accelerator/Gene Gun
Chris Kulp, Biochemistry, NC State University
Mentors and/or Co-Authors: Jose Ascencio-Ibanez
Particle acceleration is a method widely used for plant transformation and for virus delivery. We developed an adapter to take advantage of the paintball gun Tippman 98, which makes the delivery much cheaper while still providing with the particle acceleration needed for virus delivery. We tested the pressure produced by
the Tippman 98 and inoculated arabidopsis plants with the Cabagge leaf curl geminivirus. We obtained 100% inoculation with the amount of DNA used. We showed the presence of the virus by symptoms and by DNA purification and a Southern blot using a probe against the viral genome. We will next test the ability of the device to transform arabidopsis and other plants.

Poster Number: 95
**Yeast-2-Hybrid Assay Hit Prioritization Using Correlated Expression and Text Mining**  
**Jacob Lasky**, Biochemistry, NC State University  
**Mentors and/or Co-Authors:** Colleen Doherty

Yeast-2-Hybrid screening (Y2H) is a technique used to discover physical protein-protein interactions. The interaction between the bait protein and a library of other proteins is measured using a reporter system. A recent advancement in Y2H analysis has lead to the development of arrayed transcription factor libraries which allow for rapid characterization of interactions between bait proteins of interest and potential transcription factor targets. These data require extensive analysis to capitalize on the experiment, so a tool was created to accomplish this task. The tool involves analyzing the raw data for outliers and normalizing the values to generate a list of likely protein interactors with the bait. After these positives are generated, they are further evidenced by using correlated expression and protein-protein interactions. After running the tool, users are able to filter the results to determine which proteins should be picked to be their next step for further experimentation. This tool will help with choosing the top candidates to enable the most efficient allocation of resources and quickest generation of results.

Poster Number: 47
**Four Quaternary Ammonium-Based Disinfectants Show Limited Efficacy for Inactivation of Human Norovirus GII.4 Sydney**  
**Emma Lepri**, Microbiology, NC State University  
**Mentors and/or Co-Authors:** Lee-Ann Jaykus

Human norovirus (HuNoV) is a highly infectious foodborne pathogen that is difficult to inactivate even upon exposure to sanitizers and disinfectants applied under recommended use conditions. Quaternary ammonium compounds (QACs) are one such disinfectant category, but there is limited evidence of their efficacy against HuNoV. HuNoV GII.4 Sydney positive stool, a cultivable surrogate Tulane virus (TuV) cell culture lysate, and GII.4 virus-like particles (VLPs) were used to characterize the efficacy of four commercial QACs. Virucidal suspension assays were conducted using exposure times of 5, 10, 20, and 30 min. Analysis of degree and mode of GII.4 HuNoV inactivation was evaluated using a combination of RT-qPCR with RNase pre-treatment and SDS-PAGE. Analysis of TuV infectivity was done by plaque assay using LLC-MK2 cells. RT-qPCR assay results showed limited reduction in HuNoV genome copies after up to 30 min exposure to QAC4, and even less reduction with QACs 1 through 3. QAC4 was therefore chosen for additional screening with TuV and GII.4 VLPs. Though limited reduction was seen after exposing TuV to QAC4, infectivity was eliminated at time points beyond 5 minutes. SDS-PAGE of HuNoV VLPs exposed to QAC4 for up to 30 min showed minimal capsid damage, suggesting mechanism of action is not peptide bond cleavage. Collectively, this study demonstrates limited efficacy of QACs against HuNoV, but greater sensitivity of the TuV surrogate. Consistent with currently held beliefs, the QACs evaluated here would have only partial utility for HuNoV inactivation, at least given the currently available evaluation methods.

Poster Number: 149
**Testing Peptide Aptamers to Reduce Severity of Cabbage Leaf Curl Virus Infection in Arabidopsis**  
**Ryan McDonald**, Biochemistry, NC State University  
**Mentors and/or Co-Authors:** Jose Ascencio-Ilanaz

Cabbage Leaf Curl Virus (CaLCuV) is a bipartite Begomovirus that uses whiteflies as a vector to infect the plants from the Brassicaceae family. Crop damage by CaLCuV and other geminiviruses has resulted in significant economic impact to agriculture, making it important to find an effective resistance strategy to combat infections. Previous research has shown that peptide aptamers can bind to replication proteins in geminiviruses and inhibit their function, decreasing the viruses’ ability to replicate their genome. The purpose of this research was to individually insert a number of promising aptamer sequences into pCPCbLCV.007 (007) so that the impact of the peptide aptamers on the virulence in Arabidopsis thaliana could be assessed. In-fusion cloning will be used to insert aptamer sequences into 007, after which, mature A. thaliana plants will be inoculated. The symptoms and viral load in plants inoculated will be compared to the
empty 007 vector. Aptamer sequences that resulted in a decrease in virulence will then be selected and combined to generate transgenic plants and test for geminivirus resistance.

Poster Number: 13
The Pla-1 Arabidopsis ecotype shows resistance to the economically important Tomato yellow leaf curl geminivirus

Alexandra Moyer, Biochemistry, NC State University
Mentors and/or Co-Authors: Jose Ascencio-Ibanez

Geminiviridae is a family of single-stranded, circular DNA viruses affecting plants. These viruses replicate in the nuclei of infected cells and are a serious threat to crops in tropical and subtropical areas of the world. A previous study has found that the Pla-1 ecotype of the model plant Arabidopsis thaliana shows immunity to two different geminiviruses, Cabbage leaf curl virus (CaLCuV) and Beet curly top virus (BCTV). Recent reports show that Tomato yellow curl virus (TYLCV, the most economically important geminivirus) is able to infect Arabidopsis thaliana Col-0 (the most widely used ecotype). To determine if the immunity found in the Pla-1 ecotype was extended to the TYLCV, we tested A. thaliana, Col-0, Pla-0, and Pla-1. All plants were agroinoculated with TYLCV. Because symptoms of TYLCV in A. thaliana Col-0 are mild and difficult to score, to determine if the virus replicated within the plant, total DNA was purified from each plant and digested with SacI that cuts a single time in the viral genome. Digested DNA was then subject to a Southern blot hybridization analysis to determine if the DNA from the plants included TYLCV. Results suggest that Pla-1 is not infected by the TYLCV, while Pla-0 and Col-0 both are. For future research, studies are being conducted now to uncover the gene or genes responsible for encoding the immunity of Pla-1 to geminiviruses.

Poster Number: 48
Optimization of a Method for the Determination of S-phase Duration in Legumes

Patrick Mulvaney, Biochemistry, NC State University
Mentors and/or Co-Authors: William Thompson

The synthesis phase (S-phase) of the cell cycle occurs when cells replicate their genomes in preparation for mitotic cellular division. An accurate estimation of S-phase duration in plant cells is important for further research into replication timing programs as well as the relationship between S-phase duration and genome size. The method I present for S-phase duration estimation was tested upon several species of the Fabaceae family (legumes), all representing a wide range of genome sizes: fava beans (Vicia faba), pea (Pisum sativum), lentil (Lens culinaris), alfalfa (Medicago sativa), and chickpea (Cicer arietinum). This method consists of a 30-minute pulse-labeling of root tips with 5-ethyl-2’-deoxyuridine (EdU), a halogenated thymidine analog which outcompetes thymidine during DNA replication, incorporating itself into the labeled DNA. Nuclei were then isolated from the labeled root tips and analyzed using bivariate flow cytometry. The profiles generated through this method of analysis can be used to estimate S-phase duration when root tips are labeled at several time points. However, legumes present a unique set of challenges that were countered through various protocol tweaks meant to enhance EdU uptake and increase the population of mitotic cells during labeling. The results between species showed varying levels of success.

Poster Number: 66
Evaluation of Knife Skills Training Module for Nutrition Education Course

Rachel Norris, Biochemistry, NC State University
Mentors and/or Co-Authors: Natalie Cooke

Knife safety is a key concept in cooking and nutrition education. The Applied Nutrition Education service-learning course at NC State University involves an 8-week pre-service-learning training course where students learn and practice nutrition education skills, including knife safety, before teaching a cooking and nutrition education course in the community. We developed a knife skills training module to prepare students to properly use and teach safe knife techniques in the community. The purpose of this study was to evaluate the effectiveness of the module in preparing students to properly use and teach safe knife technique. The study utilized both quantitative, skills-based assessments and qualitative, in-depth, individual interviews. Students were asked to demonstrate cutting three vegetables while a research team member assessed the students’ skills on an evaluation ranking scale. After the knife skills evaluation, the researcher conducted a post-assessment interview, using a standardized interview guide. This procedure was repeated after a 2-3 week period, during which the experimental group was asked to practice and complete the training module at home and the control group was asked to practice, but was not provided the module.
Preliminary qualitative analysis of interviews revealed 3 initial themes: (1) Varying Definitions of Safety, (2) Terminology as a Barrier for Proper Skills, and (3) Self Efficacy Not Always Linked to Skill. Two preliminary observations from skills assessments include: (1) Selective Memory of Module Components and (2) Improvement in Technical Skills in Experimental Group. In-depth qualitative analysis and statistical analysis will be conducted after saturation is reached.

Poster Number: 86
Assessment of key genes in Cercospora nicotianae that encode resistance to cercosporin
Blake Oakley, Plant Biology, NC State University
Mentors and/or Co-Authors: Margaret Daub, Elizabeth Thomas

Cercospora is an assexual genus of fungi that includes more than 600 species, some of which can cause economically important diseases in a range of different host plants, including cash crops like coffee and corn. Infection by Cercospora species results in loss of photosynthetic capacity and causes reductions in yield. Many species of Cercospora, including Cercospora nicotianae, causal agent of the frog-eye leafspot disease of tobacco, produce a photoactivated perylenequinone toxin, cercosporin, which kills plant cells through the production of reactive oxygen species (ROS). Cercospora fungi are resistant to cercosporin and thus have served as a model for understanding cercosporin resistance mechanisms and for identifying resistance genes that may be useful in engineering cercosporin and disease resistance in host plants. The goal of my work was to investigate two different transporters, ATR1 (ABC transporter) and CFP (MFS transporter), that are known to be involved in cercosporin resistance in C. nicotianae, presumably by efflux of the toxin out of fungal cells. Tobacco was transformed to express the encoding genes, ATR1 and CFP, and homozygous transgenic lines were recovered. Transgenic lines were screened for cercosporin resistance by growing seedlings on cercosporin-containing medium in the light and assaying root and shoot growth. My work identified several transgenic lines that showed increased resistance to cercosporin. These lines are also being tested for resistance to C. nicotianae infection in greenhouse studies. Future research will be needed to determine if expression of both genes would further enhance levels of resistance to cercosporin and to disease development.

Poster Number: 5
Slowing the Progression of Geminivirus Infection in Arabidopsis by Modulating the ARR-7 Gene
Rohan Parekh, Molecular and Structural Biochemistry, NC State University
Mentors and/or Co-Authors: Jose Ascencio-Ibanez

Geminiviruses have devastating effects on a variety of plants in tropical and subtropical regions of the world. Cabbage leaf curl virus (CaLCuV) is part of the Geminiviridae, which are single stranded DNA viruses replicating through double-stranded intermediates in the nuclei of host cells. CaLCuV causes infection by altering gene expression. Previous studies have shown that five RNA viruses up-regulate the expression of ARR-7 (Arabidopsis Response Regulator); however, contrary to this data, microarray analysis showed ARR-7 expression in CaLCuV infection was down-regulated. The goal of this project is to provide supporting evidence of the effects of ARR-7 overexpression in slowing infection progression of CaLCuV in Arabidopsis thaliana. Several different lines of A. thaliana were inoculated with CaLCuV; ARR-7 OE, ARR-7 GFP, and Col-O. Total RNA samples were collected, which were then used in real-time PCR to show whether or not the infection was influencing gene expression of ARR-7 and other selected genes. Tests performed with ARR-7 overexpressing plants showed a reduced mortality rate and symptom expression as compared to wild type controls.

Poster Number: 114
Developing field reporter plants using anthocyanin pigment production
Luong Phan, Biochemistry / Human Biology, NC State University
Mentors and/or Co-Authors: Colleen Doherty

A steady increase in global temperature over the past 3 decades has led to decreases in crop yields. If the trend continues, a decrease in worldwide crop production would prove to be detrimental on the growing population and the global economy. A variety of stresses, including heat, are the major factors responsible for crop yield loss. An effective strategy for managing crop damage is early treatment in anticipation of stress damage. This can be done through the introduction of sentinel plants. Sentinels will take advantage of various gene promoters characterized to respond to specific stresses. By fusing them to pigment-producing genes, followed by transformation and expression in live plants, these promoters become detectors[M1]. My
research focuses on showing a biological mechanism in *Arabidopsis thaliana* by infecting it with cabbage leaf curl virus (CaLCuV) expressing the Production of Anthocyanin Pigment I (PAP1) gene. These experiments seek to show that PAP1 will serve as an effective pigment based reporter, and to show that the virus could utilize *Arabidopsis thaliana* machinery to induce PAP1 expression. PAP1 can also be driven by a variety of stress-inducible promoters such as lack of soil nutrients, low amount of water, or damage from pests. Synthetically inducing PAP1 expression in *Arabidopsis thaliana* will show that this pigment has the potential for transgenic expression. However, studies on specific stress promoters in food producing plants are needed to expand the idea of sentinel plants and furthermore help identify stresses as they begin.

**Poster Number: 130**

**Virus Adaptation: Host-Virus Interactions of a Bafilomycin-Resistant Sindbis Virus**

**Tin Phan,** Biochemistry, NC State University

**Mentors and/or Co-Authors:** Dennis Brown, Ryan Schuchman

Virus adaptations present a serious permanence and economics problem for developing anti-viral treatments in the modern world. Sindbis virus (SVHR) is an anthropo-borne, positive sense ssRNA alphavirus. Alphaviruses cause fever, rash, encephalitis and arthritis maladies in humans. It has been proposed that SVHR maturation and egress are mediated by the vacuolar ATPase (V-ATPase). Under the treatment of Bafilomycin-A (BAF) in Baby Hamster Kidney (BHK) cell cultures, the V-ATPase is inhibited and SVHR has been observed to mutate to Bafilomycin-Resistant Sindbis Virus (BRSV) after serial passaging for 22 days. Studies have shown that BRSV is capable of bypassing the normal SVHR egress pathway and instead matures into enlarged vacuoles characteristic of mammalian cells treated with BAF. It is hypothesized that specific host-virus interactions which determine canonical maturation in SVHR infection are altered in BRSV infection when a functional V-ATPase is unavailable. In this study, co-immunoprecipitation experiments at 3 hours post infection revealed an altered complement of proteins that precipitated for BRSV in the presence and absence of BAF compared to SVHR. These results provide a starting point for the identification of host cell-determinants for location of maturation.

**Poster Number: 14**

**The role of vacuole morphology in the stomatal complex of Zea mays during stomata movements**

**Jacobo Rozo Posso,** Plant & Soil Science Agribusiness concentration NC State University

**Mentors and/or Co-Authors:** Marcela Rojas-Pierce

Vacuoles play an important role in plant cells, occupying more than 90% of the volume in most cells and are essential for cellular homeostasis. Vacuole fusion is important in the formation of the central vacuole, and vacuole morphology is responsive to environmental stimuli. This is observed in guard cells during stomata movements, where vacuoles fuse in open stomata, but they fragment in closed stomata. Fragmented vacuoles also fuse after application of Wortmannin, which implicates phosphoinositides in vacuole fusion. Wortmannin inhibits the synthesis of phosphoinositides, which are important lipids for membrane trafficking. In this study, we are analyzing the role of vacuoles during stomata movements in *Zea mays*, a monocot in the grass family. Grasses have guard cells associated with subsidiary cells. We hypothesized that during stomatal opening, the vacuoles in the guard cells would fuse, and fragment in the subsidiary cells. On the contrary, during stomatal closing, the vacuoles in the guard cells would fragment but fuse in subsidiary cells. We developed stomatal assays in maize by incubating leaves in water in dark or light conditions. We stain vacuoles with fluorescent dyes, and visualize by confocal microscopy. Preliminary results show fused vacuoles during stomatal opening, and fragmented vacuoles during stomatal closing in guard cells of maize. We will examine the vacuoles in subsidiary cells using green fluorescent protein maize to visualize vacuole membrane. The stomatal complex of maize could be associated with drought tolerance, and CO2 uptake efficiency compared to other plants, which is an evolutionary advantage for the grasses.

**Poster Number: 93**

**Identifying resistance against geminiviruses using ecotype diversity in Arabidopsis thaliana**

**Taylor Ralph,** Biochemistry, NC State University

**Mentors and/or Co-Authors:** Jose Ascencio-Ibanez

Cabbage Leaf Curl Virus (CaLCuV) is one of several geminiviruses that are responsible for a considerable portion of global crop damages. The *Geminiviridae* rely heavily on host cell elements to replicate and spread infections, which can overwhelm a broad spectrum of commonly cultivated crops. This experiment seeks to test two ecotypes of *Arabidopsis thaliana* (Wei-0 and Angel-1) which showed promising results in a previous
screening for resistance. Identification of natural resistance to CaLCuV infection was observed through visual health of the plant, inspecting for less severe symptoms than normally anticipated, such as stunted growth, cabbaging, leaf distortion, etc. Samples were then taken from each plant at the end of observation to confirm the presence of CaLCuV through a Southern blot. PCR amplification of the same CaLCuV strain within the genetic sample corroborated the presence of the viral DNA in both ecotypes. Here I report that each plant sample among the cultivated ecotypes was infected with CaLCuV and did not show any resistance to the virus symptoms. My results show that the selected germplasms; Wei-0 and Angel-1 lack a natural resistance to CaLCuV infection. The lack of resistance among these ecotypes shows no promise for identifying a genetic trait that may be transferred to a plant of interest.

Poster Number: 105
**Identifying Post Translational Modifications in Mannitol Dehydrogenase**

**Krishna Ravindra**, Biochemistry, NC State University  
**Mentors and/or Co-Authors:** Michael Goshe, John Williamson

Plant cells have been shown to secrete mannosyl dehydrogenase (MTD) in response to fungal infection. MTD secretion does not follow the traditional Golgi/ER pathway as it lacks the appropriate leader sequence and its secretion is resistant to brefeldin A, an inhibitor of Golgi-secretory mechanisms. A large number of infection specific kinases have been described in *Arabidopsis thaliana*. To determine if any of the resulting infection-associated changes in phosphorylation are associated with MTD secretion, we will compare phosphorylations existing on MTD in *Apium graveolens* (celery) cells either untreated or treated with salicylic acid, a known mediator of plant respond to infection. Celery cells were grown in mannitol rich media for 7 days and then treated with or without 1 mM salicylic acid for various lengths of time. Nontreated cells were processed as a control. Cells were frozen and ground in laemmli buffer with protease inhibitors. Cytosolic protein was then recovered by centrifugation. MTD was separated with SDS-PAGE and digested with trypsin. Although analysis of digests by mass spectrometry gave generous sequence coverage in all cells, no phosphorylation PTMs were identified. Immobilized metal affinity chromatography will next be used to enrich for potential phosphopeptides prior to further analyses.

Poster Number: 44
**Development of Method for Reduction in Bitterness of Bioactive Compounds Using Aggregation**

**Piyanka Saha**, Bioprocessing Science and Chemical Engineering, NC State University  
**Mentors and/or Co-Authors:** Allen Foegeding

Many bioactive compounds with health benefits cannot be integrated into foods because they contribute an undesirable level of bitterness to products. In order to utilize these compounds in foods and beverages for nutritional purposes, the bitterness must be masked to minimize customer dissatisfaction. To prevent such compounds from binding to bitter taste receptors, bitter compounds can be trapped in protein aggregates. It is hypothesized that whey protein isolate can be used to form co-aggregates with quinine, restricting the interactions with bitter receptors and thereby reducing bitterness. Various whey protein isolate solution conditions including pH, concentration, and temperature were tested to determine if co-aggregates can be formed. The mixture of whey protein isolate and encapsulated quinine were then separated using centrifugation and filtration, and the resulting solution was measured to quantify the percentage of free, untrapped quinine that remained using UV/Vis spectroscopy. By varying the conditions of whey protein isolate, the encapsulation of quinine was optimized. The results allowed for a further understanding of how to utilize the ability of whey protein isolate to form aggregates around bitter, water-soluble, protein-reactive compounds similar to quinine.

Poster Number: 119
**Effects of Alternate-day Feeding on Feed Efficiency in Domesticated Striped Bass, *Morone saxatilis***

**Priya Shah**, Biological Sciences, Human Biology Concentration, NC State University  
**Mentors and/or Co-Authors:** Benjamin Reading, Scott Salger,Harry Daniels

Striped bass, *Morone saxatilis*, an important fish species for the North Carolina aquaculture industry, have been domesticated seven generations at the NCSU Pamlico Aquaculture Field Laboratory. Studies on the effects of alternate-day feeding have been performed in hybrid striped bass (striped bass, *M. saxatilis*, x white bass, *M. chrysops*), which are often preferred in the aquaculture industry for its higher growth rates and better feed efficiency, but comparable studies have not been conducted in the domesticated striped bass. Here, we explored the effects of feeding frequency on domesticated striped bass growth and feed efficiency.
Striped bass (60g) were randomly assigned to either a 3-day per week feeding treatment or a 5-day per week feeding treatment that was conducted over the course of 12 months. Feed conversion ratios (FCR; ratio of each gram of feed eaten to each gram of weight increase of the fish) and costs of feed and labor during the trial for each treatment were calculated. The FCR for fish less than 475g was lower for the fish fed 5-days a week (1.608) than those fed 3-days a week (1.804), but once the fish were greater than 475g, the FCR for the fish fed 3-days a week was lower (1.586) than those fed 5-days a week (1.667). These studies suggest that shifting to alternate-day feeding of domesticated striped bass after the fish reach 475g can considerably decrease feed and labor costs by 13.37% and 18.82%, respectively, while maximizing growth and feed efficiency.

**Poster Number: 8**

**Comparing relative gene expression in Arabidopsis thaliana plants under normal gravity, artificial gravity, and zero gravity**

James Sheppard, Biochemistry, NC State University

Mentors and/or Co-Authors: Colleen Doherty

With space exploration and colonization on the horizon for the human species, the link between plant growth/development and gravity is an important one to investigate. Past research done terrestrially has highlighted a clear relationship between the Earth’s gravitational pull and the genetic development of plants - particularly in the directionally-specific development of root systems. It is important, then, to investigate the development of plants grown in other gravitational fields - especially in conditions of artificially simulated gravity. This investigation aims to explore this relationship by considering differences in gene expression between Arabidopsis thaliana grown in terrestrial gravity, microgravity, and artificially simulated gravity. To achieve this, differential expression analysis will be performed on RNA-seq data generated using the Ion Torrent platform. A secondary goal of this investigation is to develop an effective pipeline for analyzing differential gene expression in IonTorrent RNA-seq data.

**Poster Number: 11**

**Production of Infectious Clones of a Virus Isolated from a Bush in Tanzania**

Sharvari Soman, Biochemistry, NC State University

Mentors and/or Co-Authors: Jose Ascencio-Ibanez

The Cassava is a plant that was indigenous to South America but through trade became an important source of carbohydrates for a majority of people in Sub-Saharan Africa and is considered to be a staple in this area. The Cassava is susceptible to the Cassava Mosaic Disease, a subset of Geminiviruses commonly found in the plant. The origin of the Cassava infecting virus is unknown. A new Geminivirus was found in Tanzania in a Bush, Deinbollia borbonica, surrounding Cassava fields and it holds many similarities to the Cassava Mosaic Virus. In this project, we aimed to produce infectious clones of the virus. The initial protocol that was used to produce these infectious clones did not produce the desired results. Therefore, another protocol, adopted from a previously published paper will be used by performing limited restriction digestion on the rolling circle amplification products to produce infectious clones. The ultimate objective of our project is to produce infectious clones of the virus and send them back to Africa to check the infectivity of the clones in Cassava plants.

**Poster Number: 103**

**Using CRISPR/Cas9 System to Develop Switchable Gene Expression Cassettes in Arabidopsis thaliana**

Racheal Spurlin, Biochemistry, NC State University

Mentors and/or Co-Authors: Colleen Doherty

Abiotic stresses such as drought and heat are major causes of crop loss around the world. Understanding how plants sense and respond to environmental stresses will provide tools to improve crop yields. Genes involved in stress responses have primarily been studied in mutant plants where the gene of interest is disrupted. However, these mutants can be lethal or have pleiotropic phenotypes, affecting more than just the stress we wish to study. These pleiotropic effects make it hard to distinguish if the original mutation or a secondary effect is causing the phenotypes observed in the mutants. I am developing an inducible system with the use of the CRISPR/Cas9 to shut off the gene after the plant has fully developed with the use of a deactivated version of Cas9 which is fused to a repressor domain targeted to the gene we want to study. This deactivated-repressor Cas9 is guided to the target gene by a maximum of four guide RNAs, which either target the promoter region in four different locations, four different target genes, or a combination. With the second
generation of transformed inducible knockouts growing, we can view the differences in size and growth of the mutants against wild-type Arabidopsis plants. Once they are grown, experiments where the targeted repressor is induced will be performed and we will examine the RNA levels to evaluate if our construct successfully represses the genes we have targeted.

Poster Number: 81
**Identifying a Selfish Gene using the CRISPR/Cas9 Gene Editing System**
Lauren Slayton, Genetics, NC State University

**Mentors and/or Co-Authors:** Marce Lorenzen

Beneficial genes normally persist and predominate in populations, while detrimental genes disappear. Some genes, however, have found ways to circumvent Mendel’s laws of inheritance and spread through populations despite their lack of adaptive significance. These are often referred to as selfish genes. The red flour beetle, *Tribolium castaneum*, harbors a family of selfish genes that are known as Maternal-Effect Dominant Embryonic Arrest (*Medea*) factors. Named for the Greek mythological woman who avenged her husband’s betrayal by killing their children, *Medea* mothers are thought to produce a toxin that leads to the death of all offspring that do not inherit the antidote. However, aside from being associated with a 21.5-kb insertion, the cause of this phenotype is still unknown. With the advent of CRISPR/Cas9-mediated gene editing we now have the ability to excise specific regions of the genome, thereby enabling a systematic dissection of the *Medea*-associated insertion. Specifically, we are using the RNA-guided endonuclease, Cas9, to delete and replace distinct portions of the *Medea*-associated insertion with a fluorescent marker gene, then test marked females for the continued function of *Medea*. This method is expected to pinpoint *Medea*, and finally unlock its potential as a gene-drive system for the control of pests and vector-borne diseases.

Poster Number: 83
**The Effect of Raising pH of the Environment with a TriSodium Citrate Buffer on the Survivability of Probiotic Lactic Acid Strains**
Shannon Stoneback, Food Science, NC State University

**Mentors and/or Co-Authors:** Fred Breidt

This research project aims to help create a probiotic pickle product by exploring the possibility of a relationship between the pH of a cucumber juice brine and the survival rates of two probiotic lactic acid bacterial strains. A cucumber juice brine was used to represent the environment of a finished pickle product and was created using an industry standard recipe. The probiotic strains used in this study were *Lactobacillus casei* (LA 284), an acid-resistant strain, and *Lactobacillus plantarum* (LA 1198), an acid-sensitive strain. The cucumber juice that the probiotics were suspended in was buffered with tri-sodium citrate to prevent the pH from decreasing during cell growth. The buffering was done to increase the survival rate of the probiotics and extend the shelf life of probiotic pickle products, compared to an unbuffered control. Although no difference was seen between the survival of the probiotics in the buffered brine compared to the control, the cells in the unbuffered brine survived much better than previous research had shown. These data indicate that undefined brine components and or environmental factors were affecting probiotic cell survival in pickle brines. Further research is needed to determine how to prolong probiotic culture survival in pickle products.

Poster Number: 31
**Estimation of Baseline of Mutation Rates in Single-Stranded DNA Viruses in Plants**
Olivia Wilkins, Biological Sciences: Integrative Physiology and Neurobiology, NC State University

**Mentors and/or Co-Authors:** Trino Ascencio-Ibanez

Geminiviruses harshly affect a wide variety of plants, especially in tropical and subtropical regions. Major food crops like the Cassava plant in Africa and Asia or the tomato plant have been heavily depleted by geminiviruses. These major crop losses have greatly impacted food sustainability and the economy of tropical and subtropical farming communities, which shows the importance of finding resistance to these devastating viruses. Geminiviruses have shown to be very diverse and to evolve rapidly. We are interested in understanding the drivers of evolution. We are using a retinoblastoma binding mutant from two bipartite geminiviruses: Tomato Golden Mosaic Virus (TGMV) and Cabbage leaf curl virus (CaLCuV). Overall, the experiment will test the differences in host pressure on virus evolution. The tentative final product is a baseline rate of mutation of single stranded DNA geminiviruses during infection in dicot plants.
**Poster Number:** 82

**Brewer's Spent Grain in Human Food Application**

**Praise Wu,** Food Science, NC State University  
**Mentors and/or Co-Authors:** Tyre Lanier

Brewer's Spent Grain (BSG) comprises 4.5 million tonnes of the total by-products in the beer industry. Incorporating BSG flour into a food product would repurpose this present waste by-product to a sustainable food ingredient, which could appeal to environmentally conscious consumers. Moreover, BSG is a nutritionally beneficial ingredient, since the majority of the starch is removed during the mashing process of beer brewing and thus the protein and fiber concentrations are relatively higher than in unprocessed grains. Our study determined whether BSG flour can be substituted into a white flour pizza dough to produce a pizza dough and crust of acceptable properties. BSG was dried to 5-10% moisture and ground to ~0.5mm particle size, yielding BSG flour. This flour was incorporated into an all purpose flour pizza dough recipe in 5, 10 and 15% substitution amounts, by weight, compensating for the superior water holding properties of BSG by altering added water amounts. Once risen, these doughs were heologically analyzed for extensibility compared against a control (0% BSG) dough. The remaining doughs were baked and the resulting crusts were tested for hardness (mechanical punch testing) and color (L*a*b*) colorimeter, also compared against a control (0% BSG) pizza crust. These data will be used to determine the suitability of BSG flour as a value-added ingredient in a widely consumed human food product in which rheological and appearance functionalities are key to consumer acceptance.

**Poster Number:** 141

**Second Generation Aptamers to Protect Plants Against Geminivirus Infection**

**Danielle Youmans,** Biochemistry, NC State University  
**Mentors and/or Co-Authors:** Jose Ascencio-Ibanez

Geminiviridae is a large family of plant viruses that are composed of circular, single stranded DNA (ssDNA). The plant virus family causes a large loss of crops around the world due to their high recombination and mutation rates. These viruses replicate in the nuclei of infected cells by using the host cell's DNA replication machinery. Geminiviruses encode for five to seven proteins. One of the viral proteins necessary for replication is called Rep. Rep is a multi-functional protein that interacts with several of the host proteins and induces the S phase on the colonized cells. Rolling circle replication (RCR) is the method of preference for geminivirus replication. Rep is involved in the viral replication, transcription and infection in plant hosts. Multiple attempts have been made to control the virus, however not all of them have been successful and new methodologies are needed. Previous research has tested peptide aptamers which inhibit viral replication and are inserted into a protein scaffold. These recombinant proteins disrupt different protein interactions and target Rep. Our research involves designing second generation aptamers and test them in a high throughput way. A cloning strategy will be developed using a geminivirus vector to produce the aptamers. The previously tested aptamers will be used as controls and as a base for our design. In this work, we are reporting a symptom scale generated using the vector that will host the aptamer for the tests.

**Poster Number:** 63

**Development of Alumni Career Profile Videos for Nutrition Research, Communication, and Careers Course**

**Samantha Younger,** Nutrition Science, NC State University  
**Mentors and/or Co-Authors:** Natalie Cooke

NTR 302: Introduction to Nutrition Research, Communication, and Careers is a new sophomore-level course seeking to provide nutrition students with a foundation in scientific literature, communication, and exploring career options in nutrition. Students are often unaware of how complex the nutrition field is and how their nutrition education can be applied to a variety of careers. To expose students to career options in nutrition, we developed a series of alumni interviews for the course. The nutrition faculty created a database of alumni jobs by analyzing alumni’s LinkedIn profiles and job updates via email conversations. We then utilized this database to create a list of alumni to interview about their professional journey. Using a standardized set of questions, we interviewed 17 nutrition alumni about how their experiences as students prepared them for their professional career, their current job responsibilities, and advice they would give to current students. We edited their answers to create videos that are each 5-7 minutes long. Videos are compiled in a YouTube playlist that is publicly available to students in the course and prospective students. We then developed a list of questions to accompany the videos and facilitate class discussion, encouraging students to reflect upon what they learned from the videos. Future work will evaluate the impact of the alumni career videos in both a face-to-face and a distance education setting.
College of Engineering
Simulation Aided Design of Long Term Cooling in a Submerged Nuclear Power Plant

Jasmin Alsaid, Nuclear Engineering, NC State University

Mentors and/or Co-Authors: Nam Dinh

This project is a study of long term cooling systems for design basis accidents in a submerged nuclear power plant (SNPP). Specifically, this project focuses on a Small Modular Reactor (SMR) designed by Babcock & Wilcox, the mPower, as its reactor in the submerged vessel. Primarily, the accidents being considered are Loss of Coolant Accident (LOCA) and Station Blackout (SBO). The two cooling systems being analyzed are a gravity-driven injection tank and a relief valve to the secondary partitioned section of the containment vessel. The computational tools being used to analyze these scenarios are GOTHIC, a thermal hydraulic analysis software provided by Zachry Nuclear Engineering; and ANSYS, a computational fluid dynamics software. The goal of this project is to optimize the cooling systems in terms of both safety and economics while adhering to the restrictions presented by the SNPP design. The unique combination of an SMR with an SNPP strives to be promising for the future in terms of safety, diversity, and practicality.

The Effects of Obesity on Bone-Promoting Endothelial Cells in Mouse Tibiae

Michael Ashburn, Mechanical Engineering, NC State University

Mentors and/or Co-Authors: Jacqueline Cole-Husseini

Obesity induced diabetes is associated with cardiovascular disease and an increased risk of bone fracture. We hypothesize that obesity-induced changes to the vascular system are detrimental to bone, and recent evidence has revealed that a subtype of endothelial cells found inside bones, type H cells, directly control osteovascular and bone growth. Obesity may alter the concentration of H cells in bone, leading to degeneration and weakening. Our objective was to determine and quantify changes in type H endothelial cells in the proximal tibia with obesity/diabetes. Sixteen, male C57Bl/6j mice were fed either a high fat diet (60 kcal% fat) or control fat diet (10 kcal% fat) for 18 weeks, starting at 5 weeks of age. After 10 weeks of diet to establish obesity-induced diabetes, mice were further divided into two exercise groups, daily treadmill exercise (8 m/min, 37 min) or sedentary. After 8 weeks of exercise, mice were sacrificed, and tibias were removed, demineralized, embedded in paraffin, and sectioned into 5-micron thick slices. Type H endothelial cells were evaluated using immunohistochemistry, where they were identified as those cells which were double positive for PECAM and endomucin endothelial markers. We quantified the number of type H cells in the proximal tibial metaphysis using fluorescence images analyzed with ImageJ and MATLAB. The number of type H endothelial cells was significantly increased with high fat diet compared with control fat diet, a change that may explain the bone loss and weakening observed in these obesity induced diabetic mice.

The Influence of Mesenchymal Stem Cells on Migration Speed of Macrophage Subsets

Andrew Baldwin, Material Science and Engineering, NC State University

Mentors and/or Co-Authors: Donald Freytes

Mesenchymal stem cells (MSCs) are multipotent stem cells typically present in only the bone marrow of adult humans and can differentiate into bone, muscle, fat, and cartilage cells [1]. Their inclusion in tissue engineering scaffolds for treatment of tissue damage, however, may promote wound healing and result in increases in blood vessel growth into tissue scaffolds. Prohealing M2 macrophages are known to be very important cells in the blood vessel repair response. Previous studies have indicated that MSCs influence the direction of prohealing macrophages to promote blood vessel growth [2,3,4,5]. This study seeks to understand how MSCs influence macrophage migration response. The macrophage subsets analyzed were M0, M1, M2a, and M2c. ImageJ cell tracking software was used to determine the velocity of migratory macrophages in the presence of MSCs. The average speed of macrophages M0 was 18 um/hour, M1 was 5 um/hour, M2a was 26 um/hour, and M2c was 52 um/hour. Before any conclusions about this study can be drawn, there are still many more variables to be considered, mainly the determination of macrophage migration pattern and direction, as well as follow up confirmation studies of macrophage speed.

Determining More Informative Experimental Design Specifications by Evaluating Arabidopsis Thaliana Time Course Data

Thomas Baraldi, Electrical Engineering, NC State University

Poster Number: 40

Poster Number: 33

Poster Number: 31

Poster Number: 80

2017 NC STATE UNIVERSITY SPRING UNDERGRADUATE RESEARCH SYMPOSIUM
**Mentors and/or Co-Authors:** Cranos Williams

Quantification of gene regulation through targeted experiments is an essential component for understanding how plants react biologically, chemically, and physiologically to an environmental stressor. The current design of experimental specifications (e.g., environmental condition, time points, cell type) serves as an effective means to maximize the information that can be obtained from the data while minimizing the time and overall cost of the experiments. Our knowledge of how to efficiently use experimental costs and time to analyze a plant’s biological response, however, is quite limited. Each gene activity measurement is expensive and time consuming, and little guidance exists for how to select the most informative time points that allow for greater insights into how plants operate at a genetic level. Effective ways for utilizing current data to guide the specifications of new experiments may also significantly improve the utility of multiple datasets. There is already a model plant with an extensively studied genome in place and several distinct datasets measuring gene expression values at various time points available. Computationally analyzing the change of gene expression in these provided datasets will determine a methodology to reveal more informative time points for these datasets and cell specific contributions towards the overall root expression at these time points. The results of this approach will provide valuable insights into a more effective means of using experimental supplies to provide a larger yield of information. Ultimately, the results of this project will illustrate a more accurate portrayal of genetic level interaction under an environmental condition.

Poster Number: 121

**Cost Benefit Analysis of Photovoltaic Integration (PV) and Energy Storage (ES) in Local Residential Settings**

**Thomas Barrett,** Electrical Engineering, NC State University

**Mentors and/or Co-Authors:** Ning Lu

This study performed a Cost Benefit Analysis to determine the Optimal Photovoltaic Array size and Energy Storage capacity for Local Residential Homes. The researchers used solar array generation data combined with data on home energy from several homes to create a small sample of home energy use profiles. Then using these profiles calculated the Benefit of varying sized Arrays between 1kW-6kW and varying sized storage will vary between 1-7kWh. We performed this study using rate structure of the local area based on an entire year of data. We successfully created the financial model based on existing flat and time varying rate structure that examines the return on investments for 6 different time periods to consider between 5 and 30 years in 5 year increments. Simplistic storage model was used which assumed to simplify the modeling. This project shows that there is combination of Photovoltaic generation and Energy storage that pay off within a decade and save the consumer thousands of dollars. We hope this research will help to reduce residential customer energy bills by helping them find the optimal Array and Storage combination base on their homes data. To assist Utilities in reducing their peak load through increased distributed generation and by increasing storage capacity. This research could help meet the renewable energy goals of policy makers such as 20% by 2030.

Poster Number: 107

**An Improved Microfluidic Device to Study Cancer Metastasis Under Hypoxia**

**Sarah Beach,** Biomedical Engineering, NC State University

**Mentors and/or Co-Authors:** Glenn Walker

Tumors often contain hypoxic regions due to their high metabolic rates and abnormal blood vessel structure. Hypoxia is known to be associated with aggressive tumors and evidence suggests that it promotes cancer metastasis. There is currently a lack of tools that can be used to study the effect of hypoxia on cancer cells in a controlled environment. Our lab previously developed an elastomer-based microdevice to study cancer metastasis under hypoxia, but the reproducibility and yield of devices was low. This current project explored a new fabrication procedure based on thin films of polystyrene that were patterned with a high resolution knife plotter. We developed a seven-layer polystyrene device that takes less time (2h vs. 48h) and has higher yield (~100% vs. <50%) than the original elastomer device. We demonstrate loading the polystyrene device with Matrigel. Our results show that the polystyrene device has the potential to mimic the function of the original PDMS device, but with a yield high enough to be practical for use in research.

Poster Number: 151

**Study of the Relationship between MRI Contrast Enhancement and PET Imaging of Renal Cell Carcinomas**
Nathan Beaumont, Biomedical Engineering, NC State University
Mentors and/or Co-Authors: David S. Lalush
Tumors are commonly analyzed for glucose metabolism with PET imaging, or for perfusion with contrast enhanced MRI. With the recent invention of combined PET-MRI imaging, a clearer image of the characteristics of a tumor could be found. In this study MRI and PET images from six UNC hospital patients with renal cell carcinomas were compared voxel by voxel. The patients had MRIs taken at one pre contrast injection time and three post injection times. Each MRI voxel intensity was normalized to pre-injection intensities and the rates of gadolinium contrast agent wash-in and wash-out per voxel were calculated with Matlab software. PET images were scaled to the same dimensions as the MRI images and PET intensity was compared to wash-in rate, wash-out rate, and signal enhancement ratio (SER) on a voxel by voxel level. No statistically significant correlation was found between PET intensity and wash-in rate, wash-out rate, or SER for the six subjects analyzed. A tumor region that has high glucose metabolism as indicated by PET shows no statistically significant correlation to high perfusion as indicated by MRI on a voxel level. This suggests that simultaneous PET and MRI of a tumor provide largely independent information and might be used to provide a more complete picture of tumor conditions.

Poster Number: 146
Orientation and Density of the Elastin Microstructure in the Jugular Venous Valve
Adam Benson, Mechanical Engineering, NC State University
Mentors and/or Co-Authors: Hsiao-Ying Shadow Huang
Chronic Venous Insufficiency (CVI) affects about 35% of the United States population with no surgically viable replacement [1]. The most promising replacements fail to remain competent over long periods (~12 months) to either thrombosis or leakage [2]. The condition mainly occurs in the saphenous vein, so the bovine jugular venous valve (JVV) is used as a preliminary study, because the valve leaflets are much larger easing mechanical tests, and handling of the tissue during NaOH treatments. Additionally, it has been questioned if competent jugular venous valves obstruct reflux to the brain preventing neurological disorders [3]. Information of tissue-level orientation of the elastin microstructure is currently unavailable, but hypothesized to play an important function in the overall mechanics of the tissue [force control data]. The elastic lamina layer of the venous valve tissue may have the ability to stretch when opened, store energy, and sling the valve closed during retrograde flow. The elastin microstructure covers the luminal side of the valve tissue and is an extension of the internal elastic lamina of the venous wall [4]. Physiologically the luminal side is advantageous for the elastin location because the luminal side experiences maximum stretch during anterograde flow. The elastin microstructure was found to make up 11.63% ± 2.64% (n=6) of the total dry weight of the venous valve tissue. Light microscopy, confocal reflectance and SEM were used to image the elastin microstructure of the venous valve tissue. It was found that elastin orients mostly radially forming a crosslinked mesh.

Poster Number: 120
Sub-channel Analysis of Boiling Water Reactors (BWR) via CTF
Margaret Buschmann, Nuclear Engineering, NC State University
Mentors and/or Co-Authors: Joseph Doster
COBRA Sub-Channel Thermal – Hydraulics Code (CTF) is an eight equation, two-fluid, pseudo three-dimensional sub-channel code designed to predict thermal hydraulic conditions in Light Water Reactor (LWR) fuel bundles. A series of cases presented in the NUPEC BWR Full-size Fine-mesh Bundle (BFBT) Benchmark released by the Nuclear Energy Agency were analyzed to provide a comparison between CTF and experimental data for prototypical Boiling Water Reactor (BWR) rod bundles over a range of operating conditions. A mesh convergence study was performed to determine the minimum number of axial nodes required for data convergence as a function of operating conditions. The study suggests that the mesh size required for the convergence of the simulation results is a strong function of flow conditions. The results generated with CTF were also compared to Cobra-EN, another sub-channel analysis code. In general, the results produced in CTF were more accurate than the Cobra-EN results for the same mesh size.

Poster Number: 40
Simulation and Design of Reactor Physics Experiments in the IPEN/MB-01 Research Reactor
Taylor Capozziello, Nuclear Engineering, NC State University
Mentors and/or Co-Authors: Joshua Hykes, Dmitriy Anistratov, Nuclear Engineering
The IPEN/MB-01 research reactor performs experiments primarily focusing on the design of critical configurations and the control of criticality through implication of burnable poisons. For the design of these experiments, the reactor-physics code CASMO-4E was utilized. The use of the code was validated through the means of several benchmarks. The three benchmarks used to validate CASMO-4E include Critical loading configurations of the IPEN/MB-01 reactor considering temperature variation from 14°C TO 85°C, Critical loading configurations of the IPEN/MB-01 reactor with U02 and U02-Gd2O3 rods, and the power distribution for the Reactor Physics Experiments in the IPEN/MB-01 Research Reactor Facility benchmark. Once validated, the produced model was then utilized in further design applications. These applications included designing an experiment to determine the critical mass of the fuel assembly reached in the least amount of loading steps. The goal behind this was to design an experiment that simulated loading fuel into the IPEN/MB-01 reactor core in a multiple step process to produce a 1/M plot behavior. This experiment consisted of multiple cases where the optimal case was found to be the one that reached criticality in the least amount of steps while maintaining the safety analysis requirements of the research reactor. The final aspect of the project was to design an experiment involving fixed burnable poisons to produce the highest neutron absorption efficiency. This efficiency is defined as the ratio between the absorption reaction rate of the burnable poison rod and the fission rate of the Uranium-235 in the fuel.

Poster Number: 2

**The Effects of Wound-Targeting Particles on Wound-associated Matrix Properties**

* Mario Castaneda, Biomedical Engineering, NC State University  
* Mentors and/or Co-Authors: Ashley Brown

Wound healing is a dynamic and essential process for the reestablishment of tissue integrity following injury. During normal wound healing, the body proceeds through several phases to reestablish tissue integrity including hemostasis, inflammation, cellular infiltration, and extracellular matrix (ECM) production; complications in any of these stages can lead to chronic wounds. Fibrous proteins like fibrin, fibronectin, and collagen play key, temporally orchestrated roles in the different stages of repair. Fibrin strengthens platelet clots, fibronectin promotes the migration of fibroblast cells into the wound site, and collagen strengthens, and forms the basis of the permanent replacement tissue. The mechanical integrity of these protein networks is compromised in non-healing wounds. The premise of this study is to develop wound targeting ultra-low crosslinked (ULC) microgels that interact specifically with these different fibrous networks and improve the mechanics of wound associated matrices. We first coupled microgels to a fibrin-binding peptide, incorporated these particles into a fibrin network and analyzed their effects on resulting network properties. Using cryo-SEM we observed that ULCs coupled with fibrin binding peptides promote more fibrin network collapse than ULCs coupled with non-binding peptides. Fibrin network collapse is associated with enhanced network mechanics and stability, indicating that this approach can be utilized to enhance wound-associated matrix mechanics. Current work is also investigating the utility of this approach with fibronectin and collagen-specific peptides. By strengthening wound associated matrices, such particles may prove useful in the treatment of chronic wounds.

Poster Number: 34

**EKG Signal Processing & Power Consumption in Android app**

* Junyu Chen, Electrical Engineering, NC State University  
* Mentors and/or Co-Authors: Edgar Lobaton, Laura Gonzalez

An electrocardiogram (EKG or ECG) is a test that checks for problems with the electrical activity of the human heart. Medical practitioners are using EKG signals to monitor threatening conditions and heart diseases such as heart arrhythmia and myocardial infarction (heart attack). Detecting peak signal from EKG in real time plays a vital role in the cardiac monitoring system and ECG applications. A normal EKG signal consists of a P wave, a QRS complex, and a T wave. A common feature in EKG signals is the QRS complex and our goal is to implement a real-time QRS peak detection algorithm on an existing Android app. Thus, medical practitioners and patients can easily track heart rate and heart health problems. However, the peak detection algorithm mentioned above require a long-term battery operation and the capacity of smartphone battery is extremely limited. Two Android app power consumption methods have been used in this project in order to understand how and when the peak detection algorithm consumes more power. Once this task is completed, we hope to be able to optimize our algorithm and the Android app to reduce battery drain. As part of our future work, we plan to look at the trade-off between computing the algorithm on the smartphone and computing the algorithm on the cloud.
Morphological changes of HUVEC under in vitro hemodynamic conditions using modular paper pumps

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Mentors and/or Co-Authors: Glenn Walker, Michael Daniele

Hydrodynamic flow is an essential stimulus in many cellular functions, regulating many mechanical sensitive pathways and closely associating with human health status and diseases. The flow pattern of blood in vessels is the key factor in causing atherosclerosis. Hemodynamics has great effect on endothelial cells' gene expression and biological functions. There are various tools that can be used for studying flow-induced cellular responses but most of them are either bulky or lack precise controllability. We develop an integrated microfluidic device with a disposable and programmable modular paper pump that can precisely generate different flow patterns to human endothelial cells cultured on-chip. A peristaltic pump was also used to induce a shear stress in the microfluidic channel where the cells are seeded. We monitored cell morphology of human umbilical vein endothelial cells under unidirectional flow by taking pictures at timepoints using an EVOS microscope in both devices, one using the peristaltic pump, and the other using the paper pump. Comparison of the morphological changes shows the paper pumps can relicate the shear stress induced by the peristaltic pump.

Load Profile : Testbench for Home Energy Management System Research

Afsana Chowdhury, Electrical and Computer Engineering, NC State University

Mentors and/or Co-Authors: Ning Lu

The primary focus of my research is to create load profile of different homes which can be used in Home Energy Management System project. The main goal of Home Energy Management System is to construct a system which can help users reduce their electricity cost by shifting the usage of controllable appliances from peak hour to off peak hour, decide the capacity of roof-top PV and energy storage device they can install, realize the best way to participate in grid services and so on. I analyse the minute-by-minute load data of several appliances (e.g. cloth washer, dishwasher, dryer etc.) of different houses by using Matlab. Then histograms, line charts, excel files are created for visualising the usage based on when the equipment was switched on, how long it was operated, how much energy it consumed in that particular operation etc. By using the information from the analysis, yearly load profiles can be created for many more houses. These load profiles can be used as testbench in Home Energy Management System project, which can ensure the feasibility of the algorithms for rate analysis, demand response, price negotiation etc. The efficiency of these algorithms can also be calculated which will help to decide which algorithm is the best for a specific kind of house. Finally, the algorithms of Home Energy Management System can contribute to the idea of smart grid by providing many new valuable energy-related applications that people can load into home energy management networks and control their usage efficiently.

Stretchable Capacitive Sensors of Torsion, Strain, and Touch Using Double Helix Liquid Metal Fibers

Christopher Cooper, Chemical Engineering, NC State University

Mentors and/or Co-Authors: Michael Dicke

Soft and stretchable sensors have the potential to be incorporated into soft robotics and conformal electronics. Liquid metals represent a promising class of materials for creating these sensors because they can undergo large deformations while retaining electrical continuity. Incorporating liquid metal into hollow elastomeric capillaries results in fibers that can integrate with textiles, comply with complex surfaces, and be mass produced at high speeds. Liquid metal is injected into the core of hollow and extremely stretchable elastomeric fibers and the resulting fibers are intertwined into a helix to fabricate capacitive sensors of torsion, strain, and touch. Twisting or elongating the fibers changes the geometry and, thus, the capacitance between the fibers in a predictable way. These sensors offer a simple mechanism to measure torsion up to 10,800 rad m$^{-1}$—two orders of magnitude higher than current torsion sensors. These intertwined fibers can also sense strain capacitively. In a complementary embodiment, the fibers are injected with different lengths of liquid metal to create sensors capable of distinguishing touch along the length of a small bundle of fibers via self-capacitance. The three capacitive-based modes of sensing described here may enable new sensing applications that employ the unique attributes of stretchable fibers.
Positron emission tomography (PET) imaging with 18F-fluorodeoxyglucose (FDG) is a successful tool for tumor detection and cancer staging. In PET imaging, a radioactive tracer is injected as a bolus to indicate tissue metabolic activity. The goal of this research project is to analyze the information from a modulated injection protocol of a series of smaller bolus injections in a specific pattern. The first step of the project involved using PET data from a bolus injection to develop a kinetic model to fit the tissue response. The data used to develop this model is the dynamic PET imaging of FDG uptake in the brain of human subjects. Kinetic models for PET imaging are based on the one-, two-, or three-compartment model, where the blood concentration of the tracer as a function of time is the input function. The first model implemented was a one-compartment model based on the Patlak analysis of PET image data. The model is simple but fails to accurately represent the early dynamic behavior of the metabolic activity. Because the one-compartment model only describes the steady state behavior of the system, a two-compartment model is being implemented. It appears that implementing the two-compartment model using Simulink will best represent the data. The next steps involve using Matlab to predict the kinetic parameters for this model. Using these predicted parameters, the modulated injection protocol can be implemented into the Simulink model to predict the tissue metabolic response to this modulated blood input function.

**Low Input Voltage Boost Converter on a Flexible Substrate**

*Zachary Coutant, Electrical Engineering, NC State University*

**Mentors and/or Co-Authors:** Daryoosh Vashaee

This project’s goal was to develop a low input voltage boost converter circuit and transfer it to a flexible substrate. This is intended to be a part of a wearable device powered by a body heat. This circuit needed to take a very low voltage signal (~40mV) from a thermoelectric generator and boost it to a more useful level (~2-5V). This circuit also needed to be on a flexible substrate so it can be more comfortable as a wearable device, as rigid circuit boards are generally uncomfortable. To realize this, we began by reverse engineering a commercial off the shelf (COTS) boost converter. By measuring continuity between different points on the board, a circuit diagram was put together. From the circuit diagram, a shadow mask, or stencil, for depositing metal was designed in AutoCAD and then laser cut. This was then used to deposit the metal pads and interconnections on a flexible substrate. An additional metal layer was grown by plating on the deposited metal to enhance the electrical conductivity. Surface mount components were then connected to the metal pads to build a boost converter on a flexible substrate.

**Studying age-dependent synaptic function under controlled neuronal activation regimes through an automated optogenetic platform**

*Zachary Crawford, Chemical Engineering, NC State University*

**Mentors and/or Co-Authors:** Adriana San Miguel

*C. elegans*, a widely studied model organism, is useful in many areas of biology, including aging and development. The extensive documentation of *C. elegans*, along with their physical transparency allow for in-depth studies on neurons and synaptic pathways, signals, and strength. In this project, we aim to understand the effects of neuronal exercise on health, lifespan, and aging of the nervous system. To investigate this we are studying age-dependent synaptic function under controlled neuronal activation regimes through an automated optogenetic platform. The platform is MATLAB controlled and operates through an intermediate Arduino board to control a blue LED. The platform enables varying light exposure settings, such as light duration and rest duration, as well as recording and analyzing videos. Once we obtain videos, we are able to determine the physiological response to our stimuli by calculating the eccentricity of our sample (a measure of animal contraction). This platform enables us to test how synaptic function changes as worms develop and age, as well as if different patterns of activity alter synaptic decline. In a future experiment we aim to test whether neuronal exercise during early development affects response to light stimuli at older age.
A direct-write near-field electrospinning system for creating 3D printed scaffolds with nanoscale structure

Zachary Davis, Material Science and Engineering, NC State University

Mentors and/or Co-Authors: Matthew Fisher

Tissue engineering is a combination of cells, scaffolds, and other biological factors to create biological tissues in vitro and in vivo. One fundamental issue within the field of tissue engineering is the inability to fabricate scaffolds that 1) allow for extensive cellular infiltration and 2) closely match the structural and mechanical properties of native tissue. Electrospinning is a procedure that creates sheets of nanofibers, similar in structure to tissue, that can be used as scaffolds. However, the nanofibers produced via traditional electrospinning are unorganized and it is difficult to create specific geometries. A greater level of control of fiber deposition is possible with direct-write near-field electrospinning.

For this project, I designed, built, and ran a direct-write near-field electrospinning system to produce 3D scaffolds. To accomplish this, a Lulzbot Mini 3D printer was used as the base system due to the ease of modifying the tool-head and systematically optimizing process parameters. The initial attempts to print polymeric structures were made with 10 weight percent polyethylene oxide in 95% ethanol. From these prints, we have confirmed via scanning electron microscopy that 2D scaffolds can be produced, and further process optimization is underway to increase control over fiber deposition in order to reliably fabricate a 3D structure with clinically relevant dimensions. Because of the potential of protein-polymer hybrid nanofibers to reproduce the structural and mechanical properties of the native extracellular matrix, the long-term goal of this project is to print anatomical structures composed of both proteins and polymers.

A Thermal Test Location in a Sodium Cooled Fast Reactor

William Dawn, Nuclear Engineering, NC State University

Mentors and/or Co-Authors: Scott Palmtag, David Kropaczek

Power Reactor Innovative Small Modular (PRISM) is a Sodium-cooled Fast Reactor (SFR) developed by GE Hitachi Nuclear Energy (GEH). The purpose of this project is to add a thermal flux trap to the PRISM reactor to enhance the versatility of the reactor as a test reactor. The current PRISM design was modeled for this project using DIF3D, REBUS-3, MC2-3, and MCNP. A working model of the PRISM reactor helps develop an understanding of the codes before the project alters the core design.

The design component of this project is to add a thermal flux region to the current fast reactor design to serve as a thermal neutron test location. Since the goal of the project is to implement test reactor capabilities into the small modular reactor, decisions have been made as to where to place test locations and how many locations there will be. When designing this core, an attempt will be made to preserve symmetry and the magnitude of fast neutron flux. Preserving symmetry will allow for lower peaking factors. Preserving fast neutron flux will retain the original SFR design. This project is mainly concerned with creating a once through cycle that lasts as long as possible; consequently we will not be looking into recycling fuel. Adding a test location to PRISM will make the design more versatile. The ability to have an experimental location, as well as generate electrical power, will increase marketability and the probability of actual implementation.

The Correlations between Dynamic Contrast Enhancement Magnetic Resonance Imaging and Positron Emission Tomography in Cervical Cancer

Ayarah Dharanikota, Biomedical Engineering, NC State University

Mentors and/or Co-Authors: David S. Lalush

This study was conducted to analyze a potential relationship between Dynamic Contrast Enhancement Magnetic Resonance Imaging (DCE MRI) and Positron Emission Tomography (PET) scans in cervical cancer. DCE MRI is used to observe leaky blood vessels which is a characteristic of tumor cells while PET is used to spot areas with high glucose metabolism uptake. In order to analyze this relationship we conducted three different experiments: (1) the link between MR Signal Enhancement Ratio (SER) and PET Standard Uptake Value (SUV), (2) the connection between patient outcome, SUV, and SER; and (3) the impact on PET from MR attenuation maps taken before and after MR contrast was administered. Using Slicer, an imaging display and analysis platform, to calculate the SER and SUV values for each patient, we found that there was no evidence of a relationship between SUV and SER. Along with there being no correlation between the SER and SUV, there was no clear trend between patient outcome and SER or SUV. Finally there was no significant impact on PET SUV values caused by MR contrast injection. Also since we only had 12 patients their outcome cannot yet
be reliably predicted from imaging measures. Since SER and SUV appear to be uncorrelated, there is potential to use these values synergistically to measure treatment effectiveness, create tumor sub-classifications, and (with potentially more patients) predict cancer outcome.

Poster Number: 80

Utilizing Nano/Macroscopic Swelling Kinetics of Physically Cross-Linked Hydrogels in the Fabrication of Hybrid Metal Gels

Joshua Dickerson, Materials Science and Engineering, NC State University
Mentors and/or Co-Authors: Richard Spontak
Thermoplastic elastomer gels (TPEGs) derived from multiblock copolymers swollen with a midblock-selective hydrocarbon oil are a fascinating class of soft materials due to a combination of unique mechanical properties and tunable morphological attributes. Specifically, their physically cross-linked nature enables them to exhibit greater elasticity and elongation than typical chemically cross-linked elastomers, while also being reprocessable and recyclable. When using polar solvents to fabricate physically cross-linked hydrogels, a midblock-sulfonated block ionomer (SBI) has been found to absorb up to ~150% water by mass. In the present work, three SBI grades differing in degree of sulfonation form films with two different nanostructures based on the casting solvent employed. The swelling kinetics of the resultant SBI films are investigated using macroscopic water uptake measurements, whereas the nanostructural details are interrogated by small-angle X-ray scattering (SAXS) performed at Argonne National Laboratory. The kinetics of the swelling process are fitted to kinetic models to permit quantitative comparisons among samples and experimental techniques. Two interesting findings observed here are that (i) the rate of swelling in these materials is independent of the starting nanostructure and (ii) good agreement exists between swelling kinetics measured on the nanoscopic and macroscopic scales. The ability of these novel SBIs to form physically crosslinked hydrogels is extended to incorporate a liquid metal, eutectic gallium indium (EGaIn), to generate highly elastic metal gels that could prove tremendously useful to electronics and sensing technologies. Here, liquid EGaIn was deposited onto lead-modified SBI films cast from solvents differing polarity and, hence, morphology.

Poster Number: 143

Validating Laser Doppler Flowmetry for In Vivo Longitudinal Measurements of Bone Blood Perfusion

Elizabeth Easter, Biomedical Engineering, NC State University
Mentors and/or Co-Authors: Jacqueline Cole
Bone is a highly vascularized tissue that requires adequate blood perfusion to maintain structural integrity, remodel in response to loading, and heal after fractures. Some pathologies associated with vascular dysfunction are also associated with bone loss. Because exercise is an important stimulator of bone remodeling and angiogenesis, it has therapeutic potential in patients suffering from cardiovascular disease-related bone loss. Laser Doppler flowmetry (LDF) has been used to measure blood flow in mouse bones in vivo, but the surgery was invasive. Our goal is to determine if our modified, minimally invasive LDF technique can be used to measure changes in blood perfusion without altering gait or causing inflammation, which confound measurements. Twenty 14-week-old male C57Bl/6j mice were divided into two activity groups for 4 weeks: active treadmill or stationary treadmill (30 min/day, 5 days/week). Mice were further divided into two surgical groups, receiving an LDF procedure either weekly for 4 weeks (Repeated LDF, n=5 per activity group) or once at the endpoint (Endpoint LDF, n=5 per activity group). LDF measurements were taken on the anteromedial surface of the right tibial metaphysis. The effect of the LDF procedure was assessed with measures of blood perfusion, wound healing/inflammation, and gait kinematics. Inflammation was assessed using wound area from weekly photographs and serum marker interleukin-6. Changes in gait kinematics were analyzed using weekly high-speed video of treadmill running. If confounding effects are not found, our LDF procedure will be used in future studies to measure longitudinal changes in osteovascular blood perfusion with various pathologies.

Poster Number: 49

Development of Real-Time Image Stabilization for an Airborne Infrared Spectrometer

Samuel Fedeler, Physics, NC State University
Mentors and/or Co-Authors: Jenna Samra, Harvard Paulson School of Engineering/Applied Sciences
On August 21, 2017, a total solar eclipse will occur across the eastern United States for the first time in one hundred years. This offers a unique opportunity for study of the corona of the sun and an infrared telescope,
AIR-Spec, currently in development for this purpose. This telescope will be the first to make observations of the corona between 1.4 and 4 micrometers and will provide a basis on which to take direct observations of the coronal magnetic field in the future. AIR-Spec will search for several magnetically sensitive emission lines, but to do so, the spectrometer must be stabilized to a spatial resolution of 4.6 arc-seconds to ensure images taken for analysis are usable. Stabilization is also important for this telescope because it will be mounted on an NCAR jet and thus must handle corrections for the motion of the jet. Software was developed to correct image motion using a programmable controller, fiber-optic gyroscope, and fast-steering mirror, and currently stabilizes images to a precision of 4.6 arc-seconds in 87 percent of 1 second camera exposures. Programs also were developed for integration of stabilization and a user interface, allowing for fine adjustments, calibration, and manual control of the telescope mirror. This software will be integrated with the physical system in Spring 2017 for test flights, then used during the solar eclipse in Summer 2017.

Poster Number: 34

**Perovskite Nanocrystal Synthesis using an Automated Flow Reactor**

**Kobi Felton**, Chemical Engineering, NC State University

**Mentors and/or Co-Authors:** Milad Abolhasani

Perovskite nanocrystals have great potential as photoactive nanomaterials in solar cells and light emitting diodes (LEDs). Large-scale manufacturing of perovskite nanocrystals will require methods to precisely tune/predict the properties of perovskite nanocrystals (e.g., size, quantum yield, size distribution, and peak emission wavelength). The recent advent of colloidal synthesis in flow offers a promising method for controlling synthesis conditions (residence time, mixing, temperature, pressure, etc). In turn, in-flow synthesis enables the formation of uniform nanoparticles with specific band gap, photoluminescence, and crystal structure. This poster presents a novel flow reactor platform for the rapid and automated synthesis of highly photoluminescent perovskite nanocrystals. The synthesis of CsPbX3 (X= Br, Cl, I) in varying conditions (room and elevated temperature; single and multiphase flow) is studied. A fiber-optic UV spectrometer and orthogonal light sources (for fluorescence and absorption) are connected to a motorized stage to capture measurements at varying residence times (while maintaining flow rates and mixing constant). Furthermore, automatic control of the experimental platform via LabVIEW enables testing of a large parameter space in a short amount of time. Thus, the nucleation and growth kinetics of the CsPbX3 nanocrystals are elucidated at an early reaction timescale (i.e., 200 ms), and a set of conditions for maximum quantum yield at each emission wavelength are determined. This reactor platform represents an important step to developing scalable methods for continuous nanomanufacturing of high quality perovskite nanocrystals for photovoltaics applications.

Poster Number: 93

**Conversion of Kasu into a Facial Cream**

**Cody Fitzgerald**, Bioprocessing Science, NC State University

**Mentors and/or Co-Authors:** Nathaniel Hentz

Ben’s American Sake has expressed interest in converting fermentative waste from their sake production (kasu) into a useable cosmetic face cream. In order to accomplish this, a study was carried out in two separate phases. The first part of the study involved executing a scheme for proximate analysis to determine the moisture content, total lipids, total protein, total free amino acids, and total phenolic acid content of raw kasu samples to gain insight regarding the kasu composition. The second phase involved designing and simulating a process that would remove unwanted components from the kasu, including fine grain particles and ethanol, and yield a product of desirable chemical stability and texture. Three different creams were produced under various process parameters, tested for physical stability by assessing phase separation over time in ambient conditions, and tested for texture by measuring shear rate and viscosity over time. These characteristics were compared with a cosmetic skin cream currently on the market, also derived from fermented plant matter (Neutrogena Naturals Multi-Vitamin Moisture Lotion), to assess how similar their quality attributes are to current cosmetics. It was hypothesized that if the treated kasu can exhibit similar quality attributes to that of the Neutrogena cream, then production of a useable face cream is both possible and economically viable. If successful, it may be marketed as the first all-natural rice-based skin cream with no chemical additives, containing phenolic acids which are known to exhibit cutaneous benefits for the skin, as demonstrated in studies over the last twenty years.
An Approach using Ablation-Dominated Capillary Plasma Source to Generate Refractory Carbide and Nitride Plasma Jets for Surface Deposition and Coating

Victoria Hagopian, Nuclear Engineering NC State University
Mentors and/or Co-Authors: Mohamed Bourham

Capillary discharges are useful devices to generate high-density plasmas from the ablation mechanism of the arc discharge in the capillary. The generated plasma is of high-density and the plasma jet exits the source with high pressure at speeds in excess of several kilometers per second. The plasma jet spreads conically and can be used to coat/deposit the ablated species on metallic and non-metallic surfaces in a single or multiple shots. In this study, the NCSU electrothermal plasma code ETFLOW was used to model and predict the plasma parameters at the exit of the capillary for a set of refractory carbides and nitrides to quantify the amount of mass production in the plasma jet that can be deposited on a substrate facing the source exit. An extensive materials library was built in the code as a module which provides all characteristics of each material from standard materials properties to thermal and ionization parameters. Computational ETFLOW results suggest that refractory nitrides and carbides would be useful capillary source liners for such plasma composition generated for deposition applications in single or multiple discharge techniques. Deposition of carbides and nitrides would provide desirable surface coating and hardening for various applications where such materials can be good diffusion, corrosion and tribology barriers.

Peer Parity Amongst Women on Stack Overflow: Does it Matter? Does it Exist? Should We Care?

Alisse Harkins, Computer Science, NC State University
Mentors and/or Co-Authors: Christopher Parnin, Denae Ford

Stack Overflow is a great learning environment for software developers to understand programming problems, but females are often deterred from using it. If females do not feel comfortable on Stack Overflow, they are missing out on an opportunity to quickly and easily enhance their programming knowledge through this popular resource. To investigate their activity, we studied how women participate on Stack Overflow and if the presence of more women on a post enhanced their activity. We determined types of activities women are participating in by reviewing a Stack Overflow data dump from September 2016, identified the gender of users, and then distinguished instances where there were only one woman on a post from instances where there were many. Comparing this to the activity of men, we found that men who were the only male on their post had a shorter average time until their next activity than women under the same criteria (16 hours v.s. 48 days); demonstrating that there is a difference in how men and women participated on Stack Overflow. We found that women on posts with other women had higher reputation (4470 v.s. 2949 points), more badges (28 v.s. 22), and a shorter time between site activity (16 Days v.s. 48 Days) on average than women who were the sole female on their post. We discuss how these findings support mentorship programs and scenarios where women exist in the same space and, through their presence, encourage each other to take part in communities such as Stack Overflow.

Towards a Flexible Epidermal Sensor for Continuous Measurement of Perspiration as a Monitor of Hydration

Cheyanne Hass, Electrical Engineering NC State University
Mentors and/or Co-Authors: Michael Daniele

Continuous and non-invasive perspiration monitoring could offer valuable insights into a person’s overall hydration levels, as sweat rate and composition may be signals of dehydration. Quantitatively measuring hydration levels outside of a lab setting is difficult due to the cost, size, and rigid nature of current monitoring systems. To address these challenges, this study demonstrates a wearable biosensor to monitor local skin perspiration. The sensor was fabricated by depositing layers of chromium and gold onto a polyimide layer. The sensor’s serpentine design helps match the strain of human skin, while its material characteristics allow for increased flexibility. Potentiometric electrochemical impedance spectroscopy was used for in-vitro characterization of the fabricated sensor. Impedance measurements were taken at varying NaCl concentrations to mimic perspiration. At very high frequencies (~0.1 MHz), impedance values were shown to be inversely related to NaCl concentration levels. Applications for this wearable perspiration sensor can be anticipated for users who engage in physical activity under harsh conditions, such as athletes, firefighters, and military personnel, in order to continuously monitor their hydration levels.
Hardware in the Loop (HIL) Wiring Harness: An Exploration of HIL Benefits

Mark Heidenfeldt, Electrical and Computer Engineering, NC State University

Mentors and/or Co-Authors: Ewan Pritchard

The focus of this research was testing using a Hardware in the Loop (HIL) system for applications such as electric vehicles (EV) and electric generators. We sought to design and construct a wiring harness for a HIL system that will be used to test a Modular Energy Generator that assists in energy generation on small-scale electric grids. The process consisted of examining needed signals and HIL testbed to determine proper signal groupings, building the harness and testing using MATLAB and Simulink programs. The final product contained roughly 100 signals from 2 electronic control unit signal outputs. Testing for the harness consisted of building models in Simulink in order to simulate various input signals and manipulating them into specific outputs. During testing, we were able to use feedback loops with sinusoidal and unit step inputs with variable gains to see how the output was affected. We could then integrate the output back into the system for further manipulation. In conjunction with the project, a literature review was written about HIL testing and the impacts that it can have on the greater research community, specifically for EV’s. That review concluded that this style of testing greatly reduces cost and time associated with development and increases testing breadth by adding the ability to simulate faults, conditions and signals. Further work will be additional testing of the harness, including its primary goal of testing with the Modular Energy Generator.

Characterizing Mammalian Cell Shear Sensitivity to Improve Cell Culture Bioreactor Efficiency

Ethan Hicks, Chemical and Biomolecular Engineering, NC State University

Mentors and/or Co-Authors: Orlin Velev, David Chang

Large scale bioreactors are used by the biotechnology industry for the production of therapeutic proteins. Bioreactors incorporate gas sparging to provide oxygen requirements for cell culture, and facilitate mixing via an impeller. Agitation of sparging generates bubbles, which can damage cell culture at the media/air interface within the culture broth and at the interface of the culture broth and tank headspace. Cell damage can impact VCD (viable cell density) and Culture Viability. To mitigate these challenges, Nonionic surfactants are included within the cell culture media. Specifically, surfactants known as Poloxamer, were evaluated in this study. Poloxamers allow for hydrophobic interactions with cell membranes, and hydrophilic interactions which sterically hinder cell-bubble attachment. This disruption of cell-bubble attachment reduces cell death in heads of foam. These interactions reduce cell damage to improve bioreactor performance. Characterization of Poloxamer effectiveness at protecting cell cultures during bioreactor operations can provide significant benefits to the manufacturing of therapeutic proteins. To evaluate the effectiveness of Poloxamer, a motorized cylindrical impeller was used to shear cells in a media solution containing Poloxamer. Experiments were designed and executed to investigate Poloxamer concentration, shear rate (RPM), and culture viability. Samples were analyzed via trypan blue dye exclusion to measure VCD and culture viability. Results from this study demonstrate a reliable method to quantify cell shear sensitivity in the presence of different Poloxamers.

Exploring New Mechanisms for 3D Printing Liquid Metals at Room Temperature to Fabricate Soft Electronic Components

Casey Hillenburg, Mechanical Engineering, NC State University

Mentors and/or Co-Authors: Michael Dickey

The purpose of this research was to develop new methods for 3D printing liquid metal at room temperature that can enable rapid prototyping of flexible and stretchable electronics. For this study, eutectic gallium-indium liquid metal with a melting point of 15.7°C was used as the printing material and a repurposed 3-axis CNC machine served as the printer hardware. Currently, printing can only happen with a very limited number of substrates (most notably glass and silicon wafers) due to the its requirement of flat/smooth surfaces. The existing printing mechanism uses compressed air to dispense the metal from a medical syringe onto the substrate. New printing methods need to be developed to improve the reproducibility of prints and expand the library of printable substrates. The two methods being developed are (i) volumetric and (ii) a spray system to dispense liquid metal on the substrate. Volumetric printing is based on a syringe pump that operates at a specified flow rate to control the amount of metal deposited on the substrate. A syringe pump will enable printing on new materials such as printed circuit boards on which conventional electronics are
patterned using complex photolithography processes. Spray printing enables printing on rough or non-uniform surfaces, however, it can only be done in two dimensions as opposed to volumetric and the existing pressure methods. These new methods will enable this 3D printing technology to enable manufacturing of flexible electronics, ultra-stretchable wires, and microfluidics.

Poster Number: 48
**Solvent-induced surface cracking of UVO-treated PDMS**
**William Hoffmann,** Chemical and Biomolecular Engineering, NC State University

**Mentors and/or Co-Authors:** Jan Genzer

Nanofabrication techniques, including bottom-up and top down approaches, have received much interest recently. In particular, surface structures have the potential to change surface properties including energy and smoothness. Introducing irregular surface cracks has been the subject of several recent studies. Surfaces stresses have been characterized using crack formation in polymer films. Crack propagation engineered by an underlying substrate has also been demonstrated. Cracking has been reported as an unintended phenomenon in dynamic mechanical analysis of a polymer network. Finally, cracking in metallic films has been induced using a stretchy polymer substrate. In the present work, cracking of ultraviolet light-modified PDMS pieces is induced by swelling in a “good” solvent. The asymmetric swelling of the bulk and the surface is believed to be due to the differences in permeability of the surface and bulk. A time study of the development of the cracking is presented. The cracks are characterized using optical microscopy. The micrographs are analyzed using Fast Fourier Transform (FFT) in Imagej image processing software, which produces information about the crack spacing. These preliminary results show the cracking to be a progressive process, with cracks appearing after 30 minutes of swelling. The density of cracking increases after that point. Before the point of cracking however, surface wrinkling is observed. Further study will be completed to robustly characterize the cracking using other microscopy techniques and to try to control cracking properties, including density, regularity, and propagation. The current findings show promise for engineering cracked surfaces of desired properties.

Poster Number: 139
**Environmental Tracking Testbed for Health Management**
**Charles Hood,** ECE, NC State University

**Mentors and/or Co-Authors:** Alper Bozkurt

The SoliBand watch focuses on measuring environmental factors in combination with physical parameters. The latest design is capable of measuring ambient ozone, temperature, humidity, motion, pulse oximetry, and skin temperature. This watch was developed through the ASSIST Center to showcase the low power metal oxide sensor in comparison to commercially available sensors. A UV light was built into the watch and used to recover the custom sensor instead of using a heating element, reducing the power consumption of the sensor by a factor of one hundred. Several iterations of the SoliBand watch have been developed that allow the incorporation of other gas sensors, such as acetone and VOCs. Additional work has been done to demonstrate biochemical sensing using a miniature potentiostat.

Poster Number: 100
**Spiderdonuts - Analyzing Walk-Entropy in Networks**
**Eric Horton,** Computer Science, NC State University

**Mentors and/or Co-Authors:** Kyle Kloster, Vida Sullivan

In data analysis, network structures can be used to store and process massive datasets, even on the scale of “Big Data.” Such networks can be processed more efficiently with knowledge about their underlying structure, including any symmetry or regularity exhibited. We can quantify how uniform or regular a network is by using a measure such as walk-entropy, a metric related to walks in a network. Previous research has investigated how well walk-entropy quantifies symmetry, and what types of network symmetries maximize walk-entropy. Recent work found that walk-regularity, a particular type of network symmetry in which each node has essentially uniform walk-structure, maximizes the walk-entropy metric. Subsequent research found that a special function of networks, the exponential, can accurately detect when a network exhibits this form of regularity. Other studies have attempted to generalize the regularity-detecting property of the exponential to a broader class of functions.

Our work explores the relationship of such function classes to walk-regularity. We present a particular kind of spider graph, which we call a spider torus, providing an infinite family of counterexamples against one
proposed function class for detecting walk-regularity. Moreover, we prove necessary theoretical conditions for any class of function to accurately detect walk-regularity. This work helps narrow the scope of the current investigation into the relationship between walk-entropy as a measure of symmetry and the particular type of symmetry, walk-regularity.

Poster Number: 83

Development of anti-microbial platelet-like-particles to augment bleeding and fight infection

Benjamin Igo, Biomedical Engineering, NC State University

Mentors and/or Co-Authors: Ashley Brown

There is an unmet need to develop novel biomaterials to stop bleeding and prevent infection following traumatic injury. Previously our group created synthetic platelet-like-particles (PLPs), which can replicate the hemostatic action of natural platelets in the body after trauma. This project builds upon the original PLP design through incorporation of gold anti-microbial elements to create particles that both stop bleeding at sites of injury and prevent infection following hemostasis. Anti-microbial PLPs were created by first synthesizing pNIPAM-co-AAc microgel particles. Next, gold was incorporated into each microgel in variable concentrations through a seeded growth technique where hydroxylamine and sodium hydroxide initiators were used to promote uptake of gold by the ULC particles through the creation of increased attractive forces. Particle size was characterized by DLS and gold distribution was characterized via Atomic Force Microscopy (AFM) and Transmission Electron Microscopy (TEM). Anti-microbial potential of the particles was characterized using a light transmission-based antimicrobial assay. Microgel size and the number of gold particles per microgel increased as the concentration of gold utilized in the synthesis increased, indicating gold incorporation on the particle level can be controlled. AFM and TEM analysis demonstrated uniform distribution of gold particles throughout microgels. Anti-microbial assays demonstrate that increasing the concentration of gold within the microgels increases inhibition of bacterial growth. Additionally, increasing the gold concentration provided statistically significant reduction in bacterial growth as compared to microgels with no gold incorporation. Collectively, these results demonstrate that microgel-based particles can be developed with antimicrobial characteristics.

Poster Number: 110

Transport of Accident Tolerant Fuel LUA Test Segments for Post-Irradiation Examination

Megan Isabelle, Nuclear Engineering, NC State University

Mentors and/or Co-Authors: Robert Hayes

The United States Department of Energy has undertaken research and development initiatives on accident tolerant fuels (ATF) with the goal of performing a lead test assembly irradiation in a commercial reactor by 2022. The resulting test assembly will then require transport by highway from reactor site to the designated post-irradiation test facility for analysis. Each test lot was expected to contain ten fuel rods designed by General Electric (GE). The intent of this study was to determine the required shoring and shielding arrangement of the fuel rods within the transport cask. In turn, this allows certification of the GE 2000 shipping cask for transport of these materials. Shielding analysis of the finalized design was conducted to ensure transport conditions meet standards set forth in 10CFR71. The finalized design underwent a full criticality safety review to ensure public safety in accordance with established ANSI standards and additional GE requirements. In addition, thermal loading analyses were conducted as to not exceed the cask internal surface maximum.

Poster Number: 84

Microfluidic studies of catalytic microgels: Towards continuous ligand-free C-C cross-coupling reactions

Andrew Kristof, Chemical Engineering, NC State University

Mentors and/or Co-Authors: Milad Abolhasani

Metal-mediated cross-coupling reactions are valuable tools to chemists and play a critical role in synthesizing numerous compounds utilized in the pharmaceutical industry. It has been demonstrated that palladium (Pd) enclosed within poly(hydroxymethylsiloxane) (PHMS) gels can be applied in heterogenous Suzuki-Miyaura cross-coupling reactions. Recent development of microscale flow technologies offers unique advantages to implement the gel-based approach as a scaffold for continuous organic synthesis. This project presents a novel microfluidic platform for the tunable and automated synthesis and collection of Pd-loaded PHMS microgels that will be utilized in heterogenous ligand-free Suzuki-Miyaura cross-coupling reactions. A 3-D co-
Modification in Actuation of Dielectric Elastomers

Sungsoh Lim, Chemical Engineering, NC State University

Mentors and/or Co-Authors: Richard Spontak

Dielectric elastomer actuators (DEAs) are smart materials that exhibit characteristics of high actuation strains (>300%), low blocking stresses, light weight, and high electromechanical efficiencies. Actuation of DEAs can be achieved by applying electric field across the elastomeric matrix. The carefully selected crosslinking architecture of these new model materials is used to induce strain stiffening behavior due to finite network extensibility. In this research, DEAs can be mechanically conditioned to suppress electromechanical instability that use only physical modifications to tailor the response of DEAs without any modifications in chemistry. Elastomers are fabricated with high dielectric constant fibers that drastically reduce electric field strengths and increase strain anisotropy. The result shows that anisotropic actuation strain was achieved at lower electric field than the isotropic actuation of a non-composite elastomer.
Materials of interest for this specific research are a class of all polyolefin thermoplastic elastomer gels (OTPEGs), and these elastomers will be conditioned with cyclic loading to take advantage of the strain stiffening behavior due to the Mullins effect to create DEAs that operate both isotropically and anisotropically

Poster Number: 154
Photomicrobiocidal Polymers: Synthesis, Characterization and Antimicrobial Efficacy
Jason Lin, Materials Science and Engineering, NC State University
Mentors and/or Co-Authors: Richard Spontak
The objective of this project was to create a self-sterilizing material that is characteristically antimicrobial and can prevent the transmission of pathogens. Previously treatable infections are resurging as microbial drug resistance increases. New sterilization techniques are emerging in an attempt to combat this problem. Photodynamic inactivation (PDI) provides a promising route of autonomously terminating pathogens from surrounding surfaces by using photosensitizers to produce reactive oxygen species. Most of the PSs used in PDI originate from tetrapyrrolic macrocycles known as porphyrins, which were the focus for our project. Physical processing methods to incorporate PSs into inexpensive commercial polymers such as PE, PVA, and, PET included solvent casting, melt pressing, and spray coating. Melt pressing was used with INFUSE 9107, an olefin block copolymer, to incorporate 1% zinc tetra(4-N-methylpyridyl)porphine (ZnTMPyP). The antimicrobial efficacy was tested with a compound free control, dark control, and light illumination at 100 mW/cm² and resulted in 5 log units of efficacy using Acinetobacter baumannii (ATCC-19606), meaning 99.999% of the bacteria were killed. Future experiments will look into chemical attachment of PSs by plasma treatment of the INFUSE 9107 with ambient air to create hydroxyl groups, which can react with cyanuric chloride to attach thionin or other PSs with reactive substituents. With successful preliminary studies, scalable processes such as the melt spinning of commercial polymers along with PSs can then be tested for their antimicrobial efficacy. From there, the project can move on to testing morphological, thermal, and mechanical properties.

Poster Number: 63
Developing an Optimized and Viable Loading Pattern for Westinghouse Two-Loop PWR Plant
Megan LoMonaco, Nuclear Engineering, NC State University
Mentors and/or Co-Authors: Maria Avramova
The objective of this project was to design an optimized and viable PWR loading pattern (LP) and create a core that is safe, reliable, and economical. The plant examined was Boundary Waters, a Westinghouse PWR two-loop core with a rated thermal power of 1677 MWt. By applying an iterative optimizing process and given inventory of fuel assemblies from Cycle 27 (information provided by Westinghouse), the goal was to meet LP requirements while satisfying safety and thermal design limits. Safety analysis calculations were performed, which included rodded peaking factors, shutdown margin, and rod ejection scenarios at various points during the depletion cycle. If the loading pattern did not satisfy the safety constraints, modifications were made, and the process was repeated. When the final loading pattern was established, operational calculations were performed, including control rod worths, isothermal temperature coefficient (ITC), hot zero power critical Boron concentration, Xenon worths, and Boron worths over cycle lifetime. In addition to the neutronics-based design parameters, a thermal-hydraulic analysis was also completed. This provided insight into the thermodynamic behavior of the design. An additional scenario was analyzed in which a main steam line break accident occurs. Lastly, the Cycle 28 Core Design and Safety Analysis Report is being developed, summarizing what plant operators should expect to see for the designed optimized core under normal and accident conditions.

Poster Number: 119
Robinson Plant Fluence Shielded Fuel Assembly Design and Evaluation
Margaret Lowe, Nuclear Engineering, NC State University
Mentors and/or Co-Authors: David Kropaczek, Scott Palmtag,
Duke Energy’s Robinson Nuclear Plant (RNP) has been granted a 20-year life extension and to minimize outages, is increasing the cycle length to 24-months. Beginning in cycle 32, Duke Energy is removing the partial length shielded assemblies (PLSAs) that have been protecting the reactor vessel welds by limiting the fluence the welds are exposed to. The PLSAs are being removed to make room for fuel to sustain a 24-month cycle. However, Duke Energy’s challenge is to design and model a RNP cycle 36 core that both sustains a 24-month cycle and implements protections for the reactor vessel welds. CASMO-4E and CMSLINK were used to
produce the two-group cross-section data for assembly designs, create a library of two-group macroscopic cross-sections, two-group discontinuity factors, etc., to be used by SIMULATE-3 to create a three-dimensional RNP core simulation to analyze pin power near the reactor vessel welds, respectively. The primary designs utilized combinations of hafnium or stainless steel, in either a wall or alternating comb pattern, and with either four or seven hafnium or stainless steel guide tube inserts within an asymmetric assembly. These designs were tested and evaluated to maximize k-infinity values, while minimizing pin peaking factors within functional requirements provided by Duke Energy. Ultimately, tests yielded a suite of viable assembly patterns that have been tested for shielding capabilities, necessary cycle length and economic cost.

**Factors affecting the Electrocatalytic Activity of Fe-doped NiO Core-Shell Nanoparticles as catalysts for the Oxygen Evolution Reaction**

_Eowyn Lucas_, Materials Science and Engineering, NC State University

**Mentors and/or Co-Authors:** Verónica Augustyn

The use of intermittent renewable energy sources such as photovoltaics and wind turbines is increasing, and with that so is the need for energy storage. One of the most promising forms of energy storage is hydrogen fuel, which could be sustainably synthesized from the electrolysis of water. The electrolysis reaction is made up of two half reactions: the oxygen evolution reaction (OER) and the hydrogen evolution reaction (HER). Of these two reactions, the OER requires higher overpotentials because it necessitates a 4-electron transfer. Fe-doped Ni oxides and hydroxides are some of the best non-noble metal electrocatalysts for the OER. This research explores the factors affecting the electrocatalytic performance of Fe-doped NiO core-shell nanoparticles with different Ni:Fe ratios (82:18, 90:10, 95:5, and 100:0). The nanoparticles were characterized with ex situ Raman spectroscopy, transmission electron microscopy (TEM), and cyclic voltammetry with a rotating disk electrode. It was found that choice of Fe precursors, nanoparticle purification, and thermal treatment can all affect the subsequent electrocatalytic activity due to their influence on nanoparticle size, morphology, surface ligand coverage, and chemical composition.

**College(s):** College of Engineering

**Poster Number:** 87

**Evaluation of an engineered biosensor for live-cell imaging of epidermal growth factor receptor**

_Jessica Mahinthakumar_, Chemical and Biomolecular Engineering, NC State University

**Mentors and/or Co-Authors:** Balaji Rao

Live-cell imaging studies can provide mechanistic insight into the receptor-mediated dynamics within the cell; however, availability of accurate intracellular biosensors remains limited. Previous studies have shown tandem SH2 domain from PLCγ1 (tSH2-WT) as a marker of phosphorylated epidermal growth factor receptor (EGFR). We show that tSH2-WT lacks specificity for phosphorylated EGFR, and high avidity of the biosensor for the target causes measured dynamic kinetics to differ from expected EGFR phosphorylation kinetics. To address these limitations of the tSH2-WT biosensor, we constructed a combinatorial library through random mutagenesis of the C-terminal SH2 domain (cSH2) of PLCγ, and the library was screened for specificity to the Y992 phosphorylation site (pY992) in EGFR, using yeast surface display to isolate a mutant protein (mSH2). Accordingly, mSH2 was shown to faithfully report the theoretical kinetics of EGFR phosphorylation in live cell imaging, but the biosensor also reacted to Platelet Derive Growth Factor (PDGF), meaning mSH2 lacked true specificity to pY992 in EGFR. To create a more specific binder, a naive library of SSO7D using yeast surface display was negatively screened against non-target phosphorylated EGFR sites and PDGF sites to develop two binders specific to pY992 and pY1148 (SPY992 and SPY1148). We show that these binders retain the expected dynamics of EGFR phosphorylation and specificity to their phosphorylated target sites during live cell imaging. Through this study we show that an effective mechanistic biosensor can be developed for specific intracellular targets.

**Poster Number:** 86

**Engineering the Sso7d Protein Scaffold to Create Binding Proteins for Fast and Efficient Immobilization of Yeast Cells on Magnetic Iron Oxide**

_Nikki McArthur_, Chemical and Biomolecular Engineering, NC State University

**Mentors and/or Co-Authors:** Balaji Rao

The purpose of this project was to isolate a binding protein with affinity to magnetic iron oxide (II,III). Selecting such a protein and expressing it on the surface of yeast has many biotechnology and environmental
technology applications. Yeast expressing this binder could be immobilized on iron oxide and used as a magnetically responsive biocatalyst for ethanol production, a biosorbent for water remediation, and an affinity reagent for protein purification. A library composed of mutant proteins derived from the protein Sso7d was created and sorted by yeast surface display. After six rounds of selection against iron oxide, one iron oxide binder was isolated. This protein, SsoFe2, was expressed on the surface of yeast and was proven to be a better iron oxide binder than other Sso7d-derived proteins through a series of yeast capture assays. Yeast capture on iron oxide was measured as a function of BSA, in the presence of other Sso7d proteins, and as a function of available iron oxide to show that the interaction between SsoFe2 and iron oxide is stronger than the interaction between uninduced yeast or other proteins and iron oxide. To characterize the mode of interaction between SsoFe2 and iron oxide, capture of SsoFe2-expressing yeast with iron oxide at different pHs and sodium chloride concentrations was quantified. This indicated that the binding of SsoFe2 to iron oxide is independent of pH and sodium chloride concentration and is not based exclusively on electrostatic interactions. This research shows that SsoFe2-expressing yeast can be used as magnetic biotechnology tools.

Poster Number: 147

**Analysis of the Glucan Degradation Locus in *Caldicellulosiruptor bescii* reveals the Critical Role of Glycoside Hydrolases in Plant Biomass Degradation**

**Bennett McKinley**, Chemical Engineering, NC State University

**Mentors and/or Co-Authors**: Robert Kelly, Jonathan Conway

*Caldicellulosiruptor bescii* is an extremely thermophilic bacterium that can degrade plant biomass, including cellulose, by secreting a variety of multi-domain enzymes. Through comparative genomics of cellulolytic and non-cellulolytic *Caldicellulosiruptor* species, it was shown that the enzymes necessary for degrading crystalline cellulose are located in one genomic locus, termed the Glucan Degradation Locus (GDL). By expressing and purifying enzymes from the GDL of *C. bescii*, the activity and cooperativity of the GDL enzymes were demonstrated on Avicel (crystalline cellulose). To characterize the roles of the GDL enzymes in vivo, various combinations of these enzymes were knocked out in *C. bescii* through the use of antibiotic and nutritional selection. The effects of these gene knockouts on the ability to degrade plant biomass was explored by growing the modified *C. bescii* strains on plant biomass substrates (poplar, switchgrass, and Avicel) to determine the amount of substrate solubilized. On Avicel, the modified *C. bescii* strains lacking the genes Athe_1867, Athe_1859, or Athe_1857 individually solubilized at worst two thirds as much as the wildtype. However, in the *C. bescii* strain that was missing all three of the enzymes, 90% of Avicel solubilization was eliminated, indicating cooperativity. On switchgrass, Athe_1857 alone accounted for about half of the solubilization. On poplar, it was shown that Athe_1867 made the largest contribution to solubilization. The results show that the relative importance of the enzymes of the GDL varies depending on the biomass substrate. This understanding will enable the engineering of future strains with improved plant biomass degradation ability.

Poster Number: 23

**Identification of adsorbent characteristics governing 1,4-dioxane removal in point-of-use (POU) treatment devices**

**John Merrill**, Environmental Engineering, NC State University

**Mentors and/or Co-Authors**: Detlef Knappe

Lifetime consumption of drinking water containing 0.35 μg/L 1,4-dioxane (14D) is associated with an excess 10⁻⁶ cancer risk. Recent data show that finished water from water treatment plants in North Carolina exceed the 10⁻⁶ cancer risk by factors of ~25, 7 and 3. We hypothesize that POU treatment devices employing carbonaceous adsorbents could be an effective 14D barrier at the household scale. My research objectives are to (1) identify adsorbent characteristics that govern 14D removal from water and (2) model 14D adsorption in POU devices under variable hydraulic conditions and influent 14D concentrations with the goal to optimize the design of POU devices for 14D removal.

Adsorbents from commercially available POU devices and a synthetic carbonaceous resin were chosen for analysis. Equilibrium parameters were determined from batch isotherm experiments, and kinetic parameters were determined from short bed adsorber column experiments. Among the tested adsorbents, adsorption capacities differed by approximately one order of magnitude [1.73x10⁻³ to 1.63x10⁻² (mg/g)(L/μg)]⁻¹/n⁻¹. Furthermore, surface diffusion coefficients, which describe adsorption kinetics, differed by more than an order of magnitude [1.47x10⁻¹⁰ to 1.89x10⁻⁹ cm²/s]. Overall, the data suggest that adsorption capacity was the principal determinant of 14D adsorption effectiveness in column experiments. Following 14D uptake, desorption of 14D was studied by switching column influent to 14D-free water. Relative to the adsorbed 14D
mass, the mass of desorbed 14D ranged from 8 to 56% at similar specific throughputs (L/g). Results suggest that adsorbents associated with the slowest adsorption kinetics were associated with the lowest desorption percentage of 14D.

Poster Number: 59
Prototype Quadrotor with Integrated Computer Vision for Autonomous Footprint Tracking and Identification
Joseph Meyers, Mechanical Engineering & Applied Mathematics, NC State University
Mentors and/or Co-Authors: Matthew Bryant
Previous methods of tracking endangered animal populations can involve sedation and tagging of animals in order to track their location and vitals. The footprint identification method of tracking relies on detailed footprint pictures to reconstruct identifying information about an animal of interest such as species, age, and sex without the invasiveness of tagging. Footprint identification techniques (FITs) have been shown to be a less invasive method of tracking endangered and elusive animal populations. While FITs reduce the intrusive nature of traditional animal tracking methods, extensive fieldwork and skilled fieldworkers are necessary to properly track a population of interest and collect images for analysis. The proposed solution to this problem is an autonomous quadrotor capable of scanning an area for footprints and automatically capturing scaled images of the footprints for analysis. For the prototype, a quadrotor was assembled with a gimbaled GoPro for imaging. An onboard Raspberry Pi 3 running OpenCV processes the image data from the camera in order to locate potential footprints and send path planning information to the autopilot software. The quadrotor scans the proximal area for footprints and then moves towards the footprint for scaled imaging. This solution offers the advantages of increasing the area surveilled by fieldworkers and automating the scaled imaging. This prototype demonstrates an alternative method for collecting footprint images for analysis of animal populations.

Poster Number: 22
Exploring Curvature with Spherical Shapes Using Pre-Strained Polystyrene Sheets
Diana Mong’are, Engineering, NC State University
Mentors and/or Co-Authors: Michael Dickey
Self-assembling structures enables various applications ranging from devices for non-invasive surgery to deployable satellite systems. By designing and harnessing man-made materials that can self-assemble, this research aims to expand the variety of complex self-curving structures that can be created from flat plastic sheets. Ink patterns are printed on pre-strained polystyrene sheets using a conventional inkjet printer. These sheets are pre-strained and shrink by ~55% when heated above ~103°C, which is material’s glass transition temperature. Samples are heated on a hot plate to ~90°C and an IR or LED light is shone on the surface. The black ink on the surface of the material absorbs the light preferentially and thus heats up faster than the transparent regions of the polymer, which soften more slowly. The heated regions relax and shrink which forces the non-patterned regions of the sample to deform as well. Previous research has focused on patterning samples with black ink to locally control the material’s shrinkage and produce desired shapes such as cubes, pyramids, curved panels, and grippers. This work explores the use of both direct and indirect mechanisms of curvature, as well as a combination of the two mechanisms to develop spherical structures with a tunable degree of “spherical fidelity.” The challenge of going form a flat sheet to an ideal sphere (that has positive and position-independent Gaussian curvature) is the specific goal that motivates our efforts. Potential applications include spherical encapsulation of micro-to-millimeter sized objects.

Poster Number: 73
Technique development for studying origins of microcracking due to inhomogeneous stresses
Caleb Mooney, Materials Science and Engineering, NC State University
Mentors and/or Co-Authors: Elizabeth Dickey, Jacob Jones
Electric-field-induced microcracking is common in piezoelectric materials due to their electromechanical response. It is known that, at low electric field values, the formation and propagation of microcracks is the dominant mechanism of electrical fatigue, and macrocracks are generated at high electric field amplitudes. In multilayer ceramic actuators (MLCAs) and capacitors (MLCCs), stresses can be largely inhomogeneous near electrode edges, exacerbating cracking and fatigue. However, few details are known about the parameters controlling microcracking in multilayer stacks, where inhomogeneous stresses appear between electrically active and inactive regions. In order to simulate the inhomogeneous stresses, finite element modeling of
Hierarchical Surface Topography via Locally Induced Thin Film Instability

**Poster Number:** 50

**Umaash Nallainathan,** Chemical Engineering, NC State University

**Mentors and/or Co-Authors:** Michael Dickey, Sungjune Park, Umaash Nallainathan,

Patterning via mechanical buckling instabilities is a promising approach to generate micro-scale features in thin films. Laminated metal/polymeric films on a rigid substrate can form a buckled topography over the entire surface. This is caused by compressive thermal stresses induced by the difference of thermal expansion of the individual layers. Here, buckles spontaneously formed in a bilayer on a silicon wafer by exposing it to infrared (IR) light. The light heats the film and causes it to buckle. Micro-contact printed stiff polymer patterns on the surface physically suppress buckling, resulting in buckling only in non-patterned regions. This approach can be implemented in several prospective applications in microelectronic mechanical systems, thin film metrology, and facile small-scale fabrication.
**DNA Data Encoding and Storage Evaluation**

Sarah Orr, Electrical Engineering, NC State University

**Mentors and/or Co-Authors:** James Tuck

Data density and storage is becoming increasingly important. Deoxyribonucleic acid (DNA) is the densest known form of information storage. Prior studies [1,2] have established a framework for encoding arbitrary data into DNA compatible strands, storing the data into a pool of DNA, and then processing the pool to access the encoded data, thereby forming a storage system. A key challenge of such a storage system is retrieving a specific file within it. Polymerase chain reaction (PCR) is a current, proven method to isolate strands that make up a particular file, specifically done by assigning each file in the storage system a distinct pair of primers, one at each end of the strand. The assignment of primers complicates encoding data since within a pool of DNA, a primer should not match any encoded data, otherwise the PCR process may amplify the wrong strands and result in lost data. This study reproduces the encoding methods laid out in several prior works, namely Bornholt et al [1] and Yazdi et al [2] alongside other established encoding methods. Then, these encodings are compared according to several metrics, namely information density, GC base pair content, and likelihood of false binding by primers. We find that the current methods in DNA data encoding do not adequately account for the primers required by the PCR process. Additionally, [2] produced a GC content that would result in unstable strands of DNA. We recommend that an encoding method be used which incorporates the specific needs of the PCR process.

**Understanding the Mechanical Properties of Graphene Oxide**

Thomas Oweida, Materials Science & Engineering, NC State University

**Mentors and/or Co-Authors:** Yaroslava Yingling

Graphene is a two-dimensional sheet of sp²-hybridized carbon with its atoms arranged in a hexagonal lattice. The addition of hydroxyl and epoxy groups to the graphene sheets basal planes and edges results in the formation of graphene oxide (GO). Graphene and GO are drawing the interest of researchers due to the material’s tailorable nature for many applications such as membranes with controlled permeability, molecular storage, and nano composite fillers. However, to tailor graphene and GO for each application, mechanical properties must be elucidated. This study provides a holistic view of three layered graphene’s in-plane and out-of-plane mechanical properties and how the addition of epoxy and hydroxyl groups affect these properties at various quantities, disregarding potential issues arising with defects and holes in the GO sheet.

**Investigation of the Public Perception of Science and Technology Policy**

Ashlie Page, Chemical Engineering; Polymer & Color Chemistry NC State University

**Mentors and/or Co-Authors:** Jobi Cook

Technology is becoming an ever-increasing necessity within the lives of individuals globally. Science, as a tool to describe the natural world, does, in fact, contribute to one’s daily life from the growing of food to the use of a laptop. Awareness of science, in particular, can allow individuals to reap its benefits. Technology, however, can also have adverse effects. Consider the potential negative consequences of nuclear power. While nuclear energy can be used to provide electricity to a large percentage of people worldwide, it can also have damaging effects on society. Consequently, technology has the potential for both positive and negative outcomes. To combat technology’s adverse effects, policies can be established to protect individuals while promoting proper usage to benefit society. All too often, however, policy lags behind the creation and widespread functioning of technology, leaving room for improper use. This gap between researchers and policymakers provides for potential hazards in emerging areas such as cybersecurity, medical techniques, cloning, and autonomous robots. This study investigates the public’s views of science and technology policy, especially within the upcoming workforce, through a survey of their involvement and desired interest in the topic. The results of this study will be used to raise awareness of such issues within the public, research, and lawmaking communities, in hopes of promoting interaction between those communities and ultimately activism within science policy.
**Projecting the Effects of Climate Change and Environmental Policy on United States Fine Particulate Matter Concentrations Under Natural Variability**

**Bret Pienkosz**, Chemical Engineering, NC State University

**Mentors and/or Co-Authors:** Fernando Garcia Menendez

Fine Particulate Matter (PM 2.5) is an air pollutant that has serious health implications and is linked to a higher mortality rate at greater concentrations. This study projects the impact of climate change on PM 2.5 over the next century, under different greenhouse gas emission policies. Unlike most prior studies, natural variability is taken into account and its effects on PM 2.5 concentration estimates is directly examined. Using an ensemble simulation of air quality generated with an Integrated Global System Modeling system, we are able to project air quality impacts in the U.S. over the next century for three different climate change scenarios. We find that more aggressive greenhouse gas emissions policies generally reduce climate-induced PM 2.5 impacts, although elevated levels remain, primarily in the Midwest and East Coast. We also find, while using a set of varying initial conditions, that multidecadal estimates generally converge onto a mean estimate of PM 2.5 impact from climate change after using an appropriate simulation length. Additionally, this study is extended to explore climate impacts under different levels of climate sensitivity.

**Characterizing Trabecular Bone Microarchitecture in Murine Bone Post-Stroke using Micro-Computed Tomography**

**Sriharsha Pinnamaraju**, BME, NC State University

**Mentors and/or Co-Authors:** Jacqueline Cole-Husseini

Stroke sufferers fall more frequently and experience hip fractures 2-4 times more frequently than with aging, yet bone health is not typically monitored during rehabilitation. Quantifying the effects of stroke on bone microstructure will help us understand how bone loss occurs and may inform therapies to prevent fracture in stroke patients. We hypothesize that stroke negatively impacts microarchitecture and that exercise therapy can offset these detriments. Male, 12-week-old, C57Bl6/J mice were given either a stroke (n=15) or sham (n=12) surgery. Ischemic stroke was induced using left middle cerebral artery occlusion (MCAo). For sham surgeries, incisions were made, but the occluding filament was not inserted. Stroke and sham mice were divided into exercise and sedentary groups for 4 weeks; exercise mice ran on a treadmill (9 m/min, 37 min, 5 days/wk), while sedentary mice were placed on a stationary treadmill. After 4 weeks, mice were sacrificed, and hindlimb bones were collected, fixed in formalin, and stored at 4°C. The distal metaphysis of right femora (affected by stroke hemiparesis) were analyzed with micro-computed tomography (10-micron voxel size). Initial results showed that exercise improved bone microarchitecture (increased bone volume fraction and trabecular thickness) and cortical area, but stroke prevented these exercise-induced gains. We have also found that this mild ischemic stroke reduced blood flow in the proximal tibia, which is known to be associated with degraded bone material properties. The combination of these findings will help us understand the underlying mechanisms for bone loss and the increased risk for fracture post-stroke.

**Investigating optogenetic response in C. elegans**

**Riley Reid**, Chemical Engineering, NC State University

**Mentors and/or Co-Authors:** Adriana San Miguel

*C. elegans* are widely studied model organisms for investigating development and disease. In particular, *C. elegans* has been useful to understand the functioning and patterning of the nervous system. In this project, we aim to understand the connection between neuronal exercise and synaptic function and plasticity. Incorporating light-sensitive proteins into specific biological functions, optogenetics enables using light to stimulate various biological processes. In this project we use a transgenic strain, which has a optogenetic neuronal activation, and motor response upon blue LED stimuli. To investigate this response, we are designing and testing a platform to perform controlled optogenetic activation of motor neurons by LED illumination. This platform involves Matlab controlled imaging and video analysis as well as LED programming. The contraction response of these nematodes changes with varying flash lengths, recovery times, feeding times, and temperatures. We will utilize this novel platform to further analyze how contractions are affected by varying stimulation conditions and ultimately how different exercise regimes affect the neuronal strength.
Poster Number: 10

**Photocatalytic Mesoporous Titania Thin Films on Porous Substrate through the Evaporation-Induced Self-Assembly Method**

Christian Rust, Chemical Engineering, NC State University

**Mentors and/or Co-Authors:** Stephen Rankin

Mesoporous titania with accessible hexagonally close-packed (HCP) pores have been layered onto a macroporous support (anodized aluminum oxide (AAO) membrane). These composite membranes have been characterized through SEM imaging, solvent flux measurements, X-ray diffraction, and Grazing-Incidence Small-Angle X-ray Scattering (GISAXS) experiments. These membranes were made by first altering the AAO support to be chemically neutral to the deposition of titania with the pore templating surfactant, Pluronic F127, then using a sol-gel method of preparation using titania tetrachloride as a precursor, and through evaporation-induced self-assembly, a porous layer of titania was deposited onto the surface of the AAO support. These membranes were then calcinated to remove the surfactant. Further these membrane’s photocatalytic properties were tested in a batch system using methylene blue as a model pollutant.

Poster Number: 57

**Evaluation of sugar utilization pathways in the extremely thermophilic plant biomass degrading bacterium *Caldicellulosiruptor bescii***

Nathaniel Seals, Microbiology, NC State University

**Mentors and/or Co-Authors:** Robert Kelly, Jonathan Conway

*Caldicellulosiruptor* species are extremely thermophilic bacteria (Topt 70-75°C) that can degrade plant biomass polysaccharides, including cellulose. The oligosaccharides liberated are metabolized by *Caldicellulosiruptor* species without observable carbon catabolite repression, making *Caldicellulosiruptor* species ideal hosts for engineering strains to produce biofuels and biochemicals from plant biomass. In order to better understand sugar metabolism in *Caldicellulosiruptor* species, genes involved in the entry of sugars into glycolysis at glucose-6-phosphate, including the glucokinase (GK), the phosphotransferase system (PTS) E1, and two phosphoglucomutases (PGM), were deleted in *C. bescii* either individually or in combination.

Knockout vectors were constructed and transformed into ΔpyrE uracil auxotroph *C. bescii* strain MACB1018. Chromosomal integration of the knockout vector was selected based on complementation with pyrE and a high temperature kanamycin resistance gene (HTK). The second crossover was resolved using counter-selection on 5-fluoroorotic acid to select for plasmid loss. To evaluate the phenotypes of these strains, their growth in defined media containing different monosaccharides and disaccharides was monitored. Based on the resulting phenotypes, PTS appears to be involved in fructose, glucose, cellobiose and maltose transport. In addition, a strain with the GK and one PGM knocked out shows decreased growth on disaccharides but not monosaccharides. These phenotypes suggest that *C. bescii* has several redundant methods for shuttling sugars into glycolysis. Evaluation of these sugar utilization pathways is yielding a better understanding of the ways *C. bescii* metabolizes the sugars it liberates from plant biomass, which will enable engineering of strains for improved plant biomass degradation and conversion.

Poster Number: 64

**Detecting Dense Structure in Networks with Spectral Analysis**

Jean-Claude Shore, Computer Science and Mathematics, NC State University

**Mentors and/or Co-Authors:** Kyle Kloster, Vida Sullivan

In today’s Big Data era, there is a great need for efficient ways to analyze enormous datasets. This analysis can require huge amounts of computational resources and time, which drives a need for faster and more efficient algorithms. Certain structural properties, if present in these datasets, enable the use of specialized algorithms that provide for more efficient data analysis. However, many structural properties of this variety are quite difficult to detect.

In this project, we represent data as graphs and study when we can detect the presence or absence of dense regions using eigenvalue and eigenvector analysis. We show that, in certain cases, the eigenvalue distribution of a graph allows a yes/no answer to the question “Does this graph contain a dense pocket of nodes?” We find that once a graph is known to possess a dense substructure, certain eigenvectors can sometimes determine which nodes are present in the dense substructure.

Exploring these questions requires the generation of thousands of different graphs with controlled structural properties, and so we implement several existing random graph generation algorithms. Our experiments show that for graphs that are too uniform, it is quite easy to detect these dense structures. We therefore design a new algorithm focused on hiding these sub-structures while still maintaining a high degree of
random structure and show that graphs produced with this algorithm possess dense pockets that are entirely invisible to our detection tools. Future researchers can use these graphs to provide a meaningful baseline against detection tools.

Poster Number: 91

**Development of Gold and Silver Loaded Antimicrobial Platelet-like-Particles**

**Supriya Sivadanam**, Biomedical Engineering, NC State University  
**Mentors and/or Co-Authors:** Ashley Brown

Hemorrhaging after trauma is a significant clinical problem and is a major cause of death world-wide. Following trauma, clot formation is usually complicated by infection. This research aims to create antimicrobial and biomimetic platelet-like-particles (PLPs) that mimic the functions of natural platelets to enhance clotting capabilities by interfacing with the coagulation protein fibrin, and aiding in prevention of infection after trauma through antimicrobial action. PLPs are synthesized using highly deformable, ultra-low crosslinked (ULC) microgels that are loaded with antimicrobial gold or silver nanospheres and conjugated to fibrin-specific antibodies. ULC microgels are loaded via a noncovalent method wherein lyophilized microgels are rehydrated in solutions of gold and silver nanospheres. Size, morphology and loading capabilities of the microgel composites were characterized with transmission electron microscopy (TEM), atomic force microscopy (AFM). The antimicrobial potential of the microgel composites was evaluated using in-liquid broth culture. TEM showed dispersion of gold and silver nanospheres within the loaded microgels. AFM revealed a high degree of spreading of the microgel composites, similar to unloaded microgels, demonstrating that the loading method utilized here does not affect microgel morphology. In-liquid broth assays demonstrated that the microgel composites reduced E. coli growth significantly compared to the ULCs alone; a positive correlation was found between the size of the nanospheres used for the loading process and the inhibition seen. These results illustrate the potential of gold and silver microgel composites for the development of PLPs to promote coagulation and prevent infection following trauma.

Poster Number: 90

**Microgrid Financial Evaluation Tool**

**Matthew Sonnenberg**, Electrical and Computer Engineering, NC State University  
**Mentors and/or Co-Authors:** Ewan Pritchard

When developing a complex system, one of the most powerful tools which can aid with the process is modeling and simulation. This is especially critical in large scale applications such as in microgrids, where the price of components can make system testing prohibitively expensive. In direct response to similar feedback acquired during FREEDM’s Annual Industry Conference, FREEDM is spearheading the collaborative development of a customizable microgrid simulation and evaluation software tool. The goal of the work is to develop open source software which is user friendly, and able to provide appropriate resolution simulations of microgrid systems. Financial evaluation will also be a key feature, allowing for users to predict financial performance of a given system for a specified range of time. The open source aspect will allow companies to modify source code and import custom files without exposing proprietary information to other parties. Matlab and Simulink is currently being used to develop a prototype of the software and a time based simulation approach will be leveraged to allow for versatility of simulation while maintaining accurate results. The project is in its first steps of development which involves creating a general microgrid model, running basic simulations, and creating a GUI to facilitate the simulation process.

Poster Number: 95

**Wireless Transfer of Energy for EcoPRT**

**Tim Sonnenberg**, NC State University  
**Mentors and/or Co-Authors:** Srdjan Lukic

The EcoPRT is a two person autonomous vehicles designed to ferry students between campuses at NC State. Electric vehicles are usually charged by being manually plugged into a charging outlet. In order to remain completely autonomous, the EcoPRT would need another method of charging. This is where wireless transfer of energy comes into play. Wireless charging will allow the vehicle to remain completely autonomous while charging at over %90 efficiency. This will be accomplished through a power electronics backbone consisting of multiple boosting and conversion stages that will bring the voltage, current and frequency to the necessary specifications. Wireless communication will be used to communicate the batteries state of charge and allow
the microcontroller to determine the appropriate rate of charge. As a result, the EcoPRt will be able to efficiently charge without need for on-site personnel.

Poster Number: 123

**Binding Site Occupancy Models of Gap Genes in Drosophila Melanogaster Fruit Flies**

**Ryan Spurney**, Electrical Engineering and Computer Engineering, NC State University

**Mentors and/or Co-Authors:** Cranos Williams, Gregory Reeves

Gene regulation plays an important role in the successful development of *Drosophila melanogaster* from embryo to mature fly. Specifically, the regulatory interactions between ‘gap genes’ have been shown to orchestrate the development of the segmented embryo, allowing individual segments to develop distinct functions based on the spatial distribution of the genes across the embryo. Models that can characterize the interactions between these genes are needed to better understand how genetic disruptions impact embryo development. This research aims to analyze one potential model of gap gene interactions known as binding site occupancy. These types of models are systems of ordinary differential equations and rely on probabilities of interactions between proteins and binding sites, which are the key mechanistic components for activating and inhibiting gene expression. The binding site occupancy model is based on real, physical interactions rather than an arbitrary formula fitted to data. This allows for the potential of higher accuracy models with stronger predictive power. Two specific studies claim to have created accurate and predictive binding site occupancy models of gap gene expression in *Drosophila*. The methods and outputs of these models are reproduced and compared to experimental data to determine their effectiveness. This ongoing analysis will reveal the validity of the claims made by these studies, which will in turn offer a more complete understanding of how best to model gap gene expression. After this analysis has been completed, if room for improvement is present, a robust and predictive model incorporating insights from both studies can be generated.

Poster Number: 71

**Characterization of current artifacts in a high frequency magnetic materials testbed**

**David Storelli,** Electrical and Computer Engineering, NC State University

**Mentors and/or Co-Authors:** Subhashish Bhattacharya, Richard Beddingfield

The Dual Active Bridge (DAB) converter is a common circuit topology for DC-DC conversion, often used in DC microgrid and other renewable energy applications. The authors have implemented a novel circuit topology which uses the DAB configuration to isolate core loss in the magnetic cores used in many types of converters. The first construction of the circuit revealed a current artifact during switching, which was thought to be the result of losses in the H-bridge circuit, however the revised circuit demonstrates a similar effect, leading to the conclusion that the artifact must be due to core loss in the transformer.

The authors propose to demonstrate that the current artifact is most likely due to eddy currents, caused by the leakage flux, by comparing the current seen in an air core transformer, which is not susceptible to eddy current losses, to those seen in ferromagnetic cores. As expected, the air core transformer does not exhibit the current artifact seen in ferromagnetic or ribbon cores, confirming the belief that the losses are due to a property of the magnetic core. Further research is required to determine the cause of the core loss, however the loss is likely to be due to the effect of eddy currents. The isolation and reduction of this transformer core loss will be critical to optimizing the efficiency of the next generation of the DAB converter to be used in the FREEDM Center’s MW solar demonstration system.

Poster Number: 28

**A Pathway to Strengthening Support for BJC Teachers**

**Meghana Subramaniam**, Computer Science, NC State University

**Mentors and/or Co-Authors:** Veronica Catete

Computer science education in high school is fundamental for increasing the diversity in computing majors at a university level. However, computer science is not often taught in America before university, and usually, the professionals who teach it are not trained experts in computer science concepts and terminology. In this paper, we introduce a new style of coding rubric, which allows teachers to better understand the fundamentals of the course being taught. In the scope of this research, we focus solely on the Beauty and Joy of Computing, an AP Computer Science Principles course. Coding assignments were collected from two groups of students, and assignments were graded and compiled by raters. After being rated, the rubrics were modified to be better adapted to teachers’ expectations.
Cardiac Muscle Extracellular Matrix Hydrogels for Cardiac Muscle Repair

Brady Trevisan, Materials Science & Engineering, NC State University
Mentors and/or Co-Authors: Donald Freyttes

Extracellular matrix (ECM) scaffolds have been shown to be effective at promoting tissue repair and remodeling. This capability can be utilized to promote regeneration of cardiac muscle that is damaged during a heart attack. For this purpose, an optimized ECM hydrogel was created from porcine cardiac muscle tissue to be used as a regenerative material that can be injected directly into the damaged site to facilitate repair or used to guide therapeutic cells. The ECM was obtained through the decellularization of porcine cardiac muscle tissue using a variety of enzymatic and detergent washes. This ECM was then digested to create a liquid stock that will gel under physiologically relevant conditions. The gelation kinetics were determined using absorbance changes over time during the gelation process and the mechanical properties measured using a rheometer. This material can be used to promote regeneration of heart muscle in damaged areas or combined with induced pluripotent stem cell derived cardiac cells with the goal of enhancing cardiac tissue healing.

Development of a "mix and read" assay for target detection using Split-luciferase reconstitution

Apoorva Thatavarty, Chemical Engineering, NC State University
Mentors and/or Co-Authors: Balaji Rao

Current detection systems used to detect specific proteins in solution utilize an elaborate array of chemical or biological labeling of the target, and thus have limitations in applications and analysis. To address the shortcomings of the typically used detection systems, such as an ELISA, the goal of this project was to develop a "mix-and-read" assay where a target protein would be detected in a single step, without the need for washes. The system is based on a luciferase complementation assay using NanoLuc. Nanoluc is an enzyme derived from a luciferase found in the deep-sea shrimp Oplophorus gracilirostris, which was dissected into two non-active components. These components, when brought into close proximity via protein-protein interactions, recombine to form an active luciferase molecule, which catalyzes a light-emitting reaction. As a proof of concept, two lysozyme binders, derived from the protein scaffold Sso7d, were fused to the N and C terminus of the split components of NanoLuc to detect lysozyme in solution. Lysozyme was detected even after 3 minutes following the addition of the detection reagent (limit of blank: 250 nM, limit of detection: 364 nM), and the luminescence response increased with lysozyme concentration and incubation time. However, due to low protein yields, we are experimenting with an improved, more stable split luciferase construct. As Nanoluc is successfully displayed on the surface of yeast at high levels, the next steps involve the development of a systematic approach to isolate Sso7d binders for other targets that could be used with the split luciferase model.

American Red Cross - Emergency Response Vehicle Optimization Project

Danielle Sumner, Industrial Engineering, NC State University
Mentors and/or Co-Authors: Maria Mayorga

This project seeks to maximize disaster coverage, or the ability of the American Red Cross (ARC) to properly respond to situations via emergency response vehicles (ERVs) to reach likely affected regions in a given time period of 24, 48, 72, and 96 hours. To maximize this coverage, we use a dynamic mathematical model which will accurately provide the best estimation for fleet size per location. The model is dynamic because it can create either a baseline for the data or work to adapt to specific disaster scenarios. For the baseline model, each demand point is set to having a low level of disaster incidence. Conversely, for the scenario-based models, specific disasters are generated to attribute to the possible randomness of events that may occur. This research also generates possibilities for those given scenarios via the use of historical data and VBA manipulation. To develop the mathematical model, we used tools such as MATLAB, Java, and C-Plex. Our current recommendations for the ARC include fleet size and prepositioned locations that differ from the current ERV delegations held by the ARC, optimizing coverage so that affected regions are more likely to be covered.
**Cloning of Sulfur Oxidation Genes into Sulfolobus Acidocaldarius**

**Kisase Uwandji**, Chemical Engineering, NC State University

**Mentors and/or Co-Authors:** Robert Kelly, Benjamin Zeldes

*Sulfolobus acidocaldarius* is a thermoacidophilic archaea found in sulfuric acid hot springs. They are versatile and thrive in hot and acidic environments (T>75°C, pH <3.5). Some of the closest organisms to *S. acidocaldarius* are known for using inorganic sulfur compounds (RISCs) as a source of energy, which lead to the belief that thermoacidophilic archaea could be used in biotechnology as source of energy-dense fuel molecules. The long term objective of this research is to create metabolically engineered strains of *S. acidocaldarius* that recover the ability to utilize CO₂ as carbon source and RISCs as energy source. Studies and analysis of the Sulfolobales has revealed some key genes that can be used to enable *S. acidocaldarius* to fix CO₂ and oxidize RISCs. The project involved the cloning of specific genes to *Saci* using a Uracil nutrient selection method. Preliminary results and progress on additional strain development will be reported.

**Finding the Optimal Footprint of Disaster Inventory for American Red Cross**

**Casey Williams**, Industrial and Systems Engineering, NC State University

**Mentors and/or Co-Authors:** Maria Mayorga

American Red Cross recognizes that finding optimal footprint of disaster inventory, particularly in disaster-prone areas, is a difficult task. The goal of this research is to identify such footprint ahead of time via mathematical modeling, and to determine the optimal locations and amount of inventories throughout the network (19 Biomedical Warehouses, 5 Disaster Field Supply Centers, and 259 Local Chapters). In this project, we developed a model which minimizes the time required to respond to disasters. The initial model determines the optimal level of disaster inventories that should be held at the 5 major warehouses and the 19 warehouses used for biomedical supplies (footprint of disaster inventory). Levels and locations of disaster inventory are determined such that inventory must be able to reach points of need within 24 hours and achieve a particular service level. The criteria to choose the levels and locations of disaster inventory would be: (1) to minimize risk, (2) to minimize cost. The model follows three steps. Step 1 is to minimize the response time to regions considering only Disaster Field Supply Centers and Biomedical Warehouses. Because some demand cannot be met in Step 1 given response time restrictions (4 hours or 8 hours) and capacity restrictions, Step 2 determines the minimum number of regions/chapters where inventory is needed to serve the demand that could not be satisfied in Step 1. Step 3 is to provide recommendations about the size and location of additional warehouses that could improve the solution already found in Step 2.

**Design of a Highly-Enriched Uranium (HEU) Metal Fast Burst Supercritical Assembly**

**Thomas Wilson**, Nuclear Engineering, NC State University

**Mentors and/or Co-Authors:** John Mattingly

North Carolina State University (NCSU) Nuclear Engineering students are conducting a senior project, in collaboration with Los Alamos National Laboratory (LANL), to design a next-generation fast burst supercritical assembly that could potentially serve as a future replacement for Godiva-IV. This new machine will enable future experiments in criticality safety, radiation damage in materials, and nuclear forensics. The machine operates by creating a burst of high energy neutrons following a prompt supercritical excursion. The point reactor kinetics model was used to simulate the transient in the neutron population and delayed neutron precursor concentrations. Monte Carlo neutron transport models were used to estimate the kinetics parameters, including the spectrum-weighted mean neutron speed (approximately 2 cm/ns), fission cross section (approximately 1.2 barns), and fission generation time (approximately 7 ns). Monte Carlo neutron transport was also used to estimate the reactivity inserted by the burst rod and the reactivity removed by the safety block. Thermodynamic models are being used to evaluate thermal expansion, which in turn is used to estimate reactivity feedback. ANSYS was utilized to map the temperature distribution transients throughout the assembly. The design has a neutron lifetime of 7 ns ±3.3% which is less than the goal of 10 nanoseconds. The FWHM for a $1.10$ pulse is approximately 40 μs and the peak power will nominally be 10 to 100 gigawatts, depending on the duration of the positive reactivity insertion.
Mentors and/or Co-Authors: Hsiao-Ying Shadow Huang

The objective of this research is to determine the mineral make-up and collagen fiber microstructure of the tendon-to-bone transition tissue, insertion. Research was done in two different ways. The first method was to analyze the mineral make-up of the tissue. The mineral composition was studied using the tendon-to-bone section of a swine’s toe. A 100mm-thick sample was placed on a microscopic slide and studied using a Raman Microscopy. Five samples were tested. Each sample was tested in five spots, one in the bone region, three in the insertion region, and one in the tendon region.

The second was to look at the fiber orientation of the tissue. This research is still in progress. A small angle light scattering system (SALS) will be used to observe the fiber orientation as the tissue is being stretched. The images of the refracted light showing the collagen fiber architecture during the test will be captured by a charged-couple device (CCD) camera. The images will be analyzed using an in-house Matlab script to determine the tendency of the fiber orientation. The in-situ angular distribution of collagen fibers under physiologically relevant strain–rates could be related to the measured tissue-level mechanical behaviors. Results for this experiment will further the knowledge of tendon-to-bone transitions by analyzing a different sample type. The two previous experiment which this study was based on used either rat or mouse tendons. The similarities between rat, mouse, and swine indicates a high possibility for strong similarities with the human tendon-to-bone tissue.

Poster Number: 42

Synthesis of Light-Responsive Azobenzene-Crosslinked Hydrogels

Caroline Wright, Chemical & Biomolecular Engineering, NC State University

Mentors and/or Co-Authors: Stefano Menegatti

Stimuli responsive hydrogels, which change in material properties in response to an external stimulus, are ideal for applications such as drug or gene delivery systems, tissue engineering, and biosensors due to the high degree of control over the properties of the gel as well as their biocompatibility. Azobenzene has been used as a light-responsive unit in many hydrogel systems because the irradiation of azobenzene units with different wavelengths of light causes them to isomerize from a trans to cis configuration. An attempt was made to synthesize light-responsive hydrogels from hyaluronic acid, using azobenzene as the light-responsive crosslinking unit. Hyaluronic acid was thiolated, azido-functionalized, and allylated using 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide (EDC) with cysteamine, 3-amino-1-propane, and allylamine, respectively. Dipropargyl azobenzene was used as the crosslinking unit for the thiolated and azido-functionalized hyaluronic acids, and was created from dihydroxyazobenzene using propargyl bromide. Diallyl azobenzene was used as the crosslinking unit for the allylated hyaluronic acid, and was created from dihydroxyazobenzene using allyl bromide. It was found that the modified hyaluronic acids were water soluble, but the azobenzene linkers were water insoluble. A solubility study was performed to identify mixed aqueous-organic reaction conditions using water with acetone, dimethylformamide (DMF), dimethylacetamide (DMA), and dimethyl sulfoxide (DMSO). Hyaluronic acid and the azobenzene linkers were found to be incompatible in all solvents. It was concluded that this was not a viable chemistry for the synthesis of light-responsive azobenzene-crosslinked hydrogels. Future work may explore the use of polyvinyl alcohol as a base polymer, crosslinked with azobenzene-4,4'-diboronic acid under aqueous conditions.

Poster Number: 19

Film Property Variations based upon Drying Conditions

Jacob Zimmerman, Chemical Engineering, NC State University

Mentors and/or Co-Authors: Richard Spontak

Previously, we were performing experiments on polymer solutions based on drying kinetics and drying times. We did a similar experiment with other commercial polymer, and got an interesting result. So, we are repeating the experiment with polyvinyl alcohol (PVA). PVA is a thermoplastic polymer that holds high potential for having several applications in industry due to its fantastic ability to form plastic films and compatibility with biological molecules. Previously, we prepared solutions of commercial polymer with varying amounts of nanocellulose included in the weight percentage. The solutions were cast into petri dishes and allowed to dry at room temperature over the course of 3 weeks. During this period, the petri dishes were weighed at regular intervals as the films developed. The mechanical properties of this are still under testing, with variation of the drying temperatures and drying times to see how the final film property is altered.
College of Humanities and Social Sciences
Evaluating Sexual Health Communication Among Parents and Adolescent Girls
Irene Ball, Business Administration, NC State University
Mentors and/or Co-Authors: Laura Widman
Parent-child sexual health communication has been shown to promote healthy sexual decision making among adolescent girls. Although there have been several studies looking at ethnic group differences for mother-daughter communication, little research exists on fathers. The current study examined if there were differences by race/ethnicity in patterns of communication between adolescent girls and both their mothers and fathers. Participants were a diverse sample of 222 girls (38% White, 24% Black, 29% Hispanic/Latina, 9% Mixed/Other; M.age=15.2) from a rural, low-income school district in the southeastern U.S. Girls reported on how often they communicated (0=never, 1=1-2 times, 2=multiple times) with both their mother and father about sexual topics throughout their lifetime. Girls of all ethnicities communicated significantly more often with their mother compared to their father (p<.001). However, there were no significant group differences in rates of parent-child communication by ethnicity (p > .05). For communication had with mothers, 80% of White, 79% of Black, 90% of Hispanic/Latina, 89% of Mixed/Other ethnicity girls spoke to their mother about sex. For communication had with fathers, only 42% of White, 30% of Black, 54% of Hispanic/Latina, 27% of Mixed/Other ethnicity girls spoke to their father about sex. There was not a specific racial/ethnic group that communicated with their mother or father in their lifetime more than the other ethnic groups. These findings demonstrate that future interventions do not necessarily need to alter their information or message to influence different ethnicities, but more studies should be conducted to further this claim.

Would GM crops benefit the poor if they were available in banned countries?
Justin Bethea, Business Administration, NC State University
Mentors and/or Co-Authors: Nora Hænn
To answer the question of whether GM crops would benefit the poor in countries where they are currently, this research compares seed chains in Kenya—where GM crops are prohibited in agriculture—and South Africa—where GM crops have been approved for planting and sale since the late 1990s. The research identified whether and where in the agricultural cycle GM products intersect with South Africa's lowest income groups. In comparison, for Kenya the research examined current seed chains to identify where hybrid seeds intersect with Kenya's lowest income groups. Hypothesizing that hybrid seeds would be replaced by GM seeds, the research questioned whether in either case study GM crops could or do meet the food or agricultural needs of the poorest sectors of these countries. GM crops offer higher yield and more resiliency to disease and pests, these factors along with a substantial push from major corporations for market entry into many African countries point to the likely conclusion that Kenya will soon implement GM crops will be implemented in addition to the current hybrid seeds. The higher yield of cheap GM crops in South Africa has proven beneficial to the lower income groups there and should stand to do the same if implemented into Kenya's current crop production.

Alternative Facts: How Japanese Neo-Nationalists Are Revising History
Margaret Bittle, International Studies, NC State University
Mentors and/or Co-Authors: Carol Lewald
Neo-nationalist efforts in Japan seek to alter historical narratives in a more pro-Japanese light within middle school and high school Japanese history textbooks. Neo-nationalists, including Prime Minister Shinzo Abe, promote patriotism by rewriting the “masochistic” versions of modern Japanese history by pressuring the Ministry of Education to limit depictions of atrocities committed in World War II and creating the revisionist text, New History Textbook (Nelson, 2002, p.130). Textbooks act as a powerful source of national identity formation for future generations as well as symbols of remittance for past atrocities. Neo-nationalist revisions ignore or justify historical moments such as the Unit 731 experiments, the Nanjing Massacre, comfort women, and the Okinawan forced suicides. This research underscores how nationalistic and revisionist ideologies erode international cooperation and diplomacy between Japan and their imperial victims, South Korea and China. International cooperation is imperative for regional stability in an increasingly codependent international system. Japanese revisionism contributes to the rise of counter nationalism and anti-Japanese sentiment in China and South Korea and the escalation of tensions over the Senkaku/Diaoyu Islands. By analyzing current scholarly literature on how neo-nationalists attempt to alter textbooks, I examine the international consequences of the neo-nationalists efforts. Despite low domestic
support of the highly controversial *New History Textbook* (Bukh, 2007, p.686), this revisionism offends the victims of Japanese imperialism by either ignoring, justifying, or uplifting the atrocities the Imperial Army committed in World War II and harms international cooperation with South Korea and China, thereby threatening regional stability.

Poster Number: 68
**Examining the Relationship Between Anticipatory Race-Related Stress and Previous Discrimination Experiences**

*Marissa Brinkman*, Psychology, NC State University  
*Mentors and/or Co-Authors*: Elan Hope  

Race-related stress can have a detrimental effect on individuals over the course of a lifetime. The negative effects of discrimination can be particularly significant during the developmental stage of emerging adulthood for African Americans (Hope, Hoggard & Thomas, 2015). In this study we investigated the relationship between anticipatory race-related stress responses and an individual's personal history with racial discrimination in order to examine the affective and cognitive consequences of discriminatory experience for Black adolescents and emerging adults (N = 893). Anticipatory stress activation and stress responses include perseverative cognition, secondary appraisal, and psychological and physiological anticipatory race-related stress. Previous discriminatory experience was assessed as being culturally, individually, or institutionally propagated. The four factors measuring anticipatory stress were each individually compared to participants' average reported affective response to each type of discrimination, and the count of different discrimination experiences. Bivariate analyses found that preservative cognition and psychological anticipation were positively correlated with participants' average affective response to discrimination across all three categories. Physiological anticipation was positively correlated with affective response to individual and institutional racial discrimination. Secondary appraisal was not significantly correlated with any categorical average response to discrimination. There were significant correlations with every measure of anticipatory stress with the count of discrimination participants reported experiencing. These findings suggest that as one encounters more situations in which they experience racial discrimination, one becomes more stressed when faced with the anticipation of future racial discrimination.

Poster Number: 1
**GM Crops are Selectively Helping to Feed the Poor**

*Alexis Brown*, Communication, NC State University  
*Mentors and/or Co-Authors*: Nora Haenn  

The makers of genetically modified crops claim these can produce greater quantities of food to feed the ever growing world population. In light of this claim, this study identified the major GM crop companies and evaluated their websites to see how they portray their purpose to the public. The study examined the top five biotech companies with greater attention to three companies--Syngenta, Bayer, and Monsanto--which consistently published material associated with the key search terms of "genetically modified", "poverty", "global south", and "food security". Syngenta, Bayer, and Monsanto were also selected because of how user friendly they were for people who know nothing about this industry. From these sites, it was determined that GM crops are helping to feed the poor in developing, third world continents such as South Africa and Asia. However, in the United States they are not tackling the problem as aggressively.

Poster Number: 3
**Attacking ISIL on Twitter: Addressing Ethical Responsibility in the Weaponization of Social Media**

*Grace Callahan*, International Studies, NC State University  
*Mentors and/or Co-Authors*: Carol Lewald  

More than 30,000 foreign fighters from over 100 countries have been recruited by ISIL with the help of social media, exposing the lack of oversight of social media platforms and the resulting ease in which terrorist groups are able to spread their message, recruit sympathizers, and maintain their network of supporters. Although no state recognizes the authority of ISIL, the group's social media presence and effectiveness of their targeted propaganda commands the attention of the world. This research examines the role of nation-states, social media entities, and the public in combating terrorist propaganda by discrediting their self-projection on social media, specifically within the context of ISIL and Twitter. Issues surrounding the implementation of regulatory measures on social media platforms are also explored, including delegating ethical responsibility among the international community, defining the limits of content to be regulated and
balancing protecting the right to privacy and freedom of speech by users with the need for international security. I argue that the most effective means of combating the spread of ISIL propaganda on Twitter involves a simultaneous joint effort by nation-states, social media companies, and the public to create a system of international oversight and regulation of social media abuse by terrorists. As each of these actors are limited in their individual capability to thwart terrorist propaganda on social media, addressing this issue necessitates a combination of their strengths in order to establish an effective counterbalance to the dissemination of terrorist propaganda.

Poster Number: 106

Offender and Victim Characteristics and Predicting Sentence Length
Caitlin Davis, Psychology, NC State University
Mentors and/or Co-Authors: Joel Cartwright

Multiple factors play a role in determining an offender’s sentence. The crime itself, evidence, and testimony, for example, are factors used to assess an appropriate sentence for an offender. While these factors are used to assess an appropriate sentence length, research on sentencing disparity argues that offender characteristics also play a role in explaining sentence length. As such, this study examines the relationship between offender characteristics and victim characteristics on sentence lengths of a nationally representative sample of U.S. inmates. Data are from the 2004 Survey of Inmate in State and Federal Correctional Facilities (N=14,499). The predictor variables of interest in this analysis are age, race, sex, criminal history, learning disability, employment at time of sentencing, whether they graduated high school, the controlling offense, relationship to the victim, and victim characteristics. I conducted regression analyses supplemented with relative weights analyses, separating non-violent offenders and violent offenders with one victim. The results from the non-violent offense analysis indicated that offender characteristics were able to explain 7% of sentence length variance ($R^2 = .07$) and age at sentencing accounted for more than 58% of the total explained variance ($RW = .04, 95\% CI = .03 -.06$). The results of the violent offense with one victim analysis indicated that offender characteristics were able to explain 12% of sentence length variance ($R^2 = .12$) and age at sentencing accounted for more than 73% of the total explained variance ($RW = .09, 95\% CI = .06 -.1$). Impacts from this study indicate that offender and victim characteristics can be used to explain some of the variance in sentence length.

Poster Number: 78

How Socialization Works at Collegiate Gaming Events through the Poker Frame
Thiago De Souza, Communication Media, NC State University
Mentors and/or Co-Authors: Nicholas Taylor

Lasting friendships can form through mutually enjoyed recreational activities, from hobbies such as scrapbooking to games of pick-up basketball. Communication scholars have long argued that video games can similarly act as a form of socialization for players. Existing research in this area typically focuses on online gaming and large-scale gaming conventions -- but what about collegiate gaming events? This presentation reports on qualitative fieldwork at the “Clash of the Carolinas”, a campus gaming tournament held at NC State in January 2016. We argue the event offered fairly constrained opportunities for socialization between participants. Those we interviewed (20 in total) were there primarily to play games, without intending to make new friends. Despite engaging in co-located play with and against other participants, there was little interest to pursue relationships beyond the game, despite their shared hobby. This presentation draws on Erving Goffman’s notion of “frames”. This framework invites researchers to compare game-based interactions to other communicative practices, and is well-established in studies of videogaming. The frame that seems most applicable for understanding socializing at Clash of the Carolinas is the poker game – an agonistic context in which the primary goal of individual accomplishment supersedes opportunities for developing relationships. This is in sharp contrast to other, seemingly comparable activities, either campus-based (student clubs and organized sports) or game-based (online collaborative play). As such, this research points to the importance of qualitative, in-depth case studies for understanding the communicative and social significance of games.

Poster Number: 112

Performance of masculinity: A comparison of men’s and women’s expectations about conformity to masculine norms
Shelby Edwards, Psychology, NC State University
Mentors and/or Co-Authors: Joseph Simons-Rudolph, Christine Brugh

Existing research shows that masculinity is built upon the expectation of self-reliance, emotional restriction, competitiveness, dominance, aggression, and toughness (Fox et al., 2014; Seabrook et al., 2016; Vogel et al., 2011). Accordingly, these typical characteristics are unhealthy for men and women; the pressure to comply with masculinity norms is associated with sexually aggressive behavior and increased negativity toward women (Fox et al., 2014; Seabrook et al., 2016). Furthermore, it is important to investigate how men and women differ in their expectations of masculine norms. The present study extends the research by precisely capturing who holds the societal expectations for masculinity by comparing scores of 96 college aged men to those of 95 college aged women using the Conformity to Masculine Norms Inventory (CMNI). Scores on the CMNI’s seven subscales were also evaluated. Our results show that, on average, men have higher overall scores on the CMNI (M=97.88) than women (M=71.29). Accordingly, men’s scores were significantly higher than women’s on each of the seven subscales: Self-reliance (Mmen=10.55, Mwomen=8.36), restrictive emotion (Mmen=16.59, Mwomen=11.52), negativity towards homosexuals (Mmen=18.04, Mwomen=13.66), avoiding feminism (Mmen=19.83, Mwomen=14.89), sexual impulsivity (Mmen=7.79, Mwomen=5.76), toughness (Mmen=14.65, Mwomen=11.08), and dominance (Mmen=17.84, Mwomen=12.27). This supports the theory that “masculinity is a performance done by men for other men” (Vandello & Bosson, 2013). The present study supports the claim that women have much lower expectations for men to practice traditional masculinity, implying that men are not performing for women.

Poster Number: 8
Evaluating College Students’ Priorities of University-Provided Sexual Health Resources
Caroline Gainey, Psychology, NC State University

Mentors and/or Co-Authors: Laura Widman

Due to risky sexual behavioral patterns, undergraduate populations are particularly vulnerable to negative health outcomes. Institutional barriers, such as limited resources or lack of valued services available, may impede students’ access to critical sexual health services. The purpose of the current study is: 1) to examine students’ priorities of NC State’s sexual health resources and 2) to understand if sexual health priorities vary by students’ gender, sexual orientation, and sexual activity status.

In Fall 2016, 576 NC State undergraduates completed a confidential survey and reported on their demographics, sexual health priorities on campus, and sexual attitudes and behaviors. Sexual health priorities were assessed with a list of 26 services that were currently offered, previously offered, or could be potentially offered to students on campus. Participants rated each service as a “must have,” “would be OK to have,” or “should not have” for their campus.

Results indicated 5 of 26 sexual health services were endorsed as “must have” by at least 75% of participants. Men equally or more strongly endorsed all services on campus than women, with three exceptions: women reported a greater need for condom dispensers, anonymous condom delivery services, and condoms of well-known brands (ps<.05).

In general, students appear to value anonymous services over those that require in-person participation. Consistent with sexual script theory, men and women may endorse different services due to the social stigma targeting women. Future research could investigate how gender stereotypes affect university-provided resource use, providing information for more effective sexual health programming.

Poster Number: 76
Examining If Spoken Language Relates to Satisfaction Ratings for a Positive Parenting Program
Kaitlyn Godfrey, Psychology, NC State University

Mentors and/or Co-Authors: Mary Haskett

Triple P, an evidence based practice to enhance parenting skills, has been implemented in more than 25 countries and has been found to be effective for parents across different cultural and racial backgrounds. Parents use satisfaction ratings to report how satisfied they are with the program. In the United States, Triple P is delivered by English-speaking and Spanish-speaking providers. There are no previous studies that have evaluated the satisfaction ratings that Spanish-speaking parents have reported about Triple P. Given the lack of literature in this area, this study was exploratory in nature. This study included 356 parents who attended a Triple P Level 2 seminar that was delivered in Spanish (N=67) or English (N=289). After the 90 minute seminar, parents rated their satisfaction level with 10 aspects of the seminar. An independent-samples t-test was conducted to compare the mean satisfaction ratings from English and Spanish speaking parents who completed the seminar. There was no significant difference in satisfaction ratings reported by Spanish-speaking parents (M = 6.59) and English-speaking parents (M = 6.31; t (354) = 2.83, p = .005). In sum,
language of delivery does not appear to impact satisfaction ratings. Future studies could examine parent satisfaction ratings with the Triple P program in a non-English speaking country to see if the results yield similar findings.

Poster Number: 89

Examining the Community Awareness of an Evidence Based Intervention Program and Parents’ Most Common Sources of Support

Shannon Grivas, Psychology, NC State University

Mentors and/or Co-Authors: Mary Haskett

Many parents seek advice regarding their child’s behavior from various sources. Triple P—Positive Parenting Program, an evidence based intervention program, supports parents by teaching parenting skills. The purpose of this study was to examine: 1) if more parents had heard of Triple P over a three-year implementation period and 2) what sources of support were most commonly endorsed by parents. We predicted an increase in Triple P awareness over the three year period and the top three sources to be family, spouse, and friends. Participants (N=784) were parents surveyed in the Raleigh area regarding awareness of Triple P and the three most common sources of support. Results from the multiple regression analysis showed that awareness of Triple P increased from year one (4.8%) to year two (12.5%) and decreased from year two (12.5%) to year three (6.8%). Contrary to our hypotheses, there was no significant relationship between the sources and whether parents have heard of Triple P. The top three sources reported by parents having heard of Triple P were friends, family, and pediatrician. The clinical implications of our findings and directions for future research are explored.

Poster Number: 107

Policy Implications of Limiting Genetically Modified Crops

Kendall Harkey, Global Sustainability and Development, Spanish, NC State University

Mentors and/or Co-Authors: Nora Hænn

Food insecurity and poverty are problems for millions of people in developed and developing countries alike. The rise of genetically modified (GM) crops has the potential to address these challenges. Thus, this study asks: How are concepts of wealth and poverty expressed in policy documents on GM crops? The research examines 6 key policy documents cited in the 2016 National Academy of Science report “Genetically Engineered Crops: Experiences and Prospects.” The documents range in length from 12 to 359 pages and include policy overviews by organizations such as the International Food Policy Research Institute (IFPRI) and the Food and Agriculture Organization of the United Nations (FAO). In order to evaluate concepts of wealth and poverty within the documents I coded the texts for mentions of income distribution, as well as language that offers a policy evaluation and evaluation of GM technology. The coding shows that GM crops have the potential to alleviate poverty for resource poor farmers and improve the health of millions of people. They can increase crop yield and reduce production costs over conventional crops, as well as mitigate the effects of climate change. As a result, resource-poor farmers can gain a higher net income and farm in a manner that is more efficient and better for their health and the environment. However, regulatory policies and delivery issues coupled with a lack of infrastructure and biotech capacity; as well as lack of information and distrust have hampered the implementation and potential success of these crops in developing countries.

Poster Number: 125

Black Youth Political Participation

Jotionette Jones, Political Science/Psychology, NC State University

Mentors and/or Co-Authors: Elan Hope

According to van Deth (2014), political participation can be loosely defined as citizens’ activities affecting politics. Black youth are involved in the political process in both traditional (e.g., voting, campaigning) and non-traditional (e.g., youth-led social justice movements, politically motivated cultural and artistic expression) ways. In the current study, we examine the percentage of young Black people (ages 15-29) have engaged in traditional and non-traditional political activities and expectation for future participation in traditional and non-traditional political activities. We then examine whether past political participation and future political participation differ by gender and by education level. Participants come from the Race and Politics Study (RAPS), a cross-sectional national survey of 893 self-identified Black youth in the United States, ages 15-29. The data shows that men typically engage in more community based work than women, such as mentoring or teaching and following political activities through the media. Women tend to put themselves at
risk more by participating in violent acts, such as risking damage to themselves and their personal property, and risking arrest for issues related to the Black community. In leadership roles that support the Black community, women tend to serve more frequently than men. Results based on education level show that the more educated you are, the more you are engaged in activities or the solving of issues within the Black community. Findings from this study highlight variation in political participation for Black adolescents and emerging adults.

Poster Number: 101

Examining the Effects of Faculty Diversity at Top 200 Universities and Colleges on Undergraduate Student Retention and Graduation Rates

Tierra Knight, Psychology, NC State University

Mentors and/or Co-Authors: Elan Hope

Diversity on college campuses is speculated to have substantial impacts on not only students of color but also white students. For example, Gurin and colleagues (2002) found that experiences with racial and ethnic diversity was positively correlated to learning outcomes for all students. Additionally, research has shown that informal interactions with diversity influenced higher levels of intellectual engagement and self-assessed academic skills (Gurin, 2002). In our current study, we use Simpson's Diversity Index (SDI) to measure the rate of student and faculty diversity in the top 200 National Universities and Colleges and the top 200 Liberal Arts Colleges. We then examined the relationships between rates of faculty diversity and undergraduate student diversity, rates of faculty diversity and undergraduate retention, and rates of faculty diversity and undergraduate graduation. Our results showed a significant positive correlation between undergraduate retention and the diversity among tenure-track faculty and tenured faculty. Similarly, there was a significant positive correlation between the rates of graduation for all racial/ethnic groups and both undergraduate student diversity and tenure-track faculty diversity. Greater diversity among faculty and undergraduate students on college campuses are positively correlated with higher undergraduate retention and graduation rates. Based on our data, we were able to conclude that undergraduate students benefit substantially from the presence of diversity in their academic environments.

Poster Number: 138

Directing a 'Theater of Terror': Press Freedom and Transnational Terrorist Attacks

Samili Marathe, International Studies - Global Relations, NC State University

Mentors and/or Co-Authors: Carol Lewald

Press freedom, defined as the right and protection to publicize ideas through media under little governmental control, allows terrorist groups to thrive (Hoffman et al 897). Press freedom conceivably allows terrorist groups to create a 'theater of terror', or dramatize and publicize their attacks to gain new recruits and spread their ideology (Yarchi, et al 265; Bell et al. 605-606). A dramatization of attacks occurs through partisan media coverage, primarily those involving conflict, powerful actors and/or prominent locations (Surette et al, 360; Hoffman et al 898). Existing research indicates there is a symbiotic relationship between the press and transnational terrorist groups (Powell, 91). This can explain why terrorists may attack countries such as France or the U.K repeatedly as opposed to Norway or Sweden. France and the U.K. are prominent locations for tourism and world events, whereas Norway and Sweden have a higher worldwide press freedom ranking (“Reporters Without”). Attacks on British or American nationals, however, offer more strategic benefits, including an increased pressure from the country’s citizens to withdraw support from a terrorist groups’ home country (Plümper & Neumayer 79-80). Therefore, by analyzing the press freedom index in relation to existing literature on transnational terrorist attacks, this study proposes that while press freedom is a motivator behind terrorist attacks, there are also other factors such as the international alliances that states have, level of political competition they offer, their respect for human rights, and an under-reporting bias within the countries’ media.

Poster Number: 91

Cross Modal Time Perception

Kevin Mathew, Statistics, NC State University

Mentors and/or Co-Authors: Douglas Gillan, Federico Scholcover

Previous work (Grondin and McAuley 2009) explored the concept of cross-modal time perception. Cross-modal time perception is when we use two stimuli, either visual or auditory, to mark the beginning and end of a duration of time. We call this an empty interval procedure because there is no stimulus between the
markers. This study extended the previous work by including within-marker sensory binding conditions. Participants were asked to measure empty intervals of different durations marked by a visual, auditory, or simultaneous visual/auditory marker. Results showed that performance was worse when the start and the end marker was the same, that is image-image, sound-sound, and simultaneous-simultaneous. The performance was best when the start and end stimulus was incongruent and when the end stimulus was an image. Results imply that sensory binding across was the best and sensory binding within imposed a penalty. If markers are the same, then the performance is the worst. These results taken together suggest that timing is best when a sensory load is low and distributed. Follow-up studies can take this in two primary directions: (1) Testing differences within a stimulus, such as using a red marker and a blue marker. (2) Testing with different time intervals, as we use different cognitive mechanisms for timing at different durations.

Poster Number: 21

Posttraumatic Growth among Military Veterans with Personality Disorders
Sarah Mills, Psychology, NC State University
Mentors and/or Co-Authors: Sarah Desmarais
This poster investigates Post Traumatic Growth (PTG) constructs among military veterans who screened positive for either Schizoid Personality Disorder (SPD) or Antisocial Personality Disorder (ASPD). Posttraumatic growth is the phenomenon of positive personal changes that result from the struggle to deal with trauma and its psychological consequences (Tedeschi & McNally, 2011). The aims of this study investigate the differences in endorsement for multiple domains of posttraumatic growth in military veterans with personality disorders, specifically including: levels of rumination, challenges to core beliefs, levels of specific domains, and endorsement of specific domains of posttraumatic growth. The data included were part of a larger subset of data from a Master's thesis by Jessica Kelley Morgan.

Poster Number: 140

A Study to Improve Sexual Health Outcomes For At-Risk Youth in Wake County
Madison Morrow, Psychology and Criminology, NC State University
Mentors and/or Co-Authors: Laura Widman
Community-based participatory research (CBPR) is a research strategy involving collaboration among researchers and community members who have mutual interests in improving community disparities. This poster will describe a project that strives to incorporate a CBPR framework to improve sexual health in Wake County youth. We will share challenges faced, lessons learned, and continued efforts to address issues throughout the project. Our research focused on: 1) developing a partnership between the Teen Health Lab and a local community agency that serves at-risk youth; 2) pilot testing an intervention program. Developing Relationship: We reached out to a local organization to assess need for sexual health programming. After establishing need, we met with organization staff to propose a web-based sexual health program called HEART and assess barriers and staff concerns. Piloting Intervention: During initial recruitment, we reached three girls in a four-month period, a rate that would make an efficacy study infeasible. We met with organization staff to brainstorm ways to streamline recruitment, making it easier for staff to refer clients to us. Additionally, staff were welcomed to add questions to our survey. A component of CBPR is dissemination and translation of research. However, while we will ensure the most benefits possible for the organization, we had to set boundaries regarding sharing information. Although we will report an aggregate of results to staff, we clarified that we must maintain participant confidentiality and cannot provide individual-level data. We will maintain contact with staff and attend staff meetings to provide updates.

Poster Number: 27

Political Reasoning Bias
Christopher Neale, Psychology, NC State University
Mentors and/or Co-Authors: Anne Mclaughlin
Voters tend to polarize towards the leaders of the two parties, and once this polarization begins, there seems to be no limit to which the voters will fight for their candidate (Thibodeu et al., 2013). Reasoning bias is defined as a flaw in decision-making that is a result of one’s desire to maintain their beliefs despite contradicting information. This bias lies in human reasoning ability, where emotion and beliefs can pass off as logic and reason (Vroling et al., 2016). We are looking to analyze the disparity of reasoning bias across party lines by providing a politically neutral article on a topic of little current significance. Participants will be
randomly assigned to be told that the topic is supported by either the Democratic National Committee or the Republican National Committee. They will be asked how much they agree with the given topic. They will then take a political alignment test via: "Political Compass" which will generate a numeric value that capture their political beliefs. The comparison of this in addition to their personal opinion score on the article should predict their reasoning bias. For example a person who scores as a strong democrat and is told the Republican National Committee disagrees with the article may show stronger agreement than if they were told the Republican National Committee agreed with the article, displaying reasoning bias. The applications of this research include the importance of phrasing amongst news articles and sources of information.

Poster Number: 81  
**Self-Efficacy for Communication and Acceptability of Dating Violence Among Adolescent Teen Girls in Rural North Carolina**  
Ndella Njie, Psychology, NC State University  
Mentors and/or Co-Authors: Laura Widman

In the U.S., one in three adolescents is a victim of physical, sexual, emotional or verbal abuse from a dating partner. There are several protective and risk factors associated with the occurrence of adolescent dating violence. Knowledge of healthy relationships, skill acquisition, and values affirmation leads to positive communication about sexual topics and is shown to yield lower levels of dating violence among adolescents. This study will examine the association between self-efficacy for sexual communication and dating violence among adolescent girls and explore whether higher self-efficacy for sexual communication results in lower acceptability of couple dating violence. Participants were 222 10th grade girls (M=15.3) enrolled in a RCT (n=107 intervention; n=115 attention matched control). At pretest and and follow-up posttest, participants completed surveys assessing outcome measures, including self-efficacy for sexual communication measured on a 4-point likert scale (1=couldn’t do it, 2=unsure, 3=sure, 4=very sure) and acceptence of couple violence measured on a 4-point likert scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree). Participants reported relatively high self-efficacy for sexual communication (M=3.56, SD=.49) and low acceptence of couple violence (M=1.28, SD=.47). The correlation between self-efficacy for communication and acceptence of couple dating violence were found to be statistically significant and negatively correlated, r(208)=-.40, p<.001. Given that high self-efficacy for communication yields lower acceptence of couple violence, increasing self-efficacy could potentially lead to lower incidences of dating violence among adolescents.

Poster Number: 87  
**Relation Between Agency Support And Practitioner Implementation Of Triple P**  
Krista Sawler, Psychology, NC State University  
Mentors and/or Co-Authors: Mary Haskett

Practitioners often struggle to implement new evidence-based practices. Workplace supports are often needed to enhance implementation. Triple P-Positive Parenting Program is an evidence-based program that enhances parenting skills. This study examines the relation between level of perceived agency support and practitioners’ belief that Triple P fits with typical services. Expected results were that practitioners with perceived moderate to high levels of agency support would feel Triple P fits better with typical services compared to practitioners with low perceived support. Triple P practitioners (N=258) were recruited from accredited Triple P providers in six county clusters. Participants completed an online 19-item questionnaire, which included questions about practitioners’ experiences with implementation and use of Triple P. Participants identified what level of support their agency provided for Triple P and how well it fit with typical services. The answers were dichotomized into two groups for analysis. Results from a Chi-Square analysis revealed a significant relation between perceived fit of Triple P with typical agency services and support from the agency to implement Triple P,χ²(1,258)= 17.395, p <.01, f=.26. There were a higher proportion of practitioners with a high level of agency support that felt Triple P fit with typical services. This study reinforces the important role agencies play in supporting practitioners to promote the use of evidence-based practices. When agencies support a new practice, practitioners are more likely to make it fit their services. Future studies could examine what forms of agency support, such as peer supervision sessions or incentives, are most successful.

Poster Number: 54  
**Influence of Westernization on Abortion Attitudes**  
Jeen Shaji, Economics, NC State University  
Mentors and/or Co-Authors: Patsy Sibley
Many scholars have discussed about varying abortion attitudes in different countries, but little is known about factors influencing this irregularity from one country to another. Bahr and Marcos (2003), Wilson et al. (2011) and Scheepers et al. (2002) consider religious affiliation and education as factors affecting moral liberalization, which influences abortion attitudes. A notable deviation with most studies is that the effect of education doesn’t hold true across different nationalities. However, none of them investigate the reason behind such cross-border differences. In response, my research aims to fill this “gap” by studying the relation between Degree of Westernization and abortion attitudes amongst students of similar educational levels.

Data was collected from college students from Mumbai (a Metropolitan city) and Kottayam (a small town) using an online survey. Amongst other results, it was found that 13.79% students from Mumbai came across the term “abortion” more than once a month while all (100%) students from Kottayam came across it once a month or less. 46.67% of the students from Mumbai chose pregnancy before marriage as a reason why they themselves would consider abortion compared to 10.71% from Kottayam. This can be an indicator of relatively more liberal abortion attitudes in places practicing a higher degree of Westernization. These results may indicate that increasing westernization can possibly lead to more liberal abortion attitudes.

Poster Number: 17
Are GM crops being used to feed the poor?

Jordan Shapiro, Environmental Science, NC State University
Mentors and/or Co-Authors: Nora Häenn

This project furthers the findings of the 2016 National Academy of Science (NAS) report on GM crops to determine how concepts of wealth and poverty are expressed in research on GM crops. The research then used this assessment to evaluate whether the crops alleviate poverty. The project gathered 10 articles from the extended bibliography of the NAS report’s chapter on socio-economic effects. The project then applied a system of codes designed to track references within the articles to ideas of income distribution, population sizes, and geographic location. Using MAXQDA software, the research applied these codes to the articles on a paragraph-by-paragraph basis; sorted the codes by frequency of use and context; and made evaluative assessments of the articles’ discussions of wealth and poverty. The research found GM crops are often advertised as a pro-poor solution to poverty related issues. However, the evidence that these crops are actually pro-poor is shallow.

Poster Number: 7
Analyzing Terrorism and Mass Shooting using Durkheim’s Four Types of Suicide

Chan-Su Simmons, Criminology, NC State University
Mentors and/or Co-Authors: Margaret Zahn

The understanding of suicide attacks involves analyzing the meaning of such actions, as well as understanding the social environment, situation, and will of the group. Durkheim used social elements to understand suicide by splitting it into four different “types” being Fatalistic, Anomic, Altruistic, and Egoistic suicide. These can be looked at as consequences of too much or too little integration, or regulation. By using the conditions and situations terrorist groups are undergoing and linking them with social psychology and Durkheim’s social understanding of different types of suicide; we can further understand suicide attackers along with their reasoning behind their actions. Even though Durkheim’s suicide theory was created to explain individuals committing suicide, we can apply his theory to analyze groups who commit suicide attacks. This research shows how these four types actually apply to terrorism and mass shootings.

Poster Number: 61
Contemporary Processes of Viticulture Abandonment in Burgundy, France

Hannah Taylor, International Studies - Sustainability and Development, NC State University
Mentors and/or Co-Authors: Seth Murray

Wine production was traditionally an integral aspect of diverse agriculture in Burgundy, France due to its success on granitic, rocky, and sandy slopes. However, cattle ranching and forestry were also important components of the rural economy in Burgundy, particularly in the 20th century when wine production markedly dropped as many farmers abandoned viticulture in favor of other types of specialized agricultural production. This poster examines the processes of abandonment of viticulture in the community of Uxeau, Burgundy. Building on a broader long-term research project that has investigated changes in the region’s agricultural history, we utilized a qualitative data software program to analyze a series of ethnohistoric interviews and associated supporting documents that were collected in 2014. Combining these with
information from historical cartography, archival photography, and cadastral records, determined some patterns of change and continuity in viticulture during the 19th and 20th centuries. This holistic analysis illuminated drivers of abandonment by associating the motivations and rationales of specific farmers within broader historical patterns of viticulture abandonment. This research revealed a range of motivations, including a lack of knowledge and resources surrounding wine production, state financial incentives, and the poor quality of locally-produced wine. These specific motivations connect to a wider context of rural desertification, an increasingly mechanized agricultural production, cheap wine imports, and world wars that disrupted production and distribution networks. Viticulture was ultimately phased out of mainstream agriculture and thought to no longer exist in Uxco; however, vines for domestic consumption are still found in some local gardens.

Poster Number: 133

Examining the Relationship Between Graduation Rates by Race/Ethnicity and Undergraduate Population Size and Composition

Sarena Taylor, Psychology, NC State University
Mentors and/or Co-Authors: Elan Hope

The climate on college campuses can impact the number of enrolled students, student academic success, and graduation rates. Climate can include campus size, the number of enrolled students, racial/ethnic diversity, and perceptions and expectations of people in the academic community (Hart, J., & Cress, C. 2008). The purpose of our study was to examine whether campus climate factors (e.g., undergraduate population, undergraduate diversity) were related to undergraduate graduation rates for students of different racial/ethnic backgrounds. We examined the US News and World Reports top 200 National Universities and the top 200 Liberal Art Colleges. We found that for Asian and Native Hawaiian/Pacific Islander undergraduate students there was a significant negative correlation between the size of the institution and graduation rates. The larger the undergraduate student body at an institution, the lower the graduation rate for Asian and Native Hawaiian/Pacific Islander undergraduates. We also found a significant negative correlation between the percentage of White undergraduate students and the graduation rates of Black students. Black students had lower graduation rates on campuses with a larger proportion of White students. These findings suggest student graduation rates are related to campus climate and these relationships are different for students depending on their racial/ethnic background. Future research should examine factors that can help support students in across various types of college campuses.

Poster Number: 108

Adapting a Web-Based Sexual Health Program for Adolescent Boys Based on Qualitative Feedback

Maiya Whiteside, Psychology, NC State University
Mentors and/or Co-Authors: Laura Widman, Brain Messina, Rossana Roberts

Adolescent boys are at high risk for sexually transmitted diseases (STDs), including HIV, due to risky sexual behavior. To prevent HIV, STDs, and unintended pregnancies, all genders must be knowledgeable of safer sex practices. The purpose of this study was to seek feedback from adolescent boys on how to adapt a web-based sexual health intervention originally created for girls, called HEART: Health Education and Relationship Training. Participants were 18 and 19 year old boys (n=13; 57.1% White 14.29% Black, 14.29% Asian/Asian-American, and 14.29% Other) who completed usability testing via a think-out-loud protocol to provide their suggestions for an adapted intervention. Participants also completed a survey to identify what aspects of the program should be kept or modified. Participants provided many helpful suggestions for adapting HEART for boys. Most participants (84.6%) said HEART should include more time to practice condom use. Further, 53.8% stated that HEART should include more examples of discussing STDs and condoms. Additionally, over half of participants indicated that HEART should include less feminine graphics and include neutral colors and more masculine characters. Adolescent boys are just as likely to engage in risky sexual behavior as adolescent girls. However, many sexual health programs do not consider the unique male experience when creating sexual health curriculums. Thus, the development of appropriate sexual health intervention content for boys is necessary. The current study will add to literature on the adaptation of web-based sexual health programming for teen boys.

Poster Number: 102

Ingredients for Student Success in Latin America: Lessons Learned From Multigrade and Community Schools

Angela Yarn, International Studies, NC State University
Mentors and/or Co-Authors: Nora Haenn

In 2015, the United Nations passed the Sustainable Development Goals, one of which focuses on providing quality education to provide a fair and effective learning environment for students around the world. Latin American countries have been attempting their own educational reforms, especially within rural communities where access to quality education can be limited. Multigrade education and community schooling are two of the most prevalent reforms. This research examines the literature on multigrade and community systems to assess the specific factors that allow for student success through these programs. Drawing on 18 key articles that encompass case studies from Brazil, Colombia, Guatemala, and El Salvador, this research pays special attention to educational funding, parental engagement and community engagement, proper teacher training, and scalability as related to multigrade and community systems. As the UN notes in its support of education, not only is a quality education a human right, but, according to researchers, it has a critical impact on a country’s economic growth.

Poster Number: 16
Gambling on Football: How Lula’s piece de resistance became his coup de grace
Joseph Yourcheck, International Studies NC State University

Mentors and/or Co-Authors: Carol Lewald

Brazil was the shining example of economic prosperity under the New Left political movement when awarded the Fifa World Cup and the Summer Olympics in 2007 and 2009. Former president Lula’s sweeping social programs like Bolsa Familiar prioritized access to education and wealth distribution, cementing his reputation as a working class hero. Seven years later, however, the waste of public funds on private interests, pay to play politics, corruption scandals, and an economic recession lead to a political upheaval and the impeachment of his handpicked successor, Dilma. This research examines how Brazil spent its construction budget for the World Cup and Rio Olympics, the economic and social impact this spending had and analyzes scholarly literature on the differing narratives on the mega-events. Through this, this paper argues that these mega-events, which were intended to be a show of power not just for Brazil but for Lula’s Partido dos Trabalhadores (PT), instead unraveled his legacy and exposed a deeply flawed system mired in corruption. Because of the higher expectations of the public created by Lula’s social programs, the PT’s reputation diminished and its corrupt system of pay to play politics became politically unsustainable under the microscope that comes with hosting these mega-events.
College of Natural Resources
Application of Autonomous Recording Units for Monitoring Marsh Birds

Lucas Bobay, Fisheries, Wildlife, and Conservation Biology, NC State University

Mentors and/or Co-Authors: Christopher Moorman

Coastal marshes support several species of birds that are endangered, declining, or of conservation concern. In addition to continued development, marsh birds are increasingly threatened by climate change, sea level rise, and the resulting effects on habitat composition. Unfortunately, most marsh birds are difficult to monitor because of their elusive behavior and the inaccessibility of the marshes they inhabit. Traditional monitoring protocols specifically designed for marsh birds include single-observer point counts. While effective, point count monitoring requires substantial effort during the repeat visits needed for estimating detection probabilities of elusive species. Acoustic monitoring using Autonomous Recording Units (ARUs) offers an alternative. Although ARUs have drawbacks - such as the need for recording analysis - their potential to gather significantly more data for less effort makes them an intriguing alternative to traditional marsh bird survey protocols. We use occupancy modeling and survey cost estimation to evaluate tradeoffs associated with using ARUs to monitor marsh birds.

Evaluation of Energy Efficiency and Renewable Energy Incentive Programs

Austin Brooks, Environmental Science, NC State University

Mentors and/or Co-Authors: Elizabeth Nichols

DSIRE (Database of State Incentives for Renewables & Efficiency) is an online resource free to the public that is hosted in collaboration with The Department of Energy (DOE) and North Carolina Clean Energy Technology Center (NCCETC). Users are voluntarily able to respond to a survey highlighting their interests in different environmental technologies while visiting the DSIRE website. By synthesizing data from the aggregate self-response user surveys, it is possible to compare responses to various programs and incentives. The goal of the data entries is to identify the number of users and to ascertain different demographics of users and their intentions for visiting the database. By comparing the number of programs available for specific technologies with the number of inquiries, it is possible to calculate the gap between program accessibility and the requests from individuals seeking assistance via web searches. The analysis will determine if certain technology incentives for consumers is sufficient to meet their requests/needs.

Habitat selection, home range size, and survival of female Bachman’s sparrows in the longleaf pine ecosystem

Daniel Choi, Fisheries, Wildlife, and Conservation Biology, NC State University

Mentors and/or Co-Authors: Alex Fish, Christopher Moorman, Christopher DePerno

The longleaf pine ecosystem, among the world’s most endangered, provides habitat for the near-threatened Bachman’s sparrow. Male Bachman’s sparrow ecology in fire-maintained longleaf pine ecosystems is well studied, but female breeding ecology is less understood. Accordingly, we determined female Bachman’s sparrow habitat selection, breeding season range size, and survival rate on Fort Bragg Military Installation, NC. We attached radio-transmitters to females during the breeding season (April-June) in 2014-2016, tracked females every 2-4 days, and calculated range size for individuals with ≥ 10 locations (n=31). In 2016, we measured vegetation at 10 observed and 10 random points for 10 females. We compared habitat selection at used and random points using GLMER models, created 23 multivariate models ranked using Akaiki Information Criterion corrected for small sample size, and calculated survival probability using the Kaplan-Meier Method. Breeding range size was 1.96 ha (SE = 1.15), which reflects previous male studies. The top habitat selection model showed females selected for greater shrub cover and intermediate grass cover compared to random use. While previous studies show Bachman's sparrows avoid extensive shrub cover, our results show sparrows use shrub cover for escape or foraging on a micro-habitat scale. Female sparrow survival through the breeding season (1 April-31 August) was 0.91. Few female survival estimates exist but annual male estimates of 0.54-0.68 indicate most annual female mortality occurs during the non-breeding season. Our results highlight the importance of understanding habitat selection at multiple scales before developing habitat management prescriptions.
Biological Divorce: How Christmas Tree Needles Go Their Own Way
Kelly Goode, Genetics, NC State University
Mentors and/or Co-Authors: John Frampton

Adhesion and separation of plant cells constitute essential features of plant development. The physiological process of an organ separation is called abscission. In conifers, needle abscission (NA) requires the transduction of input signals, dismantling of polymer networks that keep cells together, remobilization of nutrients, reorganization of tissues and the formation of a protective layer after the needle has been shed. Different studies have shown that only a few layers of cells undergo these changes, in predictable positions known as abscission zones (AZ). This is important because consumers find Christmas trees to be messy due to post-harvest NA during the Christmas season while the trees are displayed in homes. There is a growing demand for breeding Christmas tree varieties that hold their needles for longer periods of time to encourage more consumers to buy real Christmas trees instead of artificial trees. Although there are several histological and transcriptomic studies that describe abscission in different model and non-model plants, the histology and gene regulatory network of post-harvest NA (PNA) is currently vaguely described in most conifers. We are currently validating the first reference transcriptome for Fraser fir and have identified differentially expressed genes in the needle abscission zones (NAZs) from trees that exhibit good and poor needle retention. The chief objective of the present study is to characterize and examine histological aspects of NA in Fraser fir in the light of our present knowledge of those gene regulatory networks and link them to specific morphological changes.

Analysis of Nitrogen in Soil and Groundwater and Evaluation of Pine Plantation Quality for the Lee Property
Zoe Harrison, Environmental Technology and Management, NC State University
Mentors and/or Co-Authors: Elizabeth Nichols

Phytoremediation is the use of plants to remove contaminants from the environment. It is often a relatively low-cost solution for in-situ remediation of soil and groundwater. The purpose of this field study was to evaluate the efficacy of Pinus taeda in remediating nitrate-contaminated groundwater on a parcel of land in Johnston County, North Carolina. The parcel had been used from 1978-2003 for land application of wastewater from an adjacent hog farm. In 2007 it was found that groundwater on the site had nitrate levels in excess of North Carolina Groundwater Standards of 10 mg/L. Soil and groundwater samples were collected from the site to determine changes to nitrogen and total Kjeldahl nitrogen (TKN) concentrations with respect to North Carolina standards. The health and productivity of the pine plantation were evaluated by using standard silvicultural measurements for height, diameter, volume, and visual appearance to determine if identified soil RECs impact the vigor of pine stand production. Results indicate that the pine stand is effectively remediating the soil and groundwater. Nitrate levels in soil and groundwater decreased. Trees exhibited signs of stress, such as severe forking, but experienced low mortality rates and have economic value as biomass pine chips.

Exploration of Potential Development of an Inclusive Cultural Heritage Tourism Site
Tori Jones, Parks, Recreation and Tourism Management, NC State University
Mentors and/or Co-Authors: Kathy Hamilton Gore

The contributions of African Americans to American history during the early 1800s are not extensively documented and are quickly being lost or forgotten. This study focused on a little-known part of the history of America, of North Carolina, and of African American heritage: the life of John Chavis and his determined burial location on the former North Carolina Senator, Willie P. Mangum plantation of Walnut Hall. Creating an accessible and engaging documentation of Chavis’ life using an Esri Story Map application, in addition to, an analysis of the burial site and area surrounding, will support the partnered efforts of establishing an historical cultural heritage site at the location found within North Carolina State University’s Hill Forest. Historical research methods were applied to gather and analyze primary source documents. Which was combined with exploratory research to gain insight into effective storytelling techniques and analysis of an historical site’s potential visitor usability. Given the time period of late 1700s to early 1800s and the subject being a free African American living in the Southern United States, there is an adequate amount of documentation covering John Chavis’ life that can be integrated into the broader story of the location to create an inclusive historical cultural heritage site.
Salt water intrusion is a continuing threat to the biodiversity of coastal wetlands. Most of the observed increases in salinity in coastal wetlands is a result of human activities and sea level rise. Soil pH provides insight into microbial activity and the availability and uptake of different minerals in the soil. We examined the changes in soil pH in several types of wetlands (forested, marsh, transition, and open water) in sites along a salinity gradient in the Albemarle-Pamlico peninsula on the NC coast. We found that forested wetlands had the lowest pH (4.70 +/- 0.18), while open water had the highest (6.15 +/- 0.15), with marshes and transitions zones were intermediate (6.25 +/- 0.18 and 5.04 +/- 0.24 respectively). While there was not a linear relationship between chloride and pH, we found that above a chloride concentration of 500 mg/L pH tends to be around 6.5, while below that value pH ranged between 3.5 and 6.5. Overall our results suggest that saltwater intrusion will lead to increased soil pH in coastal wetlands.
The purpose of this study was to understand what are the environmental initiatives that are important to Generation Z and why. Three research questions were addressed in this study: 1) what sport-specific environmental initiatives are important to Generation Z?; 2) how do the environmental initiatives differ based on gender, college major, year of study, and sport spectator preference (college vs professional)?; and 3) how does at-home behavior relate to sport organization initiative expectations? An online survey was distributed to four student organizations at a large southeastern university (N=221). Nine sustainability initiative categories were presented for respondents to rate on a five-point scale from “not important” to “extremely important.” Additional items included demographic information about the respondent. Respondents were also asked about the sport that they watch/followed most often which was later categorized into “professional” or “collegiate.” Results found recycling and waste reduction, composting, water use reduction/efficiency, energy use reduction/efficiency, and green events were the most important sport-specific initiatives that sport organizations should implement. Analysis of variance found no significant differences (p<.05) based on age, sport spectator preference, and year in school. Females were found to rate recycling and waste reduction, composting, water use, carbon offsets, alternative transportation, green events, and food donation significantly higher than males. Students in the College of Sciences rate recycling and waste reduction, composting, water use, energy use, and food donation significantly higher than students in other colleges. Students reported at-home behaviors were found to significantly be correlated (p<.05) to sport organization initiative expectations.
College of Sciences
Higher Binding Affinities of Daidzein to ERBa and ERBb than to ERalpha in Three Estrogen Receptors in Teleost Fish

Ruhani Agrawal, Genetics, NC State University

Mentors and/or Co-Author(s): Mary Hawkins

Daidzein is phytoestrogenic soy isoflavone which is known to activate gene transcription through binding to estrogen receptors (ER) alpha and beta in human MCF-7 cells. There are three distinct estrogen receptors in teleost fish, ERalpha, ERbeta-a (ERBa), and ERbeta-b (ERBb), which bind to ligands with different affinities. These differences in binding are correlated with evolutionarily-conserved amino acids in the ligand binding domain (LBD) of teleost ER betas. Genistein, another soy isoflavone, has a 7X and 13X higher binding affinity to teleost ERBa and ERBb than to ER-alpha, but the binding of Daidzein to ER subtypes has not been characterized. In this study, we determined the binding affinities of Daidzein to the three teleost ER subtypes as a first step in identifying amino acids in the teleost ER-LBD that play a role in isoflavone affinity differences. We expressed the three ER-LBDs in bacteria and then used competitive binding assays to determine the binding affinities of Daidzein to teleost ERs. We hypothesized that like Genistein, Daidzein would have a higher affinity for ER betas and a lower affinity for ER alpha. The results for Daidzein binding supported our hypothesis with EC50 values of 1.9mM (+/-35 SEM) for ERBa; 12.5 mM (+/-35 SEM) for ERBb; and 6.4 mM (+/-2) for ER-alpha (n=3 for all ER subtypes). Our future studies will investigate the role of the conserved amino acid changes between teleost ER beta and alpha subtypes in the differential binding of isoflavonones to estrogen receptors.

Possible New Fruit Bat Species (Cynopterus sp.) Discovered on the Mentawai Islands, West Sumatra, Indonesia

Heather Alers-Hankey, Bioproccessing Sciences, NC State University

Mentors and/or Co-Author(s): Lisa Paciulli

Bats belong to the order Chiroptera, with over 1,300 known species. New species are still being discovered. For example, a bat died in a mist net in 2000 on North Pagai Island, Mentawai Islands (West Sumatra, Indonesia), and has not yet been identified. It shares some traits with fruit bats (Cynopterus sp.) such as a fox-like face, but does not have all of the characteristic traits (e.g., protruding jaw). Therefore, in this study, the identification of this unknown bat specimen was undertaken. The research question was, “To what species does the unidentified bat belong?” To answer this question, USDA import permits have to be modified so NC State can be a recipient of the bat on campus. Once the bat tissue arrives, the 16S rRNA gene will be isolated and amplified following Mayer et al.’s (2007) methods of genetic analysis. The DNA sequence will be compared against known Microchiroptera sequences in GenBank, the National Institute of Health’s genetic sequence database (Nucleic Acids Research, 2013). A literature search suggests that the unknown specimen is most closely related to the greater short-nosed fruit bat (Cynopterus sphinx), as this is the species that has been most confirmed on the Mentawai Islands. These data suggest that the greater short-nosed fruit bat migrated from mainland Sumatra to North Pagai Island. Future research should examine the specimen further, which will lead to a fuller understanding of the ecological history of fruit bats on the Mentawai Islands.

Probing and manipulating the specificity of biosynthetic pathways

Katherine Almasy, Chemistry, NC State University

Mentors and/or Co-Author(s): Gavin Williams

Many pharmaceuticals on the market today are natural products produced by organisms as secondary metabolites. Polyketides, a class of these metabolites, are produced using megaenzyme assembly lines known as polyketide synthases. These pathways are modular in nature and each enzyme works to use discrete, specific individual building blocks to build the chemical scaffold of the natural product. Extending the product requires the work of an acyltransferase (AT) which selects the next building block from the available pool and passes it on to the phosphopantetheine (Ppant) arm of an acyl carrier protein (ACP). To diversify the existing catalog of products, we can approach engineering these systems either by modifying the genes which encode the enzymes or the post-translational modifications made to them. Two projects currently underway describe a method of each; the first probes the specifications of the Ppant arm, a post-translational modification to the ACP. The second attempts to amplify and diversify the specificity of the AT KirCII, which is
normally selective for an ethylmalonyl-CoA building block. An additional part of this project involves optimizing the expression and purification conditions of the protein.

Poster Number: 104
**The Antimicrobial Efficacy of Porphyrin Embedded Polyvinylidene Difluoride**

Asha Anand, Genetics, NC State University

**Mentors and/or Co-Authors:** Reza Ghiladi

According to the CDC, the ESKAPE pathogens (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species) are responsible for infections in 5-10% of all patients admitted into a hospital, resulting in approximately 1.7 million healthcare-associated infections in the United States each year. These hospital acquired infections (HAIs) are often caused from incomplete sterilization of surfaces and instruments, and as such anti-infective coatings are envisioned to prevent the transmittance of pathogens. One potential method is antimicrobial photodynamic therapy (aPDT), which employs a photosensitizer, visible light and ambient molecular oxygen to effectively inactivate microbial pathogens. Previous work in our laboratory has demonstrated that a porphyrin photosensitizer embedded into polyacrylonitrile was effective against both bacteria and viruses. To further assess the healthcare applications of aPDT-based materials, we investigate the effectiveness of a porphyrin photosensitizer embedded in a polyvinylidene difluoride membrane (PVDF) via electrospinning. Currently, PVDF’s filtration, anti-corrosive, and heat resistant tendencies make it an ideal polymer for medical environments. Herein, we discuss the characterization of this membrane and report initial antimicrobial studies in comparison to literature results. Future implications include the use of light activated antimicrobial PVDF for the production of antimicrobial medical instruments, such as catheters, syringes, and drain tubes.

Poster Number: 135
**Caries-associated Streptococcus mutans Biofilm Disruption by two Lactic Acid Bacterial isolates**

Robert Anderson, Biological Sciences-Human Biology Concentration, NC State University

**Mentors and/or Co-Authors:** Alice Lee

Dental caries is the world’s most prevalent infectious disease, infecting up to 90% of children and the vast majority of adults (Ozdemir et al., 2013). Dental caries can be a direct result of behavioral or environmental factors, poor diet or low socio-economic status, thus more widely accessible, interceptive, nonsurgical treatments are of great concern (Chi et al., 2008). The accumulation of oral biofilms on tooth surfaces results in dental caries, with *Streptococcus mutans* being the primary causative agent (Nishimura et al., 2013). Probiotic Lactic Acid Bacteria (LABs) exhibit antimicrobial activity against *S. mutans* biofilm, but the mechanism has yet to be examined (Suskovic et al., 2010). With much new research regarding probiotic therapy within the oral cavity, determining the mechanism for inhibition is critical for developing new therapeutic interventions. Bacteriocins are antimicrobial peptides active against other bacteria, and can be produced by LABs (Suskovic et al., 2010). Two strains of LABs were isolated from home fermented pickles and yogurt. The cell-free extracts of these LAB strains exhibited inhibition of *S. mutans* biofilm production in a crystal violet biofilm assay. It is hypothesized that LAB bacteriocins may be the primary inhibitory agent of the *S. mutans* biofilm. Application of proteases and a heat treatment to the cell free extract to determine if the antimicrobial compound is a bacteriocin were inconclusive. To rule out other antimicrobial actions, the pH of the cell-free extracts were measured and catalase activity was tested. Future optimization experiments include modifications to the protease treatment.

Poster Number: 114
**Uncovering Trending Topics in Cancer Patents: Text Term Weights and Frequencies over Time**

Aaron Arthur, Computer Engineering, NC State University

**Mentors and/or Co-Authors:** Elliot Inman

Data on over 250,000 patents related to cancer research have been collected by the US Patent Office and released as a publicly available dataset. These data were compiled specifically to drive innovation in the areas of cancer diagnosis, prevention, and treatment. Using text mining and statistical techniques, the data (patent titles and associated metadata) were transformed and analyzed to see the degree to which automated text mining methods can help to group patents with a similar focus and uncover trends in scientific study. To better understand such a vast dataset, it is important to organize it in a meaningful way. First, the patent titles were normalized (text was lowercased). Documents were aggregated into groups for processing using SAS
Text Miner. The documents were parsed, stop words removed, terms stemmed, and term weights generated based on the frequency within the document collection. Finally, a regression model was used to calculate trends in term weights over time. Using the same techniques, new titles could be scored to determine whether or not they fit into current topic trends. Beyond demonstrating the usefulness of a two-stage model using text mining and linear regression, this analysis provides answers to the following real-world questions: What cancer patent topics are most significant in a given year? What topics have seen an increase in patent applications over time? What topics were popular in the past but are no longer?

Poster Number: 94
**Enrichment Effects on Corticosterone Levels in Mice from Farallon Islands**
*Brinda Bhaskar*, Biological Sciences – IPN, NC State University
**Mentors and/or Co-Authors:** John Godwin

Biological stress is the animal’s reaction to uncertainty or perception of a threat in its environment, resulting in temporary suppression of non-essential functions in order to effectively respond to the threat. Long term exposure to the stressor is detrimental to the health of the animal however, as temporary suppression gives way to chronic inhibition. The hormone corticosterone is a key mediator of stress responses in mice and can be used as an indicator for stress. This study examines the influence of two factors on the chronic activation of the endocrine stress axis as measured by fecal corticosterone levels. The first factor is the effect of environmental enrichment, specifically the availability of a running wheel. The second factor is domestication with a comparison of laboratory (C57BL/6) and wild-derived (Farallon Island) mice. Fecal samples were collected over four weeks from groups with access to a running wheel and control groups where the running wheel was present, but non-functional. Corticosterone was extracted from the fecal samples and will be measured by Enzyme-Linked Immunosorbent Assay (ELISA) to test the predictions that wild-derived mice will have higher glucocorticoid levels than a laboratory strain and that the group with access to functional running wheels will exhibit lower fecal corticosterone levels.

Poster Number: 72
**Biosensor-Directed Engineering of Extender Unit Production for Polyketides**
*Kyle Bingham*, Biochemistry, Chemistry, Biological Sciences: Human Biology, NC State University
**Mentors and/or Co-Authors:** Gavin Williams

Polyketides are a class of secondary metabolites produced by various organisms, usually bacteria or fungi. These natural products have very complex organic structures known for their high biological activity. Today, polyketides are used as anticancer drugs, antibiotics, cholesterol medications and other treatments. These natural products are synthesized in nature by a diverse class of enzymes known as polyketide synthases. The natural substrates of these enzymes are mostly malonyl-derived, CoA-linked extender units. Incorporating different natural and non-natural malonyl substrates into natural polyketide enzymatic pathways has the capability of generating novel natural products with new or improved biological functionalities. To study the promiscuity of polyketide synthases, it is necessary to develop a broad panel of malonyl-CoA derivatives at high levels in vivo. A biosensor that detects malonyl-CoA using a repressor protein, FapR, has previously been developed. Biosensor-directed engineering of the malonyl-CoA synthetase, MatB, using FapR has the potential to increase the efficiency of novel extender unit production. Currently, I’m probing the binding affinity of FapR in vitro using an electrophoretic mobility shift assay while simultaneously developing an in vivo fluorescence-based assay. Probing and modifying the ligand binding affinity of FapR is of paramount importance to the continued development and improvement of this diverse class of secondary metabolite.

Poster Number: 54
**Genetic markers: improving personalized treatments of human diseases and mental health disorders**
*James Britt*, Life Science First Year, NC State University
**Mentors and/or Co-Authors:** Lisa Paciulli, Miriam Ferzli

Modern medicine is evolving from recommending generalized to more personalized treatments for disease. Current research focuses on how new genetic markers can be effective in measuring disease risk and in determining treatment. This movement comes from the knowledge that individual responses to drugs may be in part genetically determined. In this review, multiple ways that pharmacogenetics can be applied to cancer, cardiovascular disease (CVD), and mental health were explored. In one study, breast cancer patients were treated with chemotherapy, genotyped, and examined to determine relationships between genes and treatment responses. To study cardiovascular health, the HMOX1 gene was tested with a HO-1 hemin inductor
using a rat model to observe damaged carotid arterial (CA) recovery. Neointimal formation was then analyzed 14 days after injury to the CA tissues. Another study compared healthy patients to those with bipolar disorder by examining single-gene polymorphisms in diacylglycerol kinase eta (DGKH). The results of breast cancer studies showed that certain genes (e.g., 1236C>T) played a role in adverse patient response and survival. Assays showing neointimal formation after CA injury in rats treated with an HO-1 hemin inducer revealed decreased neointimal area and thickness. The bipolar disorder genetic studies found that DGKH may play a specific role in developing the disorder. Overall, these studies show that knowing a patient’s genotype can be beneficial for planning individualized treatments. Future research should continue to build knowledge in the use of genetic markers for treating disease and mental health disorders.

Poster Number: 46

**Physiological Explanations for Molting in Ectotherms**

**Jacob Brown, Biology, NC State University**

**Mentors and/or Co-Authors:** David Buchwalter, Hsuan Chou

Temperature determines the growth rates and adult sizes of ectotherms, with larger individuals associated with cooler developmental temperatures and smaller, less fecund individuals associated with warmer developmental temperatures. This "temperature size rule (TSR)" pattern is widely observed, but the physiological processes that drive it remain poorly understood. Using the mayfly *Neocloeon triangulifer* as a model organism, we are investigating whether the molting process can help explain TSR patterns derived from rearing studies with this species. We reared mayflies from hatching eggs to adults at 18, and 26 °C, and recorded the timing and total number of molts required to complete development. For Mayflies at 26°C, the average Emergence day was 43.15 days, while mayflies at 18°C had an average emergence day of 24.78 days. Average total molts until adulthood were 14.14, and 14.0 for 26°C and 18°C respectively. Mayflies at 26°C molted an average of once every 1.7 days, while mayflies at 18°C molted an average of once every 3 days. Results indicated that molting is not driven by size, as larger mayflies reared at cooler temperatures molted an equal amount on average. Based upon our results, caloric loss due to molting seems to be higher at increased temperature, where a greater amount of the metabolized energy is being used for molting, instead of growing. Future experiments to further study the physiology behind the TSR are rearing mayflies at more temperatures, as well as measuring the expression levels of genes linked to energy metabolism through qPCR.

Poster Number: 50

**Induced Pluripotent Stem Cells as Disease Models and Treatments**

**Elizabeth Byers, Biochemistry, NC State University**

**Mentors and/or Co-Authors:** Lisa Paciulli, Miriam Ferzli

Stem cell therapy is a new treatment and potential curative tool for aggressive diseases. Stem cells are undifferentiated entities capable of embodying any cellular function. Since stem cells have traditionally been extracted from embryos, their application to scientific research has caused many moral dilemmas. A proposed solution to utilizing embryonic cells is returning adult somatic cells to their initial undifferentiated state, otherwise known as induced pluripotent stem cells (iPSCs). iPSCs can then serve as disease models by revealing disease progression and showcasing effectiveness of potential treatments. In the studies investigated in this review, iPSCs were used to replace failing human lens epithelial cells (hLECs) with nondeteriorated hLECs to treat cataracts. Also, iPSCs of familial and sporadic Alzheimer’s disease (AD) patients were differentiated into cortical neurons to test docosahexaenoic acid treatment. In addition, iPSCs were differentiated into ovarian granulosa-like cells (OGLCs) to study the cells’ use as a premature ovarian failure treatment. Li et al. (2016), Kondo et al. (2013), and Liu et al. (2016) demonstrated effective uses of iPSCs in correcting and restoring cellular functions for these diseases. The studies show that iPSC therapy can improve the quality of life for populations facing cataracts, Alzheimer’s disease, and premature ovarian failure. Furthermore, future research should implement iPSC treatments in other immune and nerve cell diseases such as Ulcerative Colitis (UC), Wernicke’s aphasia, and Broca’s aphasia - all of which are chronic diseases for which cures do not currently exist.

Poster Number: 64

**The Presence of Major Urinary Proteins in Lemurs**

**Lee Byrum, Microbiology, NC State University**

**Mentors and/or Co-Authors:** Lisa Paciulli
Pheromones are chemical signals that are secreted or excreted by individuals, and relay information to other individuals. In rodents, some pheromones are excreted in urine as major urinary proteins (MUPs). MUPs belong to the lipocalin family and are carriers for ligands that bind to pheromones. Previously, the brown-mantled tamarin (Saguinus fuscicolis) was found to excrete two different major proteins in their urine and scent marks. Because the extent to which lemurs and other primates express major proteins in their urine is unknown, the presence of MUPs in lemur urine was explored in this study. Urine samples were obtained from various lemur species housed at the Duke Lemur Center in Durham, NC. For protein detection, urine samples underwent SDS-PAGE followed by coomassie blue staining. The identification of protein bands at around 19 kDa were regarded as signifying the presence of lipocalin proteins. Preliminary results indicate that MUPs are not found in lemur urine. The presence or absence of major proteins in lemers could provide insight into physiological differences between primates and non-primates, as well as the origins and divergence of primates. For example, the shift in primates to a stronger reliance on vision than olfaction could be one of the main traits that caused their divergence from closely related orders. Future research should include obtaining urine samples from other primate species, and scent markings of lemurs, to test for the presence of major urinary proteins.

Poster Number: 24

New Pathway to the Formation of Alumina Oxide Aerogels
Abigail Carbone, Chemistry; Materials Science and Engineering, NC State University
Mentors and/or Co-Authors: Paul Maggard, Jerome Cuomo

Aluminum oxide aerogels are useful as heterogeneous catalysts, such as for the production of syngas. Previous synthetic methods required high temperatures and pressures. However, a new method has been discovered that greatly simplifies its preparation and is performed at room temperature and atmospheric pressure. This research focused on removing the passivating layer on aluminum using a liquid metal alloy, rendering the previously chemically-inert aluminum to become more highly reactive. This activated aluminum was reacted using a flowing wet carbon dioxide stream for the direct fabrication of the alumina aerogel with high surface area and porosity. Characterization of the resultant aerogel was performed using IR spectroscopy and powder X-ray diffraction, while the downstream gases were measured using gas chromatography. The ability to produce syngas together with the formation of the aluminum-oxide aerogel would have many potential applications that fall within green chemistry and the chemical fuels industry.

Poster Number: 56

The Effects of Music on Pain Perception, Cognitive/Motor Function, and the Immune system
Alaine Castillo, Biological Sciences, Integrative Physiology and Neurobiology, NC State University
Mentors and/or Co-Authors: Miriam Ferzli, Lisa Paciulli

Music can positively affect physiology and is an emerging therapy for cognitive and somatic disorders. The effects of music on pain perception, cognitive and motor functions, and the immune system have been explored. A recent study looked at music-induced analgesia by applying thermal stimulation to the palm of healthy individuals listening to music. In another study, the effects of music on pain ratings of fibromyalgia patients were examined. In addition, cognitive and motor functions were tested by active participation in long-term music-induced learning, during which participants were assessed on their memory and IQ prior to and after musical learning. Furthermore, researchers investigated immune response indicators in the saliva of cancer patients and caregivers after participation in choir rehearsals. Findings from these studies indicated that music has an analgesic effect on those experiencing pain, regardless of stimulation or chronic origins. Cognitive test results showed a significant increase in memory and IQ after participation (p=0.001). Results also demonstrated that participation in music boosted short-term immune responses, increasing cytokine levels in participants’ saliva. Overall, it was found that music can induce an analgesic effect, enhance cognitive and motor functions, and boost immune responses. Since pain, cognitive and motor dysfunction, and reduced immune activity are all side effects of cancer or cancer treatment, future research should include music therapy in conjunction with cancer therapies. Current cancer treatments are expensive and have damaging side effects. Therefore, music should be implemented as a low-cost, non-pharmaceutical substitute to facilitate a holistic approach to patient recovery.

Poster Number: 16

Effects of novel animal scents on the behavior of a captive sand cat (Felis margarita harrisoni)
Mariah Chapman, Zoology, NC State University
Mentors and/or Co-Authors: Jennifer Campbell
In captive settings, the introduction of novel scents have been proven to be an effective enrichment tool for both big cats and canids. This study focused on introducing animal scents (giraffe, porcupine, ocelot, arctic fox, and no scent [control]) via a plastic ball to a captive sand cat, Felis margarita harrisoni. The ball was placed inside the zookeeper work area of each animal for four days and then placed inside the sand cat exhibit for one day. It was hypothesized that the incidence of repetitive behavior would decrease while exploratory behaviors (sniffing, marking, climbing, etc.) would increase when an animal scent was present on the ball. There was an average increase in pacing seen when the sand cat was exposed to arctic fox (+2%) and giraffe scent (+2%) but a decrease in pacing when exposed to ocelot scent (-4%) when compared to the control. Porcupine scent had the largest effect on minimizing pacing (-13%). Further, exploratory behavior only varied from the control with the porcupine (+16%) and arctic fox scent (+3%). Visitor density and light intensity were two other variables that may have had an effect on stereotypic behavior during this study. Pacing behavior occurred more often when three or more people were present at the sand cat exhibit, and a light adjustment that made the exhibit darker also seemed to decrease pacing. More research should be done to explore how visitor density, light intensity, and porcupine scent may influence small carnivore behavior in the future.

Poster Number: 3
**Synthesis and Biological Testing of 2-AI system**

_Daxton Chapman-Scott, Chemistry, NC State University_

Mentors and/or Co-Authors: Christian Melander

Anti-biotics have been the consistent method for treating bacterial infections, but over time specific bacteria have adapted to gain resistance to these anti-biotics. The advancement of new anti-biotics has been negligible such that another method for fighting these resistant strains of bacteria was needed. New methods have been developed that show promise in re-sensitization of these resistant strains. This new therapy uses adjuvant compounds in conjunction with the antibiotic to re-sensitize the bacteria. One system of adjuvant molecules is the 2-aminoimidazole compounds that are synthesized in the Melander lab. These compounds have shown to inhibit anti-biotic resistance through the research done in the Melander lab. These adjuvant have been synthesized in lab to create a library of compounds and tested against both _A. baumannii_ and _K. pneumoniae_ to determine the degree of inhibition. Worm injection models are used for biological testing in house. Yields in the synthetic route to produce the 2-AI compounds has been approximately 20% yield or less, and continues to be tweaked for optimization of product formation.

Poster Number: 43
**Adaptive filtering for hidden node detection and tracking in networks**

_Sergio Chavez, Mathematics, NC State University_

Mentors and/or Co-Authors: Franz Hamilton

The identification of network connectivity form noisy time series is of great interest in the study of network dynamics. This connectivity estimation problem becomes more complicated when we consider the possibility of hidden nodes within the network. These hidden nodes act as unknown drivers on our network and their presence can lead to the identification of false connections, resulting in incorrect network inference. Detecting the parts of the network they are acting on is thus critical. Here we propose a novel method for hidden node detection based on an adaptive filtering framework with specific application to neuronal networks. We consider the hidden node as a problem of missing variables when model fitting, and show that the estimated system noise covariance provided by the adaptive filter can be used to localize the influence of the hidden nodes and distinguish the effects of different hidden nodes. Additionally, we show that the sequential nature of our algorithm allows for tracking changes in the hidden node influence over time.

Poster Number: 58
**Depression caused by negative life experiences and altered neurotransmission**

_Gabrielle Consing, Life Science First Year NC State University_

Mentors and/or Co-Authors: Miriam Ferzli

Depression is a common disorder that affects thought processes, feelings, and daily routine. Negative lifestyle factors and experiences can influence neurotransmission and correlate with depression. Various studies focus on the influences of lifestyle approaches leading to depression and affected neurotransmission. In one study, depression levels were compared in heterosexual and homosexual individuals while considering number of partners and sexual activity. Another study examined self-perception in parasuicidal patients...
through interviews and monitored cognitive-behavioral therapy. Using behavioral tests, one study identified environmental stimuli differences by analyzing the amount of time cognitively-impaired patients spent in an intensive care unit (ICU). Another study explored three brain-behavioral systems, behavioral-activation, behavioral-inhibition (BIS), and fight-flight systems, through adolescents’ responses to a personality questionnaire and a depression, anxiety, and stress test. One study investigated schizophrenic patients who were randomly assigned a D-serine treatment, a medication thought to target the glutamate receptor. Findings from all of these studies indicate that several factors can link with depression. Homosexual preferences were strongly related to mental illnesses. Depression rates and increased levels of negative self-perception were higher before cognitive-behavioral therapy. Prolonged time in the ICU increased cognitive impairment, which influenced depression rates. The BIS, which is associated with negative life experiences, strongly linked to depression. The D-serine treatment improved negative symptoms, showing that an abnormal expression of glutamate exists with mental illnesses. These studies are significant in identifying possible factors relating to depression in at-risk patients. Future research should continue to explore how negative life experiences cause depression and altered neurotransmission.

**Poster Number: 98**

**Growth of the algae *Dunaliella* in naturally-sourced seawater improves economic efficiency of biofuel production**

Jonquil Cothren, Microbiology, NC State University

**Mentors and/or Co-Authors:** Amy Grunden

Algae from the genus *Dunaliella* are considered unicellular, microalgae. The genus consists of over 50 morphologically diverse strains that grow in an extensive range of salinities, pH environments, light intensities, and temperatures. *Dunaliella* are specifically valued for their ability to produce bioactive compounds, such as carotene and glycerol, while synthesizing and storing lipids. Due to lipid accumulation, *Dunaliella* can provide a natural resource for commercial production of biofuels. To cultivate these algae cells at large scale for lipid extraction, it is necessary to understand which media components are vital for optimal growth and how natural resources, such as marine water, can be used as cheaper substitutions. Deionized water and other trace minerals are common ingredients in algae media and can be costly. In this study, 12 different strains of *Dunaliella* were grown in various types of media that were either non-sterilized or sterilized, varied in nutrients, and prepared with a base of deionized water or marine water. Growth was observed over 7 days and cells counts were determined using Gen5 cell count software. Results show that overall growth rate of strains in marine water out performs the controlled media made with deionized water and added salts. These results imply that successful, competitive growth of *Dunaliella* can be observed when marine water is used as a natural resource alternative to deionized water amended with salts. In conclusion, utilization of marine water as a base for growth media can prove economical and feasible for growth of *Dunaliella* strains.

**Poster Number: 67**

**RiverNet Program**

Michelle Cowan, Marine Sciences: Biological Oceanography Concentration, NC State University

**Mentors and/or Co-Authors:** William Showers

The RiverNet program is led by Dr. Showers at NC State. This program continually collects data, often remotely, for key water quality indicators such as temperature, dissolved oxygen, pH, turbidity, and nitrate concentration. Manual surveys are also done to ground-truth sensors and to sample other areas. The goal is to understand nitrogen fluxes in watersheds, especially when different land uses can be attributed to it. All information gathered is open to the public in hopes of helping promote proper management and sustainable watersheds. Remediation strategies can also be accessed using this data.

**Poster Number: 152**

**Isolation and Cultural Characteristics of a Pigment-producing Streptomyces spp**

Andrew Dalrymple, Microbiology, NC State University

**Mentors and/or Co-Authors:** Alice Lee

Natural compounds isolated from microorganisms are set to play an increasingly important role in modern industrial and commercial applications. Organic dyes, antibiotics, industrial enzymes and other biological compounds can be a source of cheap and clean substitutes for modern chemicals. Moreover, the advances in biotechnology will allow us to engineer these molecules and produce them in a efficient manner. Soil bacteria,
such as those of the genera *Streptomyces* have already exhibited promise as major producers of antibiotics, but also of other possibly important secondary metabolites, such as pigments. A novel *Streptomyces* spp. isolated from loam soil on local hiking trails may be a producer of antibiotics and possibly of other industrially or commercially significant secondary metabolites. This novel *Streptomyces* isolate produces a vibrant pink pigment and an antimicrobial compound. Optimization of growth conditions using various sugar based media as well as different incubation periods were performed. The isolate shows strong pigmentation when cultured on R2A agar at 23-25°C for 48 or more hours, but no pigmentation was observed when cultured in R2A broth. The isolate will grow, but not pigment, on other types of solid media. Future experiments will include organic extraction of the pigment, evaluation of its feasibility as an organic dye and analysis of antimicrobial activity. If so future toxicity experiments may indicate the viability of the compound as an antibiotic for human or animal consumption.

**Poster Number: 99**

**Simultaneously Monitoring Sub-Second Glucose and DA Dynamics in Rats During Intracranial Self-Administration**

Matthew Dausch, Biomedical Engineering, NC State University

Mentors and/or Co-Authors: Leslie Sombers

The detection of real-time glucose dynamics is imperative for understanding brain energy utilization, involvement in neurological disorders as well as the adaptations that occur upon exposure to substances of abuse. Glucose utilization is critically involved in the regulation of extracellular dopamine (DA) dynamics in response to drugs of abuse[1-3,10]. However, the simultaneous sub-second glucose and DA dynamics associated with drugs of abuse are unclear at this time due to the lack of analytical approaches with appropriate spatiotemporal resolution required to simultaneously detect these molecules. Within the proposed work, we aim to utilize a glucose-oxidase modified microbiosensor to monitor fluctuations in glucose and DA dynamics within the striatum using the analytical technique background-subtracted fast-scan cyclic voltammetry (FSCV), during intracranial self-stimulation (ICSS). The goal of this study is to determine how glucose and DA dynamics are related to reward driven behavior and motivation on the sub-second timescale. This study will aid neuroenergetics research and promises to inform therapeutic strategies for treating drug addiction and related disorders.

**Poster Number: 51**

**The Emerging Applications of Gene Editing Using the CRISPR-Cas9 System**

Lillie Davis, LSYF: Genetics intent, NC State University

Mentors and/or Co-Authors: Lisa Paciulli, Miriam Ferzli

Gene targeting is a technique using homologous recombination to change an internal gene to serve as a treatment for a wide range of genetic disorders. A genetic engineering tool called CRISPR-Cas9 has been successfully used to cheaply and quickly target specific genes. The system can be used to target specific segments of DNA and edit the genetic code at very precise locations. This review compiles and analyzes research conducted using the CRISPR-Cas9 system. Studies include cleaving a replication factor gene in order to inhibit a common Baculovirus in insects, and knock-in of point mutations in Zebrafish that model amyotrophic lateral sclerosis (ALS). Also, the outcomes of induced point mutations in acute myeloid leukemia cells were examined. Additionally, the effects of removing the faulty gene at exon 23 on the muscle function in mice with Duchenne muscular dystrophy were explored. An underlying result of the studies on Baculovirus and Zebrafish is the successful targeting, deletion, and replacement of genes. Additionally, the induced point mutations in acute myeloid leukemia cells were successfully targeted, offering a strategy for DNA editing. However, a limitation of the CRISPR-Cas9 system is the inability to treat chromosomal abnormalities such as aneuploidy, which is the presence of an abnormal number of chromosomes in a cell due to separation errors in chromosomes. The studies in this review offer new insights to improve techniques for the efficiency of the CRISPR-Cas9 system and offer models for further research. The application of the CRISPR-Cas9 technology has the potential to cure genetic diseases.

**Poster Number: 15**

**Investigating the Iapetus Equatorial Ridge**

Charlene Detelich, Geology and Meteorology, NC State University

Mentors and/or Co-Authors: Paul Byrne
One of Saturn’s icy moons, Iapetus, has an equatorial ridge that is ~125 km wide and stands 20 km high. It remains unclear, however, what mechanism(s) may account for the ridge’s formation. Therefore, I mapped the ridge in ArcMap with image and topographic data of Iapetus acquired by NASA’s Cassini mission to Saturn. Eighty-four topographic profiles taken across the ridge were then classified into five distinct ridge shapes. Next, I derived crater size–frequency distributions for eight sites across Iapetus, including three on the ridge itself. The other sites were directly north of the ridge, inside a crater basin, in the southern hemisphere near the prime meridian, in the northern hemisphere, and along the equator (but not on the ridge). From these distributions, I obtained strong evidence that the origin of Iapetus’ equatorial ridge is exogenic. Areal crater densities are also higher on the leading hemisphere of the moon, i.e., in the direction of orbit of Iapetus around Saturn, decreasing towards the trailing hemisphere. Most of Iapetus’ equatorial ridge is on its leading hemisphere, consistent with material in front of Iapetus being accreted onto the surface. Equatorial ridges are also observed on two other Saturnian satellites, Pan and Atlas, which reside within the rings of Saturn and likely accreted material from Saturn’s rings to form their ridges. Therefore, because the ridge is situated on the equator and mostly confined to the leading hemisphere, I propose that Iapetus’ ridge formed from the accretion of an ancient ring or moonlet.

Poster Number: 100

Computer-aided Design of Novel Bioactive Analogs of Imatinib
Khalil Duncan, Textile Engineering- Product Engineering, NC State University

Mentors and/or Co-Authors: Denis Foursches

Imatinib (Gleevec™) is an effective drug that is used as a Bcr-Abl tyrosine-kinase inhibitor and represents the first line treatment in the majority of cases of Chronic Myelogenous Leukemia (CML). While imatinib has shown great success in CML patients since 2001, the drug has shown resistance consequently leading to relapse. As a result, new imatinib analogs are urgently needed to target resistant leukemia stem cells. This project focuses on utilizing molecular modeling to analyze the structural characteristics of all known existing analogs of imatinib and propose new compounds with enhanced potency. In this study, we aimed to (i) compile a list of all published analogs of imatinib and their experimental activities against both KG1a and K562 cell lines, (ii) cluster imatinib analogs based on their structural similarity, (iii) establish structure-activity relationships, and (iv) use 3D molecular docking to evaluate the binding mode of each imatinib analog. This analysis will allow us to better understand how small structural modifications modulate Bcr-Abl activity and thus help us to prioritize new imatinib analogs to be synthesized and tested experimentally.

Poster Number: 55

An examination of abiotic biogeochemical cycles in an aquaponics system
Lauren Emer, Biological Sciences: Ecology, Evolution, Conservation Bio, NC State University

Mentors and/or Co-Authors: Lisa Paciulli

The four main abiotic biogeochemical cycles – water, carbon, nitrogen, and phosphorous - regulate the movement of important elements and substances throughout Earth’s spheres. These elements and their cycles are all present in aquaponics- a hybrid system of aquaculture and hydroponics. The research question was, “What is the amount of carbon, nitrogen, and phosphorous in the aquaponics system?” To collect these data, all variables such as the amount of light, temperature of water, food fed to the fish, etc. were kept constant. The levels of carbon, nitrogen, and phosphorous in the water were measured daily for ten days at three points in the system – in the fish tank, plant bed, and degassing tank. Carbon was measured by using a phenolphthalein indicator then completing a titration. Nitrogen was measured through tracking the levels of ammonia, nitrate, and nitrite with test kits. Phosphorous was measured by adding a phosphate reaction solution to the water samples. The ppm of each compound was multiplied by a different constant to find the ppm of its corresponding element. The results indicate that the levels of carbon, nitrogen, and phosphorus vary throughout the system. Future research should expand this study to collect data for a longer period of time to increase the sample size. Knowing the levels of the main abiotic biogeochemical cycles can help researchers better understand the system and keep it balanced.

Poster Number: 92

Epidemiological changes in wild and captive mammals in relation to increased interactions with humans
Caroline Ficca, Animal Science, NC State University

Mentors and/or Co-Authors: Lisa Paciulli, Miriam Ferzli
The increasing interactions between humans and mammals have led to changing epidemiological effects in both wild and captive mammals. Human intervention may cause animals to suffer from greater rates of infectious diseases. To examine the effects of humans on captive ring-tailed lemurs (Lemur catta) and horses (Equus caballus), as well as wild chamois (Rupicapra rupicapra), data were collected on necropsies, diets, behavior, cortisol levels, and symptoms of illness. The results suggested that animals held in captivity, in close contact and under the control of humans, may have greater rates of disease resulting from the type of management practices. Lemurs suffered from hemosiderosis as a result of dietary insufficiency of tannin in zoo diets. Domesticated horses with decreased pasture time and a regulated diet consisting of probiotics rather than fruits and vegetables were shown to have an increased risk of colic. Herds of chamois frequently in contact with domesticated animals experienced significantly increased rates of disease spread (p<.05), potentially because humans have increased populations of domestic animals. Insufficient knowledge of the effects of human-herd interactions, as well as a lack of understanding of effective captive animal management practices have altered the way disease affects these mammals. Future research should be conducted on the effects of more natural diets and increased awareness of the effects of human interactions on wild herds on reducing disease rates. These data would allow people to make wiser management decisions and lower their impact on mammal populations.

Poster Number: 126
The effects of climate change on estuary health and apex predators
Michaela Foley, Zoology, NC State University
Mentors and/or Co-Authors: Mary Hawkins
Global climate change has had profound impacts on many ecosystems, including the world’s estuaries. Changes to estuaries include increased water temperatures and decreased O2 levels. Northward movement of many fish species is correlated with these estuarine water quality perturbations. The resulting alterations in fish abundance within estuaries and source rivers may directly impact fish primary consumers in the ecosystem, which may then indirectly impact prey choice and land use by apex predators, such as gray wolves (Canis lupus). We propose an ecological community study in an estuary habitat of the Pacific Northwest to determine whether climate-induced changes in aquatic trophic levels have indirect or cascading effects on the size, distribution and behavior of resident wolf populations. For this proposed study, historical and current data will be compiled for fish species in our target habitats to document any changes to relative species composition over time. The locations and migration patterns of wolf populations in these areas will be recorded via camera traps, radio collars, tagging and tracking techniques optimized for monitoring large apex predators. Scat and kill site samples are also useful for supplemental data collection and analysis. This type of comprehensive study will better inform scientists and wildlife managers about the potential impact of climate change on higher trophic levels in the food web, and help them make management decisions on how to best mitigate both direct and indirect effects of climate change on ecological communities.

Poster Number: 150
The Impact of Salt Concentration on Microbial Succession in Pickling Brines
Brian Ford, Microbiology, NC State University
Mentors and/or Co-Authors: Alice Lee
Fermentation is a microbial process that has many applications in the food industry. Products such as beer, wine, cheese, pickles, and enzymes are all produced using fermentation processes. It is important to understand this process when producing consumable products in order to maintain high levels of safety and efficiency. Vegetable fermentation is one of the most popular in the industry. Cucumber fermentation resulting in pickles is a major product in North Carolina. The purpose of this research is to determine the effects of various environmental factors on microbial growth in pickle production. Fermentation of cucumbers were set up with varying levels of salt concentrations (0-12% NaCl). It was hypothesized that salt concentrations will impact the growth of different microbial species. The pickling brine was serially diluted and plated onto four different types of media over a sampling period of 21 days. Changes in pH, glucose, and visual appearance were also monitored to determine the relationship of these factors on microbial growth. The most notable changes in microbial growth was observed on MRS (Mann Rogosa Sharp) and VRBG (Violet Red Bile Glucose) media. MRS selects for lactic acid bacteria (LAB), the major genera of bacteria responsible for fermentation processes. While VRBG selects for enteric bacteria, which include human pathogens such as Salmonella. Analysis of the data indicates that varying salt concentrations does influence ecological succession of microbial species. Future experiments will identify the microbial species present in the brine solution and determine the optimal salt concentrations used in the fermentation process.
In the SA2 subunit of the cohesin complex, ensuring proper pairing of the sister chromatids during mitosis is crucial. Recently, researchers have observed mutations in the physiological processes involving DNA. SA2 is a core subunit of the cohesin complex that has the primary function of ensuring proper pairing of the sister chromatids during mitosis. Researchers have also found that shocked fish exhibited higher cortisol levels than the control. Combining cortisol measurements and social defeat observations, further studies could be conducted to test the effect of social defeat-induced stress on human mental health, specifically the long-term effects of bullying.
gene have been identified in several cancer types including Ewing sarcoma. The Hong Wang Laboratory at North Carolina State University recently discovered that SA2 binds to both double-stranded and single-stranded DNA. Furthermore, the Alex Bishop Laboratory at the University of Texas found that cells from patients afflicted by Ewing Sarcoma display significantly higher levels of R-loop relative to healthy cells. Ewing Sarcoma is a rare cancer of the bone that involves a translocation in the gene encoding the EWSR1 protein. Given that SA2 is mutated in Ewing Sarcoma cells, we hypothesized that SA2 and EWSR1 bind to the R-loop on double-stranded DNA to facilitate the processing of these R-loops. To directly test this hypothesis, we generated DNA substrates containing the R-loop by in-vitro transcription and characterized the binding specificity of SA2 and EWSR1 for R-loops along the double-stranded DNA using Atomic Force Microscope (AFM) imaging. We found that both SA2 and EWSR1 possess binding specificity for the R-loop on double-stranded DNA molecules. The implications of these findings could be a major step forward in understanding the molecular mechanisms that govern the tumorigenesis mediated by EWSR1 and SA2 mutations.

Poster Number: 22

**Quantitative Comparison of Enzyme Immobilization Strategies for Real-Time Glucose Detection Employing Fast Scan Cyclic Voltammetry**

**Sahaj Gosrani**, Biochemistry, NC State University

**Mentors and/or Co-Author(s):** Leslie Sombers

Electrochemical detection of non-electroactive species, such as glucose, requires biosensors which are stable, selective, and have physiologically relevant sensitivities to targeted analytes. Glucose oxidase, an enzyme, enables the electrochemical detection of glucose through the production of hydrogen peroxide. This hydrogen peroxide is electroactive and serves as the glucose reporter molecule. We have demonstrated sub-second electrochemical detection of glucose fluctuations by combining glucose oxidase modified carbon fiber microelectrodes with fast-scan cyclic-voltammetry (FSCV). FSCV has to ability to distinguish different electroactive species while maintaining effective temporal resolution and sensitivity. Carbon-fiber microelectrodes are used in conjunction with FSCV to detect electroactive molecules. The sensing surface of the microelectrode can be enzymatically modified to create biosensors. The work presented herein quantitatively compares three approaches for enzyme immobilization - physical adsorption, hydrogel entrapment, and electrospinning - on a carbon-fiber microelectrode. The data suggest that each of these methods can be used to create functional microbiosensors; however, of these, hydrogel entrapment is the most effective approach to glucose oxidase immobilization on the carbon electrode surface. These implications are useful because they define an effective strategy for microbiosensor fabrication that is broadly applicable to other oxidase enzymes, allowing the detection of non-electroactive molecules such as choline and glutamate. Overall, tools such as these will enable researchers to study multiple facets of neuroscience and tackle problems surrounding the detection of non-electroactive molecules.

Poster Number: 116

**Statistically Challenging NCAA Classifications: Alternative Methods of Classifying Colleges into Divisions**

**Christopher Gottberg**, Statistics, NC State University

**Mentors and/or Co-Author(s):** Elliot Inman

Most colleges and universities in the US participate in the National Collegiate Athletic Association (NCAA). The NCAA divides colleges into divisions based on student population, the number of sports, and other institutional characteristics. The logic for that assignment has changed over the years. At the same time, the schools within divisions change over time. The question is: Are colleges and universities currently classified into groups that reflect similarities and differences between them? This study used publicly available Title IX data from 2011-2015 for over 1500 colleges and universities. These data include: Expenses, student population, male and female participants, and revenue for revenue-generating sports. All of these data are available by individual sport. A simple outlier analysis revealed a skewed distribution for the number of participants and the revenue generated within several of the divisions. Even within the division, there were numerous extreme values. Some of these differences between divisions are due to the main revenue generating sports that bring in the highest percentage (on average) revenue from college sports. Data were separated into two data marts for further analysis: one data set including and another excluding basketball and football. Treating each data source independently, a follow-up analysis using a Generalized Linear Model (SAS PROC GLM) showed that these differences were still true even when the model controlled for state and other variables like total revenue and/or expenses. However, even with those
adjustments, differences within divisions remain. Based on these findings, suggestions are made for alternative assignments of institutions to division.

Poster Number: 88
Unconventional detection and treatment of cancer
Jonathan Grubbs, Biology - Molecular, Cellular, Developmental Concentration, NC State University
Mentors and/or Co-Authors: Mary Hawkins, Melissa Lamm
Rising lung and prostate cancer incidences have increased the search for early detection and novel treatment approaches. For example, early detection methods based on canine olfactory detection can improve cancer identification beyond the capacity of current screening technologies. Canine screening methods resulted in approximately 100% accuracy of detection across all stages of lung and prostate cancer. An approach for non-traditional cancer treatment is vaccine development based on genetically modified technology. In this approach, viral vectors carry selected genes, such as hemopexin (PEX), to promote mesenchymal cell responses to tumors. Another method of treatment is viral therapy, which is similar to bacteriophage therapy for antibiotic resistance. By pairing immune system stimulation and viral treatment, lung and prostate cancer may be eradicated with fewer untoward effects than traditional cancer regimens. To better target vulnerable populations, modeling systems based on the EbolaResponse model could be created to predict lung and prostate cancer occurrence in high-risk groups (e.g. smokers). We propose developing a predictive model to identify at-risk individuals for lung and prostate cancer screenings via canine olfactory detection of volatile organic compounds. Canine olfaction speeds tumor detection and raises efficiency of detection; tumors may then be characterized with traditional lab methods and treated with viral and vaccine methods. These unconventional methods are less detrimental to the patient than traditional methods.

Poster Number: 137
The evolution of antimicrobials in ant societies
Omar Halawani, Biological Sciences, NC State University
Mentors and/or Co-Authors: Adrian Smith
Biodiversity is important for ecosystems functioning, but it may also be a source for future drugs and novel compounds that could be used to treat human disease. Social insects live in dense groups with high probability of disease transmission and have likely faced strong pressures to develop defenses against pathogens during 150 million years of evolution. Some evidence for this already exists, but antimicrobial defenses have been tested in relatively few social insect species. We performed 96 well liquid bacterial culture assays to test the relative strength of general antibacterial compounds produced by social insects and tested evolutionary theory about where the strongest antimicrobials might be found among ants. We tested the ability of surface extracts of 20 species of ants, in concentrations ranging from 2.5-20 ant equivalents, to inhibit growth of Staphylococcus epidermidis. By measuring optical density of liquid growth cultures, with or without ant surface extracts, at 1hr intervals of a 24hr period, we found that ant antimicrobial activity is highly variable across species. We found that bacterial inhibition does not correlate with characteristics such as body size, colony size, however there was a phylogenetic signal (λ = 1.02) to the data, which suggests that strong antimicrobials are likely a characteristic of only some groups of ants.

Poster Number: 62
Flux mediated synthesis, particle morphology, and photocatalytic activity of NaNbO3
Adam Hamilton, Chemistry/Biology, NC State University
Mentors and/or Co-Authors: Paul Maggard
A variety of molten-salt flux syntheses of NaNbO3 have been investigated for their impacts on the crystal morphology and photocatalytic water splitting capabilities. In all cases the NaNbO3 samples were synthesized from Nb2O5 and Na2CO3 in stoichiometric ratios. The different fluxes used include a range of sodium halide salts (NaF, NaCl, and NaNBr) and Na2SO4. The compounds were found to be phase pure through powder X-ray diffraction (PXRD), and subsequently characterized by UV-Vis diffuse reflectance spectroscopy (UV-Vis/DRS), and with crystal lattice refinements. The synthesized powders were then platinized and used for photocatalytic hydrogen production under UV-Vis irradiation. Headspace gas was analyzed by gas chromatography (GC) and confirmed to be hydrogen. Scanning electron microscopy (SEM) images were taken of the crystallites to determine the effect of the flux reaction conditions on crystallite morphologies. The Na2SO4 flux was found to produce the highest percentage of hydrogen gas, with a total gas production of 848.3 µmol of H2 over a 6-hour period.
Spatial Analysis on the Impact of Hometown on the Success of Drafted NFL Players
Patrick Havekost, Statistics, NC State University
Mentors and/or Co-Authors: Karl Pazdernik
All great quarterbacks come from Texas. These generalizations exist within the National Football League (NFL) with respect to the performance of a player given their geographic region, but are there actually any grounds for these ideas? Knowledge of spatial patterns could assist NFL team’s scouting in providing a suggestion on which players should be focused on more than others. We used the approximate value statistic provided by pro-football-reference.com and the player’s identified hometown to test these generalizations. All data was scraped from the internet and a layout of player value was obtained through standard spatial methods.

Analysis of environmental variables affecting shade utilization and availability for elephants at the North Carolina Zoo
Monica Hendricks, Zoology, NC State University
Mentors and/or Co-Authors: Jennifer Campbell
The North Carolina Zoo in partnership with North Carolina State University investigated shade availability for and use by the facility's six African elephants. The behavior of these elephants was recorded between the months of June through November 2016 using scan sampling. The application SketchUp was used to obtain an estimate of the amount of shade available in the north and south elephant exhibits. The number of shade patches were compared to the number of elephants in each exhibit and the number of elephants utilizing shade. This information was used to determine whether there was enough shade available in the exhibits for all elephants to utilize shade concurrently. We then examined shade utilization by comparing shade use to different exhibiting hours, months, weather conditions, and temperatures, and the number of individual elephants present in the exhibit. This allowed us to understand which variables would have the greatest impact on shade use by elephants, and, therefore, which factors should be of greatest concern considering shade availability for an exhibit. Our preliminary results suggest that the amount of shade available in the exhibits at the NC Zoo is adequate for the facility's elephant population, and that several variables have an impact on the amount of time elephants will use shade. Our results give the NC Zoo the necessary information to understand the shade provided and used by their elephants in their current exhibits, and can assist other facilities with their inquiries concerning shade use and its effects on the welfare of their collections.

Influence of Environmental Stimuli on Animal Behavior
Zebria Hicks, Zoology, NC State University
Mentors and/or Co-Authors: Lisa Paciulli, Miriam Ferzli
Animals that are in contact with humans behave differently than those that are not. Likewise, animals in cooperatively breeding species interact differently than solitary animals. Multiple studies were reviewed spanning three types of environments and their effects on animal behavior: captivity in zoos, wildlife conservation, and cooperatively breeding species. Human targeted behaviors of zoo-housed great apes were documented while socially housed chimpanzees were observed during keeper absences. Data on vulture behavior was collected at conservation-aid food stations, from capture-mark resightings, and by analyzing fecundity. Observations of banded mongooses and meerkats determined individual contribution to offspring while a game-theoretical approach evaluated intra-group relatedness. For the orangutans, human-animal interactions had positive long term effects on animal behavior. Likewise, for the chimpanzees, humans provided enrichment, leading to less self-mutilation. For vultures, food stations were primarily used by juveniles, therefore increasing juvenile populations. However, large food stations placed stress on nearby breeding vultures. The mongoose-meerkat comparison showed that the presence of helpers increased offspring survival and performance as well as influenced adult behavior. The game-model demonstrated that increased intra-group relatedness improved individual contributions to offspring. Positive human intervention in animal populations was seen in the healthier captive great apes, chimpanzees, and some wild vulture populations. The health of the meerkats and banded mongooses was not dependent on human intervention, but rather on the structure of their social groups. Future research should examine the effects of animal social structure and human-animal interactions on population size.
Noninvasive and Invasive Methods of Genetic Disease Treatment

Lauren Hudak, Human Biology, NC State University

Mentors and/or Co-Authors: Miriam Ferzli

Genetic diseases are widely studied because they affect millions of people around the world. Early treatment is preferred as it is safer and more cost-effective than treating fully developed diseases. Both noninvasive and invasive techniques are utilized to combat these diseases. Noninvasive methods for Alzheimer’s and CHD treatment were studied utilizing a double-blind control group approach to test the effects of drug interventions. Behavior modification was also utilized with Alzheimer’s patients. Invasive methods utilized adenovirus vectors to carry DNA into the cells, interrupting the normal replication process with new instructions for the host cell. CRISPR/Cas9 systems were tested for their ability to target and cleave loci in target genes and then insert an unmutated donor DNA sequence into the genome. Findings were statistically significant for the use of statin drugs as a treatment for individuals at risk of CHD, while Naproxen and Celecoxib were ineffective in treating Alzheimer’s. Rather than drugs, behavior modification was significantly more effective in reducing the effects of Alzheimer’s. In contrast, invasive methods found that immune responses rejected the adenovirus vectors as foreign invaders, causing inflammation. CRISPR/Cas9 systems showed the ability to edit specific loci, which can be applied to target known disease causing mutations. These experiments help further the knowledge of genetic disease. Noninvasive and invasive measures should be combined in the future to maximize treatment effects, potentially leading to cures and elimination of genetic disease.

The Application of Case Studies for Improving Learning Outcomes in General Microbiology Lecture

Hunter Hudson, Biological Sciences, NC State University

Mentors and/or Co-Authors: Alice Lee

Student learning in the scientific disciplines largely consists of lectures followed by exams. Lack of student engagement may lead to reduced student learning outcomes. The goal of case-based learning is to introduce students to course topics in a relevant and engaging manner, typically by presenting a problem requiring students to evaluate the information and propose possible solutions. In professional schools, these case studies have shown to develop critical thinking skills. This engaging learning tool, along with collaborative discussion with classmates, can improve learning outcomes and subsequently, exam scores. To assess the impact of case studies on student learning in a large General Microbiology course, a novel case study on the interesting topic of cheese fermentation was developed. Students were assigned questions, related articles, and videos on this topic. The assignment was graded, analyzed, and compared to topical questions on the second exam. A survey was administered to address the student perspective on this case-based learning strategy. The results suggest alternative teaching strategies may improve learning outcomes in the classroom.

Woodrat sticks nests act as biodiversity hotspots

Melanie Huffman, Zoology, NC State University

Mentors and/or Co-Authors: Jennifer Campbell, Michael Cove

Woodrats build large nests out of sticks. This study focused on a population of woodrats in the Florida Keys. Using camera trap photos, we compared species richness at nests with many sticks versus few sticks by quantifying the number of species that appeared at different nest sites from July to October of 2015. Using a simple t-test, we found statistical significance indicating that woodrat nests with a high amount of sticks act as biodiversity hotspots.

The Effects of Pregnancy and Lactation on Oral Health (Cavities)

Maram Issa, Human Biology, NC State University

Mentors and/or Co-Authors: Lisa Paciulli

There has been an increase in reports from pregnant and lactating women related to tooth decay, and specifically an increase in cavities. Cavities are caused by the decay of a tooth’s enamel (outer layer) and dentin (inner layer) due to holes formed by acids in plaque. Plaque forms from a mixture of food debris,
Quantifying excitability is important because it allows researchers to measure how responsive a neuron is to inputs. Neuronal excitability, the responsiveness of a neuron to inputs, is crucial for quantitative analysis of neuronal excitability: compensating for the role of USF in regulating long genomic data for a panel of genes (e.g. Aicda, Blk, Nfkbia and Nfkbid) was confirmed using RT-qPCR. Our results suggest a novel role for USF in regulating long-term DDR. We are using crispr-targeted genome editing to delete the USF genes in both lymphocytes and in cell models of skin cancer, and will map the molecular role of USF in regulating Aicda, Blk, Nfkbia and Nfkbid gene expression.

Knockdown of USF1 and USF2 leads to long-term changes in the gene expression response to DNA damage

John King, Microbiology, NC State University
Mentors and/or Co-Authors: Michael Sikes

Cancer arises through gene mutations introduced during repair of damaged DNA. To avoid cancer, damaged cells rapidly activate a DNA damage response (DDR) that pauses the cell cycle and directs DNA repair. Transcriptional programs are activated that eventually return the cell to homeostasis, or if damage was irreparable, induce senescence and death. Unlike with repair programs, little is known about the transcription programs that guide DDR recovery. Transcription factors USF1 and USF2 are activated during DDR and remain active well after DNA is repaired. To examine the role USF plays in directing long-term responses to DNA damage, we used RNA interface to silence USF1/USF2 activity in a mouse B lymphocyte cell line. To induce DNA damage, cells were exposed to ionizing radiation (IR), and genome-wide changes in transcription were assessed at 1 and 7 days after IR. More than 2-fold change in the constitutive expression of 172 genes was seen in USF-depleted cells before or 1 day after IR, relative to control cells expressing a scrambled siRNA. In contrast, 7 days after IR we observed more than 2-fold changes in 736 genes. The genomic data for a panel of genes (e.g. Aicda, Blk, Nfkbia and Nfkbid) was confirmed using RT-qPCR. Our results suggest a novel role for USF in regulating long-term DDR. We are using crispr-targeted genome editing to delete the USF genes in both lymphocytes and in cell models of skin cancer, and will map the molecular role of USF in regulating Aicda, Blk, Nfkbia and Nfkbid gene expression.

Quantitative analysis of neuronal excitability: comparing an asymmetrical sigmoid fit to a second derivative model

Lindsey Kunz, Biological Sciences - Human Biology, NC State University
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Neuronal excitability, the responsiveness of a neuron to inputs, is crucial for the processing of information. Quantifying excitability is important because it allows researchers to measure how responsive a neuron is to inputs.
electrical stimulus. One method that currently exists for quantifying neuronal excitability is to analyze the slope of the evoked firing rate to positive current curve. The problem with this method is that it requires a subjective assessment of maximum evoked firing rate, and universal agreement on how to account for baseline measurements is lacking. To address this problem we developed two quantitative methods. The first method was based upon an asymmetrical sigmoid fit. However, since the sigmoid model assumed a logarithmic scale, there was a mathematical violation when applying it to the data set. Furthermore, the Hill slope is sensitive to baseline measurements, which is problematic given that this differs by neuron type. We concluded that the asymmetric sigmoid was an inappropriate approach. For our second method we calculated the second derivative of the frequency of evoked action potentials and identified three shifts in the resulting tangent line. The second derivative represented where the linear range of evoked firing rate ended, and therefore replaced the value of maximum evoked firing rate when re-calculating FI slope. Thus far the second derivative model approach has been applied to 60 neurons and accurately predicts initiation and termination of the functional range of a neuron's excitability. From the preliminary data we tentatively conclude that application of the second derivative method appears promising.

Poster Number: 39
**Measuring Vegetative Stress from Extended Drought**
Julia LaFond, Geology, NC State University

**Mentors and/or Co-Authors:** Erin Hestir

For the past five years, Southern California has been under an extended drought. Extended droughts negatively impact both human society and the environment through vegetation stress and mortality. As the climate continues to change, certain regions of the world may become more prone to droughts of this type. Therefore, it is imperative to understand how different types of vegetation respond to extended droughts over time. Satellite remote sensing provides an effective tool to track the effects of extended drought. In this study, I have combined vegetation maps from Landsat data with time series analysis of temperature data and gross primary productivity (GPP), a measure of carbon fixation by plants from MODIS. Using a multivariate statistical analysis, I created a remote sensing index of drought stress that can be used to indicate the severity and extent of drought across plant types using open access, readily available data. This will allow large-scale analysis of drought in at-risk regions around the globe, highlight ecosystems that are most susceptible to drought, and potentially can be used to predict drought.

Poster Number: 70
**Cradles and museums of Antarctic biodiversity**
April Lamb, Zoology, NC State University

**Mentors and/or Co-Authors:** Alex Dornburg

Isolated in one of the most extreme marine environments on earth, the teleost fish fauna of Antarctica’s Southern Ocean is dominated by one clade: notothenioids. However, as this region undergoes some of the fastest rates of environmental change, the long-term persistence of this unique fauna is jeopardized. Forecasting the response of these species to contemporary environmental perturbations requires an understanding of how notothenioids have persisted through climatic change events over their evolutionary history. Do shifts in climatic regimes correspond with changes in biogeography or pulses of extinction? Here we use a combination of phylogegetic and biogeographic modeling to infer the biogeographic history of living notothenioid fishes. We show that the High Antarctic represents a biodiversity sink. In contrast, sub-polar regions, specifically the Northern Antarctic Peninsula, have repeatedly acted as source areas for the recolonization of teleost fish biodiversity in the High Antarctic. Contemporary trends of global climate change threaten to invert these evolutionary dynamics of lineage expansion out of the Antarctic Peninsula. Today, this evolutionary refugium and speciation zone is poised to become a main entry point for invasive colonizers, while simultaneously disrupting connectivity between the Southern Ocean’s high latitudes and surrounding sub-Antarctic areas.

Poster Number: 113
**Effects of Temperature on Reactive Nitrogen Deposition**
Brandon Lewis, Meteorology, NC State University

**Mentors and/or Co-Authors:** Viney Aneja, Jordan Baker

Anthropogenic activities are altering climate and biogeochemical cycles at unprecedented rates. Key changes include elevated temperature, carbon dioxide (CO₂), and reactive nitrogen (Nr) deposition. The objective of
this study is to see if there is a correlation between temperature and deposition of reactive nitrogen. Measurements were made during Summer and early Fall of 2016 at three different eastern NC locations i.e. Duke Forest, Durham; NC State’s University Club, Raleigh; and the Cherry Research Farm in Goldsboro, NC. These sites represent three diverse areas and are characterized as a rural site, an urban site, and an agricultural site respectively. At these sites, the concentration of reactive nitrogen compounds i.e. ammonia (NH₃), nitric oxide (NO), nitrogen dioxide (NO₂); and carbon dioxide (CO₂) were measured continuously i.e. a time interval of 1 minute. The deposition flux of these gases was then calculated using published deposition velocities. The relationship of Nr deposition flux with temperature was examined and the correlation coefficient at Duke Forest is 0.52 for NOₓ, 0.47 for NO₂. For NC State’s University Club, the correlation coefficient is 0.04 for NO₂, 0.04 for NH₃, and 0.02 for NO₃. At the site in Goldsboro, the correlation coefficient is 0.04 for NO₂, 0.09 for NH₃, and 0.08 for NO₃. CO₂ deposition flux was not calculated because the net flux above natural surfaces represents the balance between soil respiration (emission) and photosynthesis (uptake) at these sites.

**Poster Number: 69**

**Wild Male House Mice compatibilities with Lab Female House Mice**

*Nicole Heard*, Biological Sciences-IPN Concentration, NC State University  
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Islands are biodiversity hotspots, home to 45% of currently endangered species and were home to 64% of the world’s extinct species. Over 80% of islands contain invasive rodents, including the house mouse, Mus musculus. Eradications of invasive rodents have been primarily through rodenticides, but this approach has inherent drawbacks. A promising potential eradication method would harness a naturally occurring gene drive, the t-haplotype (tw2). By placing the Sry male gene necessary for male gonadal development into the t-haplotype construct, the majority of the mice born should be phenotypically male. This should result in fewer females and a steady decrease in the population. In order to develop this eradication approach, research is needed to understand wild house mouse mating behavior. This experiment seeks to test reproductive compatibilities between wild and laboratory strains utilizing Farallon Island derived male mice and females from two lab strains: C57BL/6 and a strain carrying the t-haplotype (tw2). Previous research has shown that wild-derived females are compatible with laboratory males and the transmission of the t-haplotype may be higher in wild/lab mice than in just lab mice. This experiment seeks to confirm that wild-derived males show mating compatibility with laboratory-strain females and that the t-haplotype is being transmitted. The key variables of interest are mating behavior, litter size, pup weight, and transmission rate of the tw2 allele. The study of mating behavior of wild mice should aid discovery of more humane eradication methods and contribute to understanding how invasive mice can so dramatically affect island environments.

**Poster Number: 10**

**Ultra-bright BODIPY functionalization for application as a biological dye**

*John Johnson*, Chemistry, NC State University  
*Mentors and/or Co-Authors:* Walter Weare

Near-unity boron-dipyrromethene (BODIPY) compounds have been lauded as potent fluorophores, and are thus prime candidates for application in the field of biological dyes. For a dye to be effective, it must emit at a penetrative wavelength, bind to intended targets, and be stable in an aqueous medium. A series of reactions were carried to these hands on a previously synthesized mesityl-substituted BODIPY, conjugated to align its emissions with acceptable ranges for in vivo detection. The extension of the π system in the this BODIPY, through Knoevenagel condensation, has a two-fold purpose – the bathochromic shift to a tissue-penetrative wavelength and the addition of two symmetrical phenol groups primed for individual functionalization. Reaction with maleic anhydride yields a maleimide substituent that is key in protein-binding in vivo through harmless cross-linking interaction with sulfhydryls in cysteine residues. The sulfonation of the BODIDY core creates a water-soluble salt which can be placed in aqueous medium for biological purposes, though careful attention must be given to quenching mechanisms, which proved troublesome. Other sulfhydryl-reactive species are being considered in order to optimize post-reaction fluorescence.

**Poster Number: 37**

**Assessment of Reliability of Exotic Husbandry Resources**

*Joshua Limer*, Zoology NC State University  
*Mentors and/or Co-Authors:* Jennifer Campbell
As exotic pet ownership becomes increasingly common and complex, we explore if commonly available exotic pet husbandry guidelines are reliable. As the variety of species kept as pets expands, the body of knowledge surrounding exotic animal husbandry must grow in order to maximize animal welfare. There are nuances involved with keeping a variety of species and the average owner’s understanding on how to care for any given exotic pet is poorly understood. It has been noted (L, 2010) exotic pet owners often underestimate the husbandry needs of their animals. This idea is further complicated by the understanding that the resources available to potential pet owners can vary in the specificity of information provided. This disjunction of information, and the reliability of pet owners, can lead to high morbidity and mortality in captive exotic pets. Here, we examine the accessible husbandry guidelines for common exotic pets (ball pythons, leopard geckos, hedgehogs, chinchillas, finches, and parakeets) that represent various taxa. To complete this investigation, we will compare those guidelines, created from a Google search relating to the specific animal’s care, with the verdict of animal care professionals (i.e., veterinary offices, museum staff, zoo staff). The goal of this project is to determine if the husbandry information available to exotic pet owners is reliable for keeping their animals and should help provide a basis for improving commonly available exotic husbandry guidelines. So far, data from professional input has not shown easily available husbandry information is trustworthy.

Poster Number: 102

Element Production Through the Neutrino-p Process in Supernovae

Jacob Lineberry, Physics, NC State University

Mentors and/or Co-Authors: Carla Frohlich

An understanding of the creation of elements heavier than Fe has remained an open question in Astrophysics. The r-process is thought to create the heavier elements beyond Fe, and simulated r-process match well with observed abundances. However, there is a discrepancy between the observed abundances and the r-process predicted abundances for elements such as Sr, Y, and Zr. The Lighter Element Primary Process (LEPP) (Travaglio et al. 2004) has been hypothesized to resolve this discrepancy. The neutrino-p process provides a candidate for the LEPP, and better predicts the abundances of heavier elements through simulation. Following core collapse and explosion of a massive star, the newly formed proto-neutron star powers a neutrino-driven wind. As this neutrino wind drives ejecta outward, a very proton-rich environment is created which is ideal for the neutrino-p process and the associated synthesis of Sr, Y, and Zr. The goal of this project is to investigate the neutrino-p process nucelosynthesis and production of Sr, Y, and Zr resulting from varied conditions in the neutrino wind of core-collapse supernovae. I present several regions where the abundance ratio of Sr/Y matches observed conditions due to the neutrino-p process and discuss trends at various electron fractions.

Poster Number: 66

More Food, Less Space: Preventing Extinctions Using GM Crops and Traditional Farming Techniques

Katie Lucas, Zoology, NC State University

Mentors and/or Co-Authors: Mary Hawkins, Melissa Lamb

The Neolithic Revolution with its corresponding agricultural development has directly contributed to global human expansion. However, this human presence has negatively impacted many species, including the thylacine (Thylacinus cynocephalus). Thylacines went extinct on mainland Australia circa 3500 BP and also on Tasmania in 1936. The earlier extinction is thought to be due to human intensification and dingo introduction, while the latter was caused by targeted extermination to protect domestic stock. It is clear that land appropriation by humans contributed to the loss of the thylacine. We propose that extinctions of species that are currently threatened or endangered due to habitat loss from human activity could be prevented via more intensive crop production through both modern and traditional agriculture techniques. For species that are threatened or endangered due to habitat loss, genetically modified (GM) crops could slow modern-day extinctions by increasing yields per acre near their habitats. A variety of genetic modifications, including resistance to unfavorable environmental conditions (e.g., DREB1A gene for drought resistance), and increased activity in processes that promote growth (e.g., wheat ADP-glucose pyrophosphorylase (AGP)) have increased efficiency of crop yield per acreage in wheat. Traditional techniques, specifically intercropping, could also increase yield per acreage by stimulating favorable growing conditions. This may result in less native habitat destruction by humans, thus allowing species to survive despite human competition. Additionally, the cause of historical extinctions like the thylacine should be reevaluated with habitat loss due to agriculture included in the ecological models.
Poster Number: 144

Realization of noise reduction in coupled circuits

Theodore MacCabe, Physics, NC State University

Mentors and/or Co-Authors: Behnam Kia

Chaotic systems are inherently sensitive to their initial conditions, so even a small amount of noise can significantly change the system’s behavior. Previously, our lab has used simulations to show that chaotic Chua circuits that are coupled (which means they are connected to each other in a certain way) contain less noise than individual Chua circuits. Our lab found that noise robustness, a measure of resistance to noise, is proportional to the number of circuits in the simulated coupled network. In my ongoing project, I am performing a similar experiment using physical circuits rather than simulations in order to evaluate this noise reduction effect in a physical application and compare it to the simulated results. My project’s goals are to show the effectiveness of this noise reduction strategy in physical chaotic systems. This may allow chaotic systems to be used even in applications that involve substantial noise.

Poster Number: 28

Residual Gas Analysis of Adsorbed H2O and D2O on Deuterated Polystyrene Surfaces

Monique Martone, Physics, NC State University

Mentors and/or Co-Authors Kent Leung

The neutron EDM experiment seeks to find if the neutron has a permanent electric dipole moment, a property that violates time-reversal symmetry, and could explain why there is more matter than anti-matter left over after The Big Bang. This is one of the biggest mysteries of modern science. The nEDM experiment is performed using ultracold neutrons, which have a “temperature” of ~2 mK, that become lost due to H2O physisorption to surfaces and thus contaminating them. We have found that removal of H2O via heating in a high vacuum is an effective tool for its removal. We performed studies of deuterated polystyrene coated acrylic samples using a Residual Gas Analyzer (RGA) device. By heating the sample externally at different temperatures, we were able to observe the partial pressure with RGA to calculate the binding energy of molecules outgassed. We also investigate whether we can replace surface H2O with D2O or HDO by dipping the sample in D2O. Deuteration causes significantly less ultracold neutron loss than hydrogen. We use RGA to measure the distribution of D2O and HDO by observing their outgassed time constants and binding energies. Finally, we used time-of-flight secondary ion mass spectroscopy (ToF-SIMS) to measure the composition of our samples as a function of depth to verify our results.

Poster Number: 39

Investigation of Beta-methylamino-L-alanine (BMAA) Misincorporation into Cellular Protein

Ahmed Mashal, Chemistry, NC State University

Mentors and/or Co-Authors: Michael Bereman, Joshua Beri

Significant progress has been made to investigate genetic factors linked to Amyotrophic Lateral Sclerosis (ALS). However, only about 10% of ALS incidences are explained by primary genetic factors, and there is ample evidence to support that the environment plays a significant role in ALS development. The first clue of an environmental contribution to ALS development came on the island of Guam in the 1960’s. Researchers noted that natives succumbed to an ALS-like disease with 100 times greater incidence than the rest of the world, eventually identifying beta-methylamino-L-alanine (BMAA), a non-natural amino acid, as a potentially causative exposure. It has been hypothesized that BMAA becomes misincorporated into cellular protein in place of L-Serine during synthesis. Herein, we investigate the possibility of BMAA misincorporation into cellular protein by in-vitro cell-free protein synthesis. To overcome dynamic range limitations, we synthesized a novel BMAA alkyne derivative to perform enrichment for proteins containing BMAA-misincorporation via click chemistry.

Poster Number: 62

Real-Time Striatal Measurements of Oxidative Stress and Dopamine in the Dyskinetic Rat During Chronic L-DOPA Treatment for Parkinson’s Disease

Catherine Mason, Biology concentration in Integrative Physiology and Neurobiology, NC State University

Mentors and/or Co-Authors: Leslie Sombers
Parkinson’s disease (PD) is a neurodegenerative disease characterized by the slow degeneration of dopaminergic neurons found in a region of the midbrain called the substantia nigra. Dopamine (DA) plays a key role in regulating motor function. Thus, the destruction of these neurons and the consequential decrease in DA concentrations in the striatum leads to the deterioration of motor control. The drug Levodopa has been used to treat PD by helping to increase the concentration of DA in the brain. This drug has been proven to alleviate the motor symptoms of PD; however, after a short period of time, dyskinetic symptoms can develop. It is thought that oxidative stress is a principal contributor to the destruction of dopaminergic neurons, and possibly to the development of dyskinesias, in PD and its treatment. To date, oxidative stress has been difficult to measure due to the high reactivity of oxygen radicals, however the generation of hydrogen peroxide ($\text{H}_2\text{O}_2$) can serve as an indicator of the presence of oxidative stress. This experiment uses fast-scan cyclic voltammetry coupled with carbon-fiber microelectrodes to simultaneously monitor rapid, real-time, fluctuations of DA and $\text{H}_2\text{O}_2$ in the dorsal striatum. These neurochemical dynamics can be time-locked to dyskinetic episodes. Overall, these studies will aid in our understanding of how oxidative stress modulates nigrostriatal DA signaling, as well as the behavioral consequences of this interaction. The results will inform improved therapeutic strategies for the treatment of PD.

Poster Number: 29  
**Raman Microspectral Analysis of Freshwater Microfiber Plastics**  
*Chanelle McArthur, Geology, NC State University*  
**Mentors and/or Co-Authors:** John Fountain

Water samples collected from the Neuse River in Raleigh, North Carolina were shown to contain microfiber plastics after visual examination by microscope. The purpose of this research is to use Raman microspectral analysis to determine the specific type of microfiber plastics found in the river with the goal of identifying the point sources of these pollutants. Published studies have indicated that Raman microspectral analysis can characterize common fibers. Environmental scientists have documented the widespread presence of microfiber plastics in freshwater systems. There is uncertainty regarding the effects of microfiber plastics in freshwater ecosystems due to their prolonged decomposition times and the potential for aquatic organisms to ingest these microfibers, thereby introducing plastics into the food web. This is cause for concern as microfiber plastics have the ability to leach toxic chemicals and adsorb pollutants. Raman spectra of standard samples indicates that this method is capable of discriminating common fibers. Analysis of samples is ongoing.

Poster Number: 127  
**Insulin regulation of leptin in a teleost fish**  
*Meredith Meyer, Molecular, Cellular and Developmental Biology, NC State University*  
**Mentors and/or Co-Authors:** Russell Borski

Leptin is a cytokine hormone that plays a major role in regulating energy expenditure. In mammals, leptin is hypoglycaemic and its secretion is stimulated by insulin, however little is known about the interaction between these hormones in fish or in ectotherms generally. Thus, this study investigated the effect of insulin on leptin expression by hepatocytes isolated from the Mozambique tilapia (*Oreochromis mossambicus*). As leptin is hypoglycaemic in fishes, it was hypothesised that its expression would be suppressed by insulin to prevent the mobilisation of glucose stores. We used qPCR to measure mRNA levels of the two leptin isoforms present in the tilapia, *lepa* and *lepb*. The data suggest that increasing concentrations of insulin inhibit transcription of both leptin isoforms and that *lepa* is the predominate isoform expressed. Future studies are required to investigate the effects of insulin on leptin secretion.

Poster Number: 145  
**Microsatellite Mapping of Sex Determination in *P. livingstonii* and *C. trewavasae***  
*Adam Miranda, Genetics, NC State University*  
**Mentors and/or Co-Authors:** Reade Roberts

African cichlids are a particularly interesting genetic model system due to the wide variety in traits among closely related species. Sex determination is one of these variable traits and the mechanism of sex determination can be quite different among species. Uncovering the mechanisms behind sex determination can be key to understanding evolutionary transitions between sex determination systems, and sex-linked traits that differ among cichlid species like sexual dichromatism. Using microsatellite marker mapping we are
characterizing the sex determination mechanisms of the species *Pseudotropheus livingstonii* and *Copidichromis trewavasae*. In *P. livingstonii*, associations on linkage group 7 suggest a male heterogametic (XY) sex determination system. Mapping studies in *C. trewavase* are ongoing. We provide evidence for sex determination mechanisms in species where this trait has not been previously characterized, and we discuss our results in comparative context of other cichlid species with known sex determination systems.

**Poster Number: 68**

**Central American Biomass Burning Aerosols and Their Impact on Southeastern United States Tornado Events**

**Michael Mugrage**, Meteorology, NC State University  
**Mentors and/or Co-Authors:** Nicholas Meskhidze

Due to the increase of population in our nation’s cities, it’s becoming increasingly paramount for meteorologists to accurately predict tornado outbreaks. Prediction accuracy can be improved by understanding the fundamental physical processes driving these outbreaks. Among these important processes is the role of aerosols in cloud formation, specifically the severity and intensity of tornado outbreaks, and individual tornadoes, respectively. This research explores the relationship between biomass burning aerosols generated in Central America and the severity of tornado outbreaks in the southeastern United States, with respect to their role as cloud condensation nuclei (CCN). Data consists of Moderate Resolution Imaging Spectroradiometer (MODIS) Thermal Anomalies, MODIS 8’s Aerosol Optical Depth (AOD), Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) Trajectories, and NOAA’s Storm Prediction Center (SPC) tornado reports covering 108 days or “events”, encompassing 16 Spring seasons (2001-2016). Using the southeastern United States as a reference region, the number of tornado reports is cross referenced with the MODIS 8’s AOD thickness per event. Additionally, HYSPLIT trajectories and thermal anomalies are cross referenced with tornado reports across Central America and the Gulf of Mexico. These references are split into two groups consisting of high and low probability events. The antecedent cross-references are confirmed through utilization of linear regression, allowing for relationships to be drawn between AOD and southeast U.S. outbreaks. Through this analysis, it’s determined there’s considerable connection exists between aerosol production, via biomass burning across Central America, and the increase in tornado outbreak severity and tornado intensity across the southeastern United States.

**Poster Number: 4**

**A Preliminary Comparison of Morphological Features of Extinct Giant Aye-Aye (*Daubentonia robusta*) and Extant Aye-Aye (*Daubentonia madagascariensis*).**

**Taylor Nguyen**, Anthropology, NC State University  
**Mentors and/or Co-Authors:** Lisa Paciulli

The aye-aye (*Daubentonia*) is a monotypic genus belonging to the Primate suborder, *Prosimii*. There is one extant species, *D. madagascariensis* (*D. mad.*), in Madagascar, and it is known for its distinct anatomic structure. Aye-ayes have large ever-growing incisors and an elongated tapping finger, which allows for unique foraging behavior. Subfossils dating to less than ~1,000 years ago of a giant version of the present day aye-aye were found in arid environments in the south and southwest regions of Madagascar (Simons 1994). They were brought back to the *Institut de Paléontologie in Paris*, and were identified as belonging to the species, *D. robusta* (Simons 1994). In this study, a comparison of the anatomy of the extinct and extant ay-ayes was undertaken. Digital calipers were used on digital micro–computed tomography (micro-CT) scans of the subfossil bones to take measurements such as proximal-distal length and medio-lateral width of the limb bones. Results were compared to measurements of the extant aye-aye taken from the literature. The size, robusticity, and inferred locomotor patterns of the two species were compared. In addition to having longer limbs, *D. robusta was ~1.2 times more robust than D. mad.* Due to this robusticity, the extinct aye-aye most likely moved slowly and was primarily terrestrial, compared to the extant form, whose lighter and more gracile limbs allow for more rapid locomotion and arboreality. Future research should include a comparison of the diets of the two *Daubentonia* species to see what differences exist that contribute to their size differences.

**Poster Number: 71**

**Visual Exploration of Collegiate Basketball Schedules Aided by Rvest Data Scraping**

**Christopher Nobblitt**, Statistics, NC State University  
**Mentors and/or Co-Authors:** Justin Post
Data scraping is an imperative tool for the automation of gathering and cleaning massive amounts of data from online sources. This project examined collegiate basketball schedules from the 351 Division I Universities in the United States, which were scraped from ESPN’s website using the R programming package, rst. Geospatial data queried from Google Map’s API was combined with the basketball data to create an interactive application that enables users of any statistical experience to visually explore the travel patterns of collegiate basketball teams. Because the associated data is generated using an automated data scraping process, future use of this application will incorporate new and updated information, an example of how researchers can save valuable time for data exploration and analysis. A guide for data scraping using R was created to assist undergraduate students for learning this tool.

Poster Number: 127
**Differences in Lemur Placentas**

**Camille Overcash,** Biological Sciences, NC State University

**Mentors and/or Co-Authors:** Lisa Paciulli

Most primates, including humans, typically give birth to singletons. Tamarins and marmosets (Primate Subfamily: Callitichinae) are exceptions, and have been known to have multiples a majority of their pregnancies. It was found that although common marmoset (*Callithrix jacchus*) placentas were significantly under-grown during pregnancies with multiples, the efficiency of the placentas was increased (Rutherford 2008). Like other anthropoids (monkeys and apes), marmosets have hemochorial placentas. In contrast, prosimians (lemurs, lorises, and galagos) have epitheliochorial placentas, which means that fetuses are separated from the mothers’ blood by three layers of tissue. Some prosimian species also can birth multiples at one time. One such species, the ring-tailed lemur (*Lemur catta*) normally has one offspring in the wild, but can have twins. In captivity, twinning is more common. In this study, placentas from captive ring-tailed lemur single and multiple births were examined to see if 1. placentas were significantly under grown, and 2. placental efficiency was increased. Four frozen lemur placenta were obtained from the Duke Lemur Center. Measurements such as placental weight, thickness, and volume were recorded, and compared with neonatal weights. Ring-tailed lemur are endangered (IUCN 2014). In the wild, infants live in difficult environments, fall, and succumb to predation, all of which contribute to ~50% mortality during the first year of life (Garbutt 2007). It is important to understand how the ring-tailed lemur’s fetal lives (*e.g.,* in utero), affects their start in life. Future research should increase the sample size of ring-tailed lemur placentas studied.

Poster Number: 36
**Hydrogen peroxide specific sensors for in vivo measurements using chronically implanted carbon-fiber microelectrodes.**

**Sambit Panda,** Biomedical Engineering and Biology, NC State University

**Mentors and/or Co-Authors:** Leslie Sombers

Hydrogen peroxide (*H₂O₂*) has been implicated in the slow destruction of dopaminergic neurons in Parkinson’s disease (PD). This neurodegenerative disease affects more than one million people in America, creating a critical need to identify the mechanisms through which *H₂O₂* interacts with dopaminergic neurons. Real-time detection of this analyte *in vivo* has recently been described using fast-scan cyclic voltammetry at carbon-fiber electrodes. However, distinguishing *H₂O₂* from interferents such as adenosine and pH shifts remains a challenge. Additionally, chemical agents used to pharmacologically verify the presence of hydrogen peroxide production in the brain, such as mercaptosuccinic acid (MCS), have similar oxidation peaks to that of the target analyte, further convoluting the characterization of robust *H₂O₂* dynamics in the brain. We have addressed these problems by fabricating mechanically robust *H₂O₂* selective electrodes. 1,3-phenylenediamine (mPD) was electrodeposited onto the surface of the carbon-fiber electrode to render it insensitive to the larger analytes. Since pH changes generate a well-characterized and distinct voltammogram, they can easily be removed from the signal using principal component regression, leaving an electrochemical signal due solely to the oxidation of hydrogen peroxide. This technology was fully characterized and the work will facilitate the selective detection of *H₂O₂* *in vivo*, opening the door for further elucidation of the neurodegenerative role it plays in PD, as well as other neuropathies involving oxidative stress.
Alzheimer’s disease (AD) represents a severe condition that plagues over 20 million people worldwide [Ballard et al., 2011]. AD is the most common form of dementia and is a neurodegenerative condition that results in cognitive decline, memory loss and ultimately death for the sufferer [Dineen et al., 2014]. The current anti-AD drugs are primarily acetylcholinesterase inhibitors and NMDA antagonists, both of which fail to delay the progression of AD. The β-amyloid (Aβ) peptide is a significant contributor to AD and its progression due to the peptide’s ability to accumulate and form protein plaques. One protease responsible for the production of the Aβ peptide is the β-site APP cleaving enzyme (BACE1). As a result, the design of small molecule BACE1 inhibitors has recently received interest for the purposes of AD treatment. However, the active site of the BACE1 protein is long, shallow and hydrophilic; therefore, efforts to create BACE1 inhibitors have resulted in polar compounds with unfavorable physicochemical properties, pharmacokinetics and central nervous system penetration [Thomas et al., 2014]. In this project, we compiled the largest dataset of publicly available BACE-1 inhibitors and conducted a cheminformatics-based analysis in order to (i) cluster all known inhibitors based on chemical similarity and study local structure-activity relationships, (ii) develop predictive quantitative structure-activity relationship (QSAR) models, and (iii) dock all active BACE-1 inhibitors to study their consensus binding modes and extract new knowledge for designing new inhibitors with enhanced BACE1 binding affinity.

Golgi staining allows visualization of neuron morphology by using heavy metals to permanently label neuron morphology from brain tissue. Golgi staining is an appealing method due to its cost effectiveness, easy tissue preparation, and wide applicability to tissues from various species. One morphological feature revealed by Golgi staining is neuronal dendritic spines. Spines are important to visualize because they are indicative of excitatory synaptic connections made onto neurons. Higher numbers of excitatory synaptic inputs are usually reflected by increased numbers of dendritic spines. Here I apply the Golgi method to visualize the dendritic spine morphology of Medium Spiny Neurons. Medium Spiny Neurons are the primary neurons in the Nucleus Accumbens Core, which is a brain region known to be involved in mediating reward-related behavior. In this experiment, I used Rapid Golgi Stain Kit by FD Neuro-technologies to visualize the dendritic spines of Medium Spiny Neurons (MSNs) in the Nucleus Accumbens Core of an adult female rat. After much troubleshooting, the Golgi staining was successfully executed and resulting images were visualized through a light microscope. I then learned how to apply the RECONSTRUCT and ImageJ NIH software programs to quantify dendritic spine density and size. I then created a protocol to allow others to perform this technique. The successful application of this technology will now enable our laboratory to test hypothesis relating to excitatory synaptic inputs, which are sensitive to important processes such as biological sex, and behaviors including learning.

Zearalenone is a mycotoxin that is a common contaminant of grains worldwide. In addition to general toxic effects, zearalenone is thought to cause reproductive disorders in animals and humans due to its interaction with estrogen receptors. Like mammals, teleost fish have multiple estrogen receptor subtypes with different tissue distributions and ligand binding affinities. However, teleost fish possess an additional ER subtype not found in mammals called ER beta-A (ERβα). Zearalenone (ZEAR) binds to the teleost fish ERβα with 11X lower affinity than to ER-alpha. This difference in affinity correlates with evolutionarily conserved amino acid substitutions in the ligand-binding domain of the teleost ERβα subtype. To investigate the role of one of these substitutions in the differential binding of ZEAR to teleost ERs, we mutated the Atlantic croaker ER-alpha Cysteine (C) to ERβα Methionine (M) at the amino acid position corresponding to human ER-alpha C530. We used this acER-alpha(C- M) construct for bacterial protein expression and subsequent competitive binding
studies with ZEAR as the competitor. The binding affinity of ZEAR to the acER-alpha(C-M) mutant was unchanged from that of acER-alpha, indicating that the methionine substitution in ERßa is not responsible for the lower binding affinity of ZEAR to the ER beta-A subtype. In contrast, preliminary studies in our lab show that the reciprocal substitution, ER beta-A(M-C) does alter binding affinities, suggesting that ERßa(M) may interact with additional ERßa-specific amino acids of the teleost ligand-binding domain.

Exhibit Number: 1
**Dystopia: Plastic Kills**

*Angela Perez, Art+Design: Fibers, NC State University*

**Mentors and/or Co-Authors:** Jennifer Campbell

Dystopia: Plastic Kills was influenced by the amount of trash that is in the ocean; specifically plastic. According to National Geographic, from 2015, “There are 5.25 trillion pieces of plastic debris in the ocean. Of that mass, 269,000 tons float to the surface, while some four billion plastic microfibers per square kilometer litter the deep sea.” It takes roughly 450-1,000 years for plastic to decompose. Sea animals eat the plastic, get trapped by the plastic, and become poisoned by the toxins in plastic; all resulting in death. Not only does plastic affect animals, it also harms humans. Micro-plastics from the ocean end up in our food sources and become ingested, having negative health effects.

Dystopia: Plastic Kills is made of 90% reusable material. Every component is found and reused material except for the resin. This piece will resemble a small portion of the ocean, frozen in time by encapsulating materials in resin. It is focused around how plastic is harming our ocean environments. The stepping stones, chair, and table are to feel cohesive in bringing awareness to the viewers of how easy it is to throw away plastics and not recycle them. The second thing that this art piece is meant to do, is show viewers that people don’t have to just recycle their plastics, they can turn them into a work of art or something useful. An informational poster with facts on plastic will further the knowledge obtained from this piece.

Poster Number: 30
**Synthesis of Novel 2-aminoimidazoles as Potential Codrugs Against Biofilm Forming Bacteria**

*Matthew Peszko, Chemistry, NC State University*

**Mentors and/or Co-Authors:** Christian Melander

The problem of antibiotic resistant bacteria is a growing concern for humanity. The potential epidemics that could result from an inability to combat bacteria such as *Mycobacterium tuberculosis* is reason enough to develop novel drugs or codrugs to circumvent resistance. One mechanism responsible for antibiotic resistance is the formation of biofilms, extracellular matrices enabling up to a 1000 fold increase in antimicrobial resistance. Biofilm forming bacteria express different properties while in the biofilm, and possible mechanisms of action for antibiotic protection arise as a result. Potential sources of resistance include the biofilm acting as a protective layer which prevents penetration by antimicrobial molecules, as explained by Stewart. Another possibility includes the existence of microgradients within the biofilm which offers areas of lowered growth, pH gradients, or oxygen concentration changes; all of these factors could alter the potency of antibiotics. The idea of persisters is also hypothesized, in which a small subset of cells exist in a spore-like, protected state, and are not affected by antibiotics even during prolonged exposure. Potential codrugs containing a 2-aminoimidazole (2AI) moiety show promise as biofilm inhibition and dispersion agents. Here is shown the synthesis for several novel 2AI scaffolds, with inspiration from previous work by Melander, that are to be tested as potential adjuvants for dispersing and inhibition of bacterial biofilms.

Poster Number: 89
**Probing and characterizing the promiscuity of Germicidin Synthase (GcS), an unusual biosynthetic enzyme**

*Vishwas Rao, Chemistry, NC State University*

**Mentors and/or Co-Authors:** Gavin Williams

Polyketides are a class of natural products with high therapeutic value as anticancer, antifungal and antibiotic drugs. These synthetically complex molecules are produced through mega-protein assembly lines called polyketide synthases (PKSs). PKSs are typically classified into three classes based on their protein domain organization. Type I and II PKSs are multidomain enzyme complexes, where each domain catalyzes a specific reaction or type of reaction. Type III PKSs differ in that they consist of only one enzyme with a multifunctional active site. Germicidin Synthase (GcS) is a type III polyketide synthase that produces the antibacterial compound germicidin. This enzyme catalyzes unusual carbon-carbon bond formation with
several naturally occurring substrates. Here within, we describe our efforts to characterize its substrate specificity. By characterizing its promiscuity, we can learn more about the chemistry and functionality of this class of enzymes while simultaneously producing germicidin analogs that can be further tested for pharmaceutical properties.

Poster Number: 33
**Statistical Evaluation of Two Global Climate Datasets in Support of Pest Forecasting Models**
Kieran Riban, Statistics, NC State University
**Mentors and/or Co-Authors:** Heather Dinon Aldridge

Invasive pests pose a risk to agriculture and natural resources in the United States, causing economic and environmental harm and creating challenges for the trade of agricultural products. Pest forecast models are utilized to help protect against the entry, establishment, and further spread of significant pests while also facilitating safe trading systems. These models rely on global climate datasets of temperature and precipitation to provide atmospheric conditions at a variety of spatial and temporal resolutions. This study quantitatively analyzes minimum and maximum temperature as well as precipitation data for two global climate datasets – Climate Forecast System Reanalysis (CFSR) and Climate Forecast System Version 2 (CFSv2) – to determine the level of accuracy as compared to Global Historical Climatology Network-Monthly (GHCN-M) data. Global error and bias of the two Climate Forecast System datasets are calculated using ground-station – grid-point pairs all over the world. In addition, a regional scale analysis is performed for each continent and sub-region within the continental United States. Results from this study provide global climate data recommendations for the models used in the Spatial Analytical Framework for Advanced Risk Information Systems (SAFARIS) project – a collaboration between the Center for Integrated Pest Management (CIPM) at NC State University and the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS). The goal of SAFARIS is to contribute forecasts of the behavior of potentially harmful pests to APHIS’ Plant Protection and Quarantine (PPQ) program.

Poster Number: 26
**Lake Bottom Sedimentary and Aqueous Analysis of Greenland’s Coastal and Inland Lake Systems**
Stephen Richardson, Geology, NC State University
**Mentors and/or Co-Authors:** Chris Osburn

Arctic lakes contain important records of environmental change in their sediments. The purpose of this study is to utilize optical and chemical analysis of chromophoric dissolved organic matter (CDOM) to determine patterns in the abundance and sources of organic matter deposited in numerous inland and coastal lakes situated across a climatic gradient in southwest Greenland. Through the analysis of CDOM properties from sediment cores and the pore water found within discrete strata, we compare and contrast organic matter sources which reflect historical and current aquatic conditions, and to infer the driving force behind the change in abundance of sequestered organic material at each site. Through this approach, we may discover correlations between CDOM information contained in these lakes and various events throughout geological time, including, but not limited to, deposition events, climatic variability, and shifts in aquatic chemistry. Relationship between these events and subsequent organic matter deposition in these lakes can inform us as to how carbon sequestration in Arctic lakes might vary in response to global environmental change.

Poster Number: 45
**Evaluation of Cetylpyridinium Resistance in Delftia Species and Analysis of Prevalence with a Unique Genetic Sequence**
Noah Riley, Genetics, NC State University
**Mentors and/or Co-Authors:** Carlos Goller

*Delftia acidovorans* and *D. tsuruhatensis* are gram-negative, aerobic, rod-shaped bacteria formerly classified as *Comamonas*. The SPH-1 and Cs1-4 strains of *D. acidovorans* have been computationally predicted to contain a gene which confers resistance to cetylpyridinium (CP), an antibacterial chemical used in mouthwashes and toothpastes as cetylpyridinium chloride (CPC) to fight plaque and gingivitis. This unique sequence exists solely in *Delftia* species, but its ability to confer CP resistance has not previously been experimentally confirmed. To amplify the putative CP gene, primers were designed using genomic DNA from the fully sequenced SPH-1 strain of *D. acidovorans*. Growing *D. acidovorans* strains SPH-1 and Cs1-4 and *D. tsuruhatensis* in tryptic soy broth at varying concentrations of CPC indicated that each can survive at different Minimum Inhibitory Concentrations within a range of 0.002% - 0.0025% CPC (mouthwashes generally
contain ~0.5% CPC). Environmental metagenomic DNA was isolated and purified, and specific CP probes were designed for use in a real-time qPCR assay to determine sequence presence and quantify the number of copies in complex genomic DNA samples. This novel qPCR assay has been adapted for a liquid handler robot enabling high-throughput identification of *Delftia* spp. in a variety of samples. Utilizing this method, the CP gene DNA can be accurately detected at approximately 2 molecules per sample. Together, this project for the first time verifies the existence of minimal CP resistance in *Delftia*, thus providing a better understanding of the bacterial species' unique properties and shedding light on the overall ecology of *Delftia*.

Poster Number: 134
**Cloning and Recombinant Expression of Thermophilic Proteases for Potential Applications in Microalgal Biomass Recycling**

Shelby Roland, Biochemistry, NC State University

Mentors and/or Co-Authors: Amy Grunden

Thermophilic enzymes exhibit extreme temperature, chemical and pH stability making them excellent candidates for industrial processes. We have identified and cloned four novel proteases, Geoth_0289 and Geoth_0344, from a thermophilic soil bacterium, *Geobacillus thermoglucosidasius* and Gst_sub and Gst_pro from *Geobacillus steaorthomophilus*. The goal of this study is to characterize these putative proteases for their potential use in spent microalgal biomass recycling. Gene-specific primers were used to amplify *Geoth_0289* and *Geoth_0344* proteases for cloning into the expression vector pET28a and overexpression in *Escherichia coli* strain BL21(DE3). Recombinant expression of *Geoth_0289* and *Geoth_0344* was performed for cultures grown in LB broth at 20°C overnight. SDS-PAGE analysis revealed that both the proteins failed to over-express in *E. coli* BL21(DE3) under the conditions tested. Genes encoding a thermitase homolog, Gst_pro and a subtilisin homolog, Gst_sub from *G. steaorthomophilus*, were commercially synthesized and cloned into the pET28a vector. Following sequencing confirmation, both the constructs were expressed in *E. coli* BL21(DE3) in LB broth at 20°C over-night and in *E. coli* Arctic Express in LB broth at 16°C for 24 hours. SDS-PAGE analysis of Gst_pro and Gst_sub over-expressed in *E. coli* BL21(DE3) revealed that both proteins were highly expressed but insoluble. Analysis of Gst_pro and Gst_sub over-expressed in Arctic Express strain revealed low levels of soluble expression even though most of the protein was still insoluble. Further fine-tuning of Gst_pro and Gst_sub over-expression in *E. coli* Arctic Express should enable the purifying these proteases which can be utilized for studies involving algal biomass recycling.

Poster Number: 1
**Possible Contact Seam on Asteroid 433 Eros Supports a Binary Fusion Origin**

Alexander Ruley, Geology, NC State University

Mentors and/or Co-Authors: Paul Byrne

The asteroid 433 Eros is an oblong-shaped body, 25 km long, that orbits the Sun in the inner asteroid belt. Its surface displays a variety of landforms, many of which we interpret to be tectonic (such as faults and fractures). From our observations of this object, we have found what may be a seam characteristic of two formerly separate asteroids that have joined together. We mapped the orientation of tectonic structures with ArcGIS and the JHU/APL Small Bodies Mapping Tool. Previous research identified a 22 km-long linear feature that runs from the Rahe Dorsum ridge through the Psyche crater and Callisto Fossae troughs. Our mapping indicates that this structure continues around the asteroid to connect as one encircling feature. Planes defined by sets of linear structures on the asteroid recognized by previous workers suggest two possible scenarios under which the asteroid formed. Under the first scenario, a larger parent body was destroyed, with two of the associated fragments later colliding to form Eros; in contrast, the second scenario posits that Eros is one solid impact fragment. The contact seam we identify implies that two component fragments coalesced, as in the first scenario. This conclusion is consistent with those reached for other asteroids, suggesting that binary fusion is a common process for minor bodies in the Solar System.

Poster Number: 49
**Viral and Parasitic Transmission Pathways**

Tanner Russ, Microbiology- Microbial Health Science, NC State University

Mentors and/or Co-Authors: Lisa Paciulli, Miriam Ferzli

Viral infections affect many people, ranging from the common cold, a type of rhinovirus, to potentially life threatening viruses such as polio. Viruses have developed several ways to spread and attain hosts. Pathways examined include transmission through direct contact, animal vectors, and exposure to infectious sites like...
wastewater. Methods of direct contact included introducing an infected organism to three uninfected organisms, and measuring viral transmission rates. Another method was identifying viruses in pigs, and phylogenetically comparing them to local human virus samples. Methods of vector transmission examined melanization rates after feeding mosquitoes plasma from healthy or infected chickens with the presence of dead or live sigoetes. In addition, viruses, such as enterovirus strains, were identified and quantified using real-time Reverse Transcription Polymerase Chain Reaction (RT-PCR) in water. The results demonstrated that viruses were transmitted through direct contact between different common pet species, as well as from pigs to humans. Results also identified mosquitoes as strong indirect transmission vectors due to the immunosuppression by the host malaria parasite and the melanization rates of infected mosquitoes. In addition, RT-PCR showed that infective enterovirus was able to survive in a wastewater environment.

Overall, viruses and parasites infect hosts through many different transmission pathways and mechanisms that increase their chances of survival and reproduction. Knowledge of the various viral transmission pathways can lead to better prevention methods and more effective treatments. Future research should focus on identifying transmission pathways of new and dangerous viruses and parasites such as hepatitis strains and giardiasis.

Poster Number: 35
Molecular Characterization of Two Virulence Factors in Campylobacter jejuni
Jacob Rutherford, Microbiology, NC State University

Mentors and/or Co-Authors
Jonathan Olson

Campylobacter jejuni is the most common cause of food poisoning worldwide; because of this, it is important to improve our understanding of it. C. jejuni produces two proteins of interest to us; the first is a protein found in the periplasm, CueO, which is a multicopper oxidase that contains copper in its active site. The last 78 amino acids of CueO contain 3 amino acids that bind to a copper in the active site of the protein. We hypothesize that this copper binding site is responsible for increased sensitivity to copper oxidative stress caused by a mutant version of CueO that does not transport out of the cytoplasm. We studied how expression of a gene segment containing the last 78 amino acids from CueO affected the growth, and we studied the copper binding properties of the gene segment. The second protein of interest is cytolethal distending toxin (CDT), one of the proteins responsible for its pathogenic effects. We have created a cloning vector for the CDT gene that has a selective marker, and a reporter gene that we can use to study the expression of the CDT gene.

Poster Number: 113
Cytokine Production by Rat Mesothelial Cells Exposed to Carbon Nanotubes as a Means of Assessing Long-Term Risks for Mesothelioma
Sreepradha Sridharan, Biological Sciences: Integrative Physiology and Neurobiology, NC State University

Mentors and/or Co-Authors: James Bonner

Carbon nanotubes (CNTs) are a type of man-made nanomaterial that have many potential uses yet cause lung disease in rodents after inhalation and therefore may pose a human health risk. Of particular concern is whether different types of CNTs (rigid vs tangled CNTs or CNTs coated with metal oxides by atomic layer deposition, ALD) can cause mesothelioma, a rare cancer of the pleural lining of the lungs. We hypothesized that long-term exposure to either tangled vs rigid CNTs causes transformation of normal mesothelial cells to mesothelioma cells in vitro that can be predicted by the induction of specific inflammatory cytokines and that ALD coatings may alter cytokine production and neoplastic transformation. Normal rat mesothelial cells (NRM-2) were grown in 6-well cell culture plates in vitro and exposed for 28 weeks to rigid CNTs, tangled CNTs or tangled CNTs coated by ALD with aluminum or titanium. The mRNAs encoding the cytokines osteopontin (OPN), CCL2, CXCL10, and IL-6 were quantified by real-time PCR. A remarkable increase in OPN was observed in mesothelial cells after 28 weeks post-exposure to rigid CNTs, but not tangled or ALD-coated CNTs. These findings suggest that OPN is a valuable biomarker of mesothelial cell transformation and that rigid CNTs pose the greatest risk for mesothelioma.

Poster Number: 74
Chemical influences on Sex Determination in the Freshwater Crustacean Daphnia pulex
Cherisse Tabb, Zoology, NC State University

Mentors and/or Co-Authors: Gerald LeBlanc
Daphnia pulex is a branchiopod crustacean which can reproduce either sexually or asexually, depending on environmental cues. While these cues can be anything from short photoperiod, cool temperatures, or the presence of certain hormones or chemicals, the mechanism of how these cues are sent remains unclear. The N-methyl-D-aspartate receptor, or NMDAR, is an ionotropic glutamate receptor crucial to almost all organisms' nervous systems, and is believed to work in tandem with these environmental cues to influence D. pulex reproduction. We hypothesized that NMDAR operates upstream of the hormone signalling pathway such that exposing D. pulex to NMDAR-targeting compounds would alter brood sex. Here we study the effects the NMDAR agonists glycine and NMDA, as well as the antagonist MK-801, on male production in D. pulex. Additionally, we assayed the herbicide atrazine, which is suspected of altering male production in daphnids. Adult daphnids exposed to glycine or NMDA produced fewer males on average, while adults exposed to the NMDAR antagonist MK-801 showed significantly higher percentages of males compared to controls. The herbicide atrazine impacted male production similar to a NMDAR antagonist and significantly increased male production. This provides strong evidence that the NMDAR plays an important role in daphnid sex determination, and may be impacted by chemical contaminants in the environment. Since daphnids are considered a keystone species in lake habitats, the presence of NMDAR-targeting compounds has broader implications for overall ecosystem health.

Poster Number: 124
Atmospheric Modeling and LIDAR Remote Sensing
Omokuyani Udiani, Physics NC State University
Mentors and/or Co-Authors: Hans Hallen

We hear dire warnings of impending climate change, yet the predictions vary significantly from one study to another, primarily due to unknowns in climate modeling. The most important unknown is the mechanisms of energy exchange in regions of the atmosphere, such as water to air, near clouds, and from the upper atmosphere. These are complex systems that need measurements to identify physical mechanisms to enable complex model building, and data to test the accuracy of predictions. This project would take a step towards answering these needs with preliminary measurements and simple models. A Light Detection and Ranging (LIDAR) instrument consisting of a 1 ns pulse-length, 532 nm wavelength laser source and detector has been constructed. The device enables the detection, in real time, of distant objects. The studies of time series of these measurements allows ‘watching’ the development of atmospheric phenomena and thus yield insights on the formation of clouds, presence of aerosols, boundary layer formation and weather patterns. A modeling platform was designed to simulate molecular interactions in Earth’s thermosphere, mesosphere and stratosphere. The 2-D simulation consisted of Lennard-Jones molecules in the presence of photons and high energy cosmic rays. The simulating region was stratified into three regions by density, and velocities of particles to simulate characteristics in the thermosphere, mesosphere, and stratosphere. It was shown that cosmic rays increased the chances that molecules in the simulated thermosphere could be driven towards the stratosphere and mesosphere. The simulation provides better insights into energy and temperature distributions in the atmosphere.

Poster Number: 117
Aggressive behavior and hormone levels of pregnant female ruffed lemurs (Varecia) as predictors of neonatal outcomes.
Amaya Watters, Biological Sciences, NC State University
Mentors and/or Co-Authors: Lisa Paciulli, Mary Beth Hawkins

Hormones are the body’s chemical messengers, and are vital in regulating the body’s natural functions. They can be used during pregnancy to predict changes in the mother’s physiology. In addition, agonistic behavior affects some hormones. A female’s hormones and behavior are important in shaping the environment in which the fetus develops during pregnancy. This study was conducted to see if hormone levels and agonistic behaviors can be used to predict neonatal outcomes in non-human primates. Behavioral observations of five captive Duke Lemur Center ruffed lemurs (Varecia variegata and V. rubra) were made before, during, and after pregnancy. Female fecal samples were collected and kept on dry ice every week for seven months. They will be analyzed via radioimmunoassay, and hormone levels for six hormones will be documented. Results will be statistically analyzed longitudinally for changes in behavior and hormones over time. The data will be compared to neonatal outcomes. The results from this study will help document reproductive hormonal changes in adult female ruffed lemurs. These changes may be used to predict neonatal outcomes including miscarriages, preterm birth, low birth weight, and potential medical complications of the mother and/or
infant. Future research should be conducted on more non-human primate species to examine the relationship between pregnancy hormones and neonatal outcomes.

Poster Number: 9
**Who’s That? Can Nocturnal Aye-Ayes (Daubentonia madagascariensis) Determine Who is Talking?**

**David Watts,** Zoology, NC State University  
**Mentors and/or Co-Authors:** Lisa Paciulli

Communication is the hallmark of human and other animal societies. Animals use varying methods to broadcast their location, reproductive status, reassure group members, etc. Vocal communication of nocturnal species potentially contains more information because they cannot communicate using sight as much as diurnal species. Aye-ayes (*Daubentonia madagascariensis*) are a nocturnal lemur (Family: Lemuridae) that make six vocalizations to convey location, aggression, and converse with potential mates (Stanger & Macedonia, 1994). However, much is still not known about aye-aye vocalizations, including whether identifying information is transmitted in vocal calls. Therefore, in this study, the vocalizations of captive aye-ayes at the Duke Lemur Center were examined to see whether or not they contain information about the identity of the caller.

Aye-ayes were presented with a novel object (a box wrench or human) for five minutes. A Sennheiser ME66 microphone was placed through the ceiling of the cage, and aye-aye vocalizations were recorded with a Tascam DR-680MKII audio recorder. The recordings were analyzed with Adobe and Cornell University software to determine if there were any unique features linked to specific individuals’ vocalizations. A total of forty-five vocalizations from nine individuals (three male, six female) were recorded. Results indicate that while there were some slight differences between individual aye-aye vocalizations, they will not be significant. One reason for this could be that the repertoire of captive aye-aye vocalizations has diminished due to a lack of selection from not being exposed to predators in captivity.

Poster Number: 96
**A Reanalysis of the Extended Multivariate ENSO Index (MEI extortion) and Comparison of the 1877-78 and 2015-16 El Niño Events**

**Eric Webb,** Meteorology/Atmospheric Science, NC State University  
**Mentors and/or Co-Authors:** Anantha Aiyer

El Niño Southern Oscillation (ENSO) is the most robust, coupled ocean-atmospheric component of intraseasonal-interannual variability on the globe. The Extended Multivariate ENSO Index (MEI extortion) is originally defined by Wolter and Timlin (2011) as the combined, bi-monthly, leading principle component analysis (PCA) of Sea Level Pressure (SLP) and Sea Surface Temperature (SST) over the Tropical Pacific in the HADSSST2 and HADSLP2 datasets. While useful for broad interpretations of long-term ENSO variability, the original Extended MEI and principal components that comprise it are based on relatively older and defunct data, do not account for significant climatic and observational mean state changes in the past few centuries, uncertainties in the SLP and SST fields, and is not available in real-time. Hence, this work is intended to be a major improvement upon the original Extended Multivariate ENSO Index (MEI extortion) to increase the quality and reliability of the data, and depict the astounding similarities in evolution and amplitude between the 1877-78 and 2015-16 “Super” El Ninos, which are among the strongest ENSO events observed within the past 200 years. The reanalysis of the Extended MEI confirms previous findings that ENSO variability was much larger near the turn of the 20th and 21st centuries, with a relative lull in the mid 20th century, and exhibits similar timing, duration, and amplitude to available indices with most ENSO events. The reanalyzed Extended MEI attempts to maximize both longevity & data assimilation over the entire 165-year instrumental record, as well as be available for real-time scrutiny.

Poster Number: 18
**The Climatological Influence of ENSO and Hurricane Frequency in North Carolina**

**Lexia Williams,** Meteorology, NC State University  
**Mentors and/or Co-Authors:** Aaron Sims

El Niño-Southern Oscillation (ENSO) and tropical cyclone activity are known to bring significant fluctuations in precipitation to regions across the globe. This study investigates how these events directly affect precipitation totals in North Carolina (NC). Daily precipitation data from about 150 weather stations across NC are evaluated for all La Niña and El Niño events between the years of 1981 and 2010. In addition, this research investigates active hurricane seasons occurring where NC has been impacted both by direct and
indirect land-falling storms. Each individual El Niño, La Niña, and hurricane event shows a non-linear trend in precipitation accumulation. A few case studies indicate a shift in the timing of when a location receives fifty percent of normal precipitation during different ENSO phases. As expected, North Carolina’s coastal plains receive the most precipitation from hurricanes; however, precipitation in the mountains has the highest departure from normal during hurricane season. Future work includes relating ENSO phase and hurricane seasons to yearly distribution of precipitation, both spatially and temporally. This work will become a basis for a web-based tool that will display precipitation comparison plots for user-selected time periods.

Poster Number: 121
Comparison of Statistical Techniques for Handling Missing or Undetectable Air Toxic Measurements
Olivia Wright, Statistics, NC State University
Mentors and/or Co-Authors: Jonathan Duggins

Air toxics are pollutants that are harmful to our health or to the environment. Air toxic levels are analyzed to evaluate trends and health impacts of emission sources, as well as to characterize potential risks, develop air quality models, and target over-emitting sources. Sensor systems are set up by the US Environmental Protection Agency (EPA) and other organizations to monitor air toxics on a continuous basis. However, data from those sensor systems are sometimes missing, because the amount of air toxic substance being is too small to detect, or due to equipment malfunction. These are reported as non-detect (ND) values. How these data are handled can make a significant difference in statistical modeling and scientific findings. This study uses EPA air toxic data from 2003-2015. The question is: How should ND values be treated to allow for an accurate analysis of trends over time?

Three statistical techniques were applied to the EPA data. The first technique substituted the ND value with one-half of the Method Detection Limit (MDL) value for the specific air toxic. The MDL is the smallest amount of a substance that can be reported with 99% confidence. The second technique substituted ND values using imputation of values from Regression on Order Statistics (ROS). The third technique, Kaplan-Meier, estimated a probability distribution for the censored data, which was then used to estimate means, and variances. Results of the effects of the three approaches are compared.

Poster Number: 27
Finding the most powerful gene expression analysis methods for different experimental outcomes
Dingkun Yang, Statistics, NC State University
Mentors and/or Co-Authors: Alison Motsinger-Reif, John Jack

The analysis of gene expression data is a powerful tool for understanding a wide variety of biological problems while enabling better clinical diagnosis, e.g., predicting the presence of diseases. Gene-set analysis, also called pathway analysis, is a common approach to analyzing gene expression data. There are a number of popular gene-set analysis software packages including sigPathway, GSEA, and CAMERA. However, there is not a straightforward way for a typical user to determine which approach would be best for their data. We performed a simulation study to analyze the differences of the statistical properties of the most commonly used gene-set analysis methods and software packages with an “end-user” focused approach. We used real data on 424 samples, 264 prostate cancer and 160 normal tissue samples with Affymetrix gene expression data to provide realistic gene expression profiles for the simulations. We used the statistical computing tool R to generate a large range of simulated datasets. The simulation study focused on two key pathways: KRAS and TGF-β. We assessed the power of each of the gene-set analysis methods by creating 100 bootstrapped samples from the differentially expressed datasets. For different experimental parameters, e.g., magnitude (effect size) and proportion of genes differentially expressed, we calculated the power of each gene-set analysis method. Our comparison shows how experimental results impact the statistical power for the popular gene-set analysis methods. These results can be useful for experimentalists to determine the most powerful methods to analyze their particular data.
College of Textiles
Molecular Modeling Studies to Elucidate the Effect of Structure and Isomerization on Disperse Dye Photodegradation

Ciera Cipriani, Polymer and Color Chemistry, NC State University

Mentors and/or Co-Authors: Melissa Pasquinelli, Nelson Vinueza

Azo compounds are commonly used in the textile industry. Trans isomers of azo dyes are more thermodynamically stable in the ground state. However, many azo dyes can undergo reversible photoisomerization between their cis and trans structures, where cis structures are thermodynamically more stable in the excited state. Previous studies have indicated that azo dyes generally break down at their azo bonds by photodegradation. A recent study on azo dyes demonstrated that the dye Disperse Red 1 photodegraded at its ethyl and hydroxyethyl groups. The major photodegradation products that were identified by high resolution mass spectrometry were not based on the azo bond breaking but rather dissociation of side groups. In this study, the photodegradation mechanism proposed previously for Disperse Red 1, Disperse Black 9, and Disperse Oranges 3, 25, and 37 was investigated using density functional theory calculations. The reactivities of these dyes for both the ground and excited states as well as for the cis-to-trans transition were determined. A trend existed in the reactivity of the studied azo dyes, in which the trans isomers were generally more susceptible to radical attack at their amino end groups, while the cis isomers were more reactive at their azo bonds. The molecular structure of the terminal groups, pendant side chains, the reduction of the azo bond, and conformation were determined as main factors that change the reactivity of different regions of the dye molecules. Thus, altering the location and mechanism of photodegradation within azo dyes is possible by controlling the molecular structure.

Wireless Power Transmission in a Knitted Garment

Tyler Henson, Textile Engineering, NC State University

Mentors and/or Co-Authors: Warren Jasper

With society moving toward a more wireless lifestyle, the demand for new innovative wireless technology increases. One way to approach the increase in demand is through wearable wireless power transmission. Wireless power transmission has not been widely accepted due to its low power efficiency and high costs. I am designing and creating a comfortable, physically appealing, and efficient knitted tank-top with a helical conductive coil embedded directly into its knitted structure. This knitted coil will act as a wireless power bus for charging mobile devices and will be powered from a stationary transmitter coil that is embedded in a car seat cushion (any stationary source). Through inductive coupling using capacitors and inductors I will achieve about 30 percent power transfer efficiency. Traditionally stainless steel is a non-elastic material, but because of its high conductivity and corrosion resistance to water it makes an excellent conductive fiber for textile applications. Through different knitted designs the stainless steel fiber will be able to be given the ability to elongate from its static state within the textile. I currently have a working prototype that functions and easily demonstrates the wearable power transfer applications. I will be spending the remainder of my time designing new prototypes and improving the power transfer efficiency.

Gel-spun PVA/Lignin Fibers: A Comparison of Diameter Calculation from Linear Density Values and Image Analysis

Nortee Louder, Textile Engineering concentration in Product Engineering, NC State University

Mentors and/or Co-Authors: Ericka Ford, Chunhong Lu

High performance fibers cost $20/lb. Low cost, plant based materials are economical raw materials that could be used to reduce the price of high performance fibers. The overall goal of this research is to manufacture strong fibers from plant based raw materials. To characterize the mechanical properties of those fibers, we must normalize the load-displacement curves by the fiber’s cross sectional area or linear density. Thus, the effect of gel spinning parameters (linign weight percentage and gel aging time) on fiber morphology was studied. Pine lignin was incorporated into polyvinyl alcohol (PVA) fibers at 5 and 30% lignin to polymer. Both polymers were dissolved into a homogeneous solution and then gel spun within a low temperature coagulation bath. Gel fibers were then aged at low temperatures for 1, 14, and 30 days prior to drawing. Confocal microscopy was used to image the cross-sections of the fully drawn fibers. ImageJ software was then used to analyze the fibers’ cross-sectional areas, determine their average diameter, and calculate the circularity index of each fiber. Diameter values based on image analysis were compared to the
values of fiber diameters as calculated from linear density, to determine which method is better suited for determining fiber strength.

Poster Number: 106

**Morphology of Electrospun Polyvinyl Alcohol/Polyvinyl Acetate Blends**

*Melisa Pasili, Polymer and Color Chemistry, NC State University*

**Mentors and/or Co-Authors:** Ericka Ford, Preeti Rawat

The electrospinning technique is used to manufacture nanofibers. These nanofibers can be used in gas and liquid filtration. Our goal for this research is to make affinity membranes. Secondary bonding between affinity membranes and molecules in the liquid is used to filter those molecules out of the liquid. In this study, we will tune the hydrophobicity of the affinity membranes by spinning polymeric solutions of polyvinyl alcohol-PVA, a hydrophilic polymer- and polyvinyl acetate-PVAc, a hydrophobic polymer-. Nanofibers were spun from homogeneous mixtures of both polymers. At the following blend ratios, the PVA/PVAc solutions were compatible at: 100:0, 75:25, 50:50, 25:75, 0:100. We observed the effect of polymer blending on the morphology of the nanofibers.

Poster Number: 55

**Influence of E. coli Growth Rate on its Adhesion onto Nonwoven Textiles**

*Erin Roberts, Textile Technology: Medical Textiles, NC State University*

**Mentors and/or Co-Authors:** Ericka Ford, Terrence Gardner

Nonwoven fabrics are highly engineered textiles that are produced from economical manufacturing techniques. Nonwoven product applications include filters, crop covers, and medical scaffolds for tissue engineering. The unwanted adhesion of bacteria to nonwoven fabrics can result in the biofouling of ground water filters, infection due to the accumulation of pathogens onto medical implants, and the deterioration of crop covers or capillary maps. The overall research goal was to understand the fundamentals of bacteria adhesion onto textile fibers. To achieve this goal, the relationship between bacterial adhesion onto nonwoven textiles and the growth phase of bacteria was explored in this study. The growth curve of *E. coli* was experimentally determined using spectrophotometer absorbance measurements at 660 nm. Using a light microscope equipped with a variable rate flow cell, bacterial adhesion onto glass slides and polypropylene nonwovens was determined experimentally and compared to the growth phases.
College of Veterinary Medicine
Enteric Glial Cells Stimulate Colon Cancer Stem Cell Chemoresistance in a p53-independent manner.

**Gregory Bacola**, Biology, NC State University  
**Mentors and/or Co-Authors:** Laurianne Van Landeghem

Cancer stem cells (CSCs) are a subset of cancer cells that are able to initiate the formation of a tumor identical to the primary one, and are highly chemoresistant and metastatic. Alongside CSCs in the tumor microenvironment are enteric glial cells (EGCs), which regulate and promote barrier functions of the epithelium in a healthy intestine. Within a tumor, the proximity of EGCs to CSCs allows for paracrine signaling between these two cell types. Our group’s work has shown that EGCs stimulate CSC tumorigenicity via an mPGES-1/PGE2/EP4 pathway. Preliminary work suggested that EGCs also increase CSC chemoresistance to 5-Fluorouracil (5-FU), a chemotherapeutic drug widely used in the treatment of colon cancer. Here we aim to investigate whether EGC impact on CSC chemoresistance involves the p53 pathway, which plays a major role in chemoresistance.

EGCs were isolated using Fluorescence-Activated Cell Sorting (FACS) from HT29 (p53 deficient) and HCT116 (p53 proficient) human colon adenocarcinoma cell lines based on CD24 and CD44 expression. They were 3D cultured in Matrigel in the presence or absence of EGCs seeded on Transwell filters, only authorizing paracrine interaction. The impact of EGCs on CSC chemoresistance was evaluated on numbers and size of tumorspheres grown from CSCs in the presence of 5-FU. EGCs increased numbers of tumorspheres grown from HT29 CSCs, and numbers and size of tumorspheres grown from HCT116-derived CSCs in the presence of 5-FU. These results suggest that EGCs stimulate CSC ability to give rise to tumorspheres in the presence of 5-FU in a p53-independent manner.

Determining molecular mechanisms generating left-right asymmetry within the developing stomach

**Kristen Bagley**, Biological Sciences conc. Integrative Physiology and Neurobiology, NC State University  
**Mentors and/or Co-Authors:** Nanette Nascone-Yoder, Nirav Amin

The establishment of left-right (LR) asymmetries in organs such as the heart and stomach during embryonic development is crucial; approximately 1 in every 10,000 newborns exhibit Heterotaxy syndrome, a disorder in which multiple organs, including the stomach, fail to establish proper shape and orientation with respect to the LR axis. To understand the root of these defects, we must first understand the molecular mechanisms that determine organ asymmetry. During development in mammals and frogs, the stomach begins a straight tube that differentially rearranges cells along the LR axis to expand the left stomach wall, forming the greater curvature and eventual J-shape of the adult stomach. We hypothesized genes are asymmetrically expressed on the LR axis influencing this cellular behavior. We have used RNA sequencing to screen the left and right halves of the developing stomach to identify hundreds of LR differentially expressed genes, including Pax2, the only factor already known to be localized asymmetrically during organ development. I have performed in situ hybridizations on a subset of these genes to determine their spatial and temporal patterns of expression within the developing stomach as it establishes curvature. These studies have uncovered roles for genes in two layers of the stomach, endoderm and mesoderm. Moreover, my work shows that these layers influence each other during curvature formation and in generating smooth muscle in an asymmetric manner. These studies provide insight to how organs develop LR asymmetry and potential causes of developmental disorders such as Heterotaxy syndrome.

PGF-2α receptor (FP) regulation by TNF-α in the porcine corpus luteum

**Anna Beam**, Animal Science, NC State University  
**Mentors and/or Co-Authors:** John Gadsby

Reproductive management of female swine is a major challenge for producers due to the insensitivity of the porcine corpus luteum (CL) to prostaglandin F2-alpha (PGF-2α) in the first 12-13 days of the estrous cycle. Our laboratory has shown that Tumor Necrosis Factor (TNF)-α produced by macrophages sensitizes porcine luteal cells to PGF-2α, although this mechanism is unknown. Our hypothesis is that Tumor Necrosis Factor (TNF)-α increases Prostaglandin (PG) F-2α (FP) receptor concentration in porcine luteal cells, promotes FP internalization and translocation to the nucleus, and thereby sensitizes luteal cells to PGF-2α. To test this hypothesis, luteal cells were isolated from porcine CLs and were cultured with 0, 1 or 10 ng/ml TNF-α for 48 hours. These cells were then collected for analysis of FP RNA (Q-PCR), protein (Western Blotting; WB), ligand (PGF-2α) binding, and localization/internalization (WB of subcellular fractions, and immunofluorescence =
Our data showed that TNF-α decreased FP RNA, but increased FP protein. Preliminary data indicated that while the internalization of FP (ligand-binding) was mediated by TNF-α, its translocation to the nucleus (chromatin; WB) and/or peri-nuclear region (IF), was not. These data support (in part) our hypothesis, and suggest that while TNF-α sensitizes porcine luteal cells to PGF-2α by increasing FP protein, the role of FP internalization/nuclear translocation in this mechanism remains unclear. It is hoped that these data will contribute to the development of novel drugs and protocols to synchronize estrous cycles in female pigs, for the benefit of the swine industry.

Poster Number: 101
**Is lipophilicity a valid predictor of drug sequestration? An investigation in support of lipid resuscitation.**

**Nicholas Biondo**, Animal Science, NC State University

**Mentors and/or Co-Authors**: Belinda Akpa

In the 18 years since lipid therapy was first revealed as a potential intervention for drug-induced heart failure, clinical reports have detailed a range of outcomes - including some rapid and dramatic resuscitation successes when all conventional life support efforts have failed. In anesthesiology in particular, physicians have begun to generally accept this method as part of the toolkit for addressing local anesthetic toxicity. However, the question of whether this approach should be used as even a last resort in other drug poisonings remains controversial. Data surrounding the practice is anecdotal, scarce, and heterogeneous. Furthermore, our understanding of the therapeutic agent reveals a complex, multifunctional method of action. In this work, we focus on what is likely a highly variable element of the proposed therapeutic activity - sequestration of drugs in the blood. Through coarse grained molecular dynamic simulations of a selection of drug molecules with differing physicochemical properties, our research aims to interrogate the determinants of drug partitioning into lipid emulsions.

Coarse-grained molecular topologies were developed for 5 drugs and their free energy of partitioning was evaluated for both their ionized and neutral form in octanol/water and triglyceride/water systems. Partition coefficients evaluated on this basis were used to assess the predictive value of logP, the neutral-state octanol/water partition coefficient. With this information, we have proposed which properties of a given drug dictate its likely susceptibility to scavenging in vivo. This work contributes to a rational framework clarifying the appropriate uses of lipid resuscitation.

Poster Number: 12
**Custom Primer Sets for the Identification of Alleles That Code for Eye Color in Humans Based on IrisPlex Model.**

**Sarah Ermatinger**, Biochemistry, NC State University

**Mentors and/or Co-Authors**: Seth Faith, Deborah Soares B. S. Silva

Forensics scientists would benefit greatly from being able to identify an individual's phenotype, physical appearance, from their genotype, DNA. This information would give investigators possible leads for finding suspects using biological evidence form crime scenes. Prior research yielded a tool for determining the probability of an individual's eye color using six highly deterministic single nucleotide polymorphisms (SNP's) of DNA - the IrisPlex model from the Forensic Molecular Biology Department of Erasmus MC. Using genetic typing approaches, the SNP markers are characterized as being A,C,T or G and an algorithm is used that gives the probability that a person with these SNP’s will have brown, blue, or intermediate eyes. This study was designed to replicate and improve upon the IrisPlex tool by coupling the approach to other forensic DNA analysis methods developed at NC State for human identification. Primer sets for PCR amplification of the SNPs were designed and tested for their effectiveness of targeting the parts of the genome, as a single-plex and also multiplex. The PCR products were sequenced by Next-generation sequencing and raw data analyzed with Bioinformatics to determine IrisPlex SNP states. An algorithm was evaluated and tested against unknown samples to determine reliability compared to the IrisPlex model. Further, the eye-color prediction method evaluated here was assessed as a companion tool to the NC State human identification method to discover any additional benefits of using both systems in parallel. The results presented will illustrate the potential benefits of this new technology as related to crime scene investigations.
TGF-β2 downregulates MHC expression and cytotoxicity of bone marrow-derived mesenchymal stem cells

Alexandra Grobman, Animal Science, NC State University

Mentors and/or Co-Authors: Lauren Schnabel

Mesenchymal stem cells (MSCs) are connective tissue progenitor cells that, if used in an "off-the-shelf" manner, would provide a time and cost-effective therapy for the treatment of musculoskeletal diseases. However, major histocompatibility complex (MHC)-mismatched MSCs can be recognized as foreign and rejected by the recipient's immune system. Equine MSCs constitutively express MHC I and may express MHC II, particularly after stimulation with inflammatory cytokines like interferon-γ (IFN-γ). My central hypothesis is that transforming growth factor-β2 (TGF-β2), an immunomodulatory cytokine, reduces IFN-γ-induced MHC expression levels and decreases cytotoxicity of MHC-mismatched MSCs. In measuring MHC expression, bone marrow was obtained from the sternum of four healthy horses and MSCs were isolated, divided, and cultured to passage 3 in standard MSC media or media containing 1 ng/ml TGF-β2. Untreated and TGF-β2-pretreated MSCs were stimulated with IFN-γ over a 72-hour period, and MHC surface expression was measured by fluorescent activated cell sorting. The results of this first objective revealed that TGF-β2 partly obstructs upregulation of MHC surface expression on MSCs following an inflammatory stimulus. To test my second objective, effector cells (ECs) will be generated in a one-way mixed leukocyte reaction (MLR) and then used in a cytotoxic T lymphocyte killing (CTL) assay involving incubation of ECs for four hours with autologous and allogeneic untreated or TGF-β2-treated MSCs. The long-term goal of this research is to generate non-immunogenic MSCs for "off-the-shelf" use in horses with musculoskeletal diseases, which will also serve as a translational model for the treatment of human musculoskeletal diseases.

Enrichment Preferences of FIV Infected Laboratory Cats

Claudia Kennedy, Animal Science, NC State University

Mentors and/or Co-Authors: Barbara Sherman

Environmental enrichment is critical for alleviating the stress of laboratory felines. However, there is a paucity of information about suitable environmental enrichment for cats. The aims of this study were to determine realistic and affordable enrichment preferences of cats used in a longitudinal study of the behavioral and physiological effects of chronic FIV infection in cats, and to determine if the FIV status of the cats affected enrichment preferences. Preference testing was performed with two types of brushes, three different enrichment play options, including a laser, ball, and social interaction with a familiar investigator, and two types of scratching items. We found that, based on their preferences, cats can be separated into high and low interest groups. "High interest cats" preferred a specific brush type, playing with a laser, and scratching on an inclined box scratching item. In contrast, "low-interest" cats did not indicate clear preferences. There were no differences in preferences between FIV-infected and sham-infected cats. These enrichment preferences can be used to advise laboratory animal facilities and researchers about how to provision cages to best accommodate the behavioral needs of laboratory cats.

Mitochondrial dysfunction examined using a mitochondrial label to quantify hydroquinone toxicity in canine retinal pigment epithelium cells

Regan Lane, Animal Science, NC State University

Mentors and/or Co-Authors: Freya Mowat

Mitochondrial dysfunction is implicated in ageing, and may contribute to pathology of the retinal pigment epithelium (RPE) in age-related macular degeneration (AMD), which affects the central cone photoreceptor-rich macular region of the retina causing blindness. The canine retina, unlike rodents, has a focal cone-enriched region, the area centralis, comparable to the human macula. We tested the hypothesis that Mitotracker®, a fluorescent dye containing a thiol-reactive chloromethyl moiety that accumulates in active mitochondria, can be used to quantify toxicity in the canine area centralis RPE from hydroquinone, a mitochondrial toxicant component of cigarette smoke, important in AMD pathogenesis. We harvested and cultured RPE cells from 4 regions of the eye from mixed-breed dogs following humane euthanasia. Cultures were treated with 6 hour exposures of hydroquinone, every 3 days for a total of 5 times to induce subacute toxicity. We used Mitotracker Red® and ImageJ analysis program to measure the percentage area of mitochondria and individual cell size in confluent RPE cell cultures. Counterstains with Hoechst 33342 (nuclei) and wheat germ agglutinin (cell membranes) were used. Cells were imaged using an Olympus IX83.
fluorescence microscope. Following single and repeated hydroquinone exposures percentage area of mitochondria in the area centralis and peripheral retina decreased. There was large cell size variation between individuals, and an increase in cell size variability in the area centralis following hydroquinone exposure. The method was successful for identifying effects on mitochondria in RPE cells and our studies indicated that hydroquinone impairs mitochondrial function.

Poster Number: 99
**Evaluating the regulation of expression of the reverse transcriptase in Salmonella Typhimurium**

*Paige Laverick, Nutrition Science, NC State University*

*Mentors and/or Co-Authors: Johanna Elfenbein*

*Salmonella enterica* serovar Typhimurium is a Gram-negative zoonotic pathogen. It causes infection by colonizing the intestinal tract of the host and leading to symptoms of fever, diarrhea, abdominal cramps, vomiting, and nausea. Prior work in our lab discovered that intestinal colonization requires a unique molecule called multicopy single-stranded deoxyribonucleic acid (msDNA). This molecule is an RNA-DNA hybrid that is made by a reverse transcriptase, encoded by the gene *STM3846*. This gene is expressed during exponential growth but the regulatory network controlling its expression is unknown. The purpose of this project is to identify the regulatory network that controls the expression of the reverse transcriptase, *STM3846*. I hypothesize that the aerobic expression of *STM3846* is altered by one or more of the following regulatory proteins: *stpa, arcA, fnr,* and/or *deoR*. I used a strain in which the reverse transcriptase is replaced by *lacZ*, which encodes b-galactosidase, to measure the expression of *STM3846*. b-galactosidase activity was measured by the Miller method hourly for 6 hours. I found that *deoR, stpa,* and *arcA* have no apparent effect on the aerobic expression of the reverse transcriptase. However, Fnr represses the aerobic expression of *STM3846* during stationary phase. Fnr is known to influence the expression of numerous genes, including those for virulence and anaerobic metabolism. These data suggest that *STM3846* is in the Fnr regulon. Future work will determine whether these observations may be reproduced in the infection-relevant condition of anaerobiosis.

Poster Number: 122
**Using MRI to Evaluate Norepinephrine’s Role in the Development of Brain Structure**

*Benjamin Peterson, Materials Science & Engineering, NC State University*

*Mentors and/or Co-Authors: Sabrina Robertson*

Release of norepinephrine (NE) is essential for the maintenance of critical behaviors such as attention, mood, memory, and arousal. NE neuron disruption in adults has been linked to disorders including anxiety, depression, Parkinson’s, and Alzheimer’s disease. However, it is unclear if NE neuron dysfunction during development contributes directly to these disorders. Our genetic-based approach utilizes a mouse model with a hM3Dq DREADD (Designer Receptor Exclusively Activated by a Designer Drug) receptor targeted to a genetically-defined subpopulation of NE neurons (LC-En1 neurons) in vivo. To enable in vivo manipulation of LC-En1 neurons, mice were treated with a pharmacologically inert drug-CNO, from embryonic day 12 thru post-natal day 10, resulting in aberrant NE release in the DREADD mutants. We hypothesize that this NE neuron stimulation throughout critical developmental timeframes will impact the brains development, structure, and function. To test this hypothesis, DREADD expressing mice and their controls were tested in the light-dark anxiety-related paradigm at post-natal day 29. DREADD mice spent significantly less time on the light side of the chamber compared to littermate controls. These behavior deficits led us to explore the impact of LC-En1 NE neuron over activation on embryonic brain development utilizing MR contrast imaging. Here we outline our MRI analysis pipeline utilizing freeware packages, ITK-Snap, 3D Slicer, FSL, and ANTs to measure cortical thickness and other regions of the brain involved in anxiety-related behaviors. DREADD animals will be compared to controls to determine if activation of a subset of NE neurons throughout embryonic development impacts brain structure.

Poster Number: 79
**Iron dextran injections at weaning in pigs and interaction of antibiotics with responses to M. hyopneumoniae and porcine circovirus type 2 vaccination**

*Savannah Royal, Animal Science, NC State University*

*Mentors and/or Co-Authors: Glen Almond*

The objectives of this study were to determine if supplemental iron dextran injections at weaning reduce anemia in pigs and to examine if antibiotics interact with responses to *Mycoplasma hyopneumoniae* (*Mhyo*)
and porcine circovirus type 2 (PCV2) vaccination. Pigs (n=64) were selected at weaning and assigned to 8 treatment groups (n=8/group) in a 2x8 factorial arrangement. Treatments included control, Mhyo and PCV2 vaccine only, Draxxin only, Excede only, Baytil only, and the combination of the Mhyo and PCV2 vaccines and one of the antibiotics. Four pigs in each group were injected with 200 mg of iron dextran at weaning (day 0). Body weights and blood samples were collected on days 0, 14, 21, and 35. Complete blood counts, numbers of immune cells, and antibody titers to Mhyo and PCV2 were determined on all blood samples. Supplemental iron failed to alter any parameter. Mhyo antibody levels were highest at day 0 and lowest at day 35 across all treatment groups. Control and antibiotic treatment groups had highest PCV2 antibody titers at day 0. The titers decreased steadily over the 35 d. The PCV2 vaccine only and vaccine and antibiotic combination treatment groups showed increased PCV2 titers at day 35. Results indicate that there is no advantage to supplemental iron injections at weaning in efforts to eliminate anemia. Additionally, there was no interaction between the PCV2 vaccine and the three antibiotics, which is contrary to previous reports. Further, the Mhyo vaccine failed to increase Mhyo antibody concentrations.

Poster Number: 118
Exploring the Role of Norepinephrine Neurons in Embryonic Brain Development
Claire Ruddiman, Chemical Engineering, Biochemistry, NC State University
Mentors and/or Co-Authors: Sabrina Robertson
Release of norepinephrine (NE) is essential for the maintenance of critical behaviors such as attention, mood, and appetite. NE neuron dysfunction in adults has been linked to several disorders, including anxiety; however, it is unclear if dysfunction during development contributes directly to these disorders. Our unique genetic-based approach utilizes a mouse model with an hM3Dq DREADD (Designer Receptor Exclusively Activated by a Designer Drug) specifically targeted to a small, genetically-defined subpopulation of NE neurons (LC-En1) in vivo. To enable in vivo manipulation of LC-En1 neurons, mice were treated with an otherwise pharmacologically inert drug, CNO, from embryonic day 12 (E12) to E15, resulting in aberrant NE release in the DREADD mutants. We hypothesize that excessive LC-En1 NE neuron stimulation throughout critical periods of brain maturation will impact neuronal development, gross anatomy (reduced cortical thickness), and ultimately behavior. To test this hypothesis, DREADD mutants and their littermate controls were tested in the light-dark anxiety-related paradigm at post-natal day 29. DREADD mutants spent significantly less time on the light side of the chamber compared to littermate controls, which led us to explore the impact of LC-En1 NE neuron overactivation on embryonic brain development. We have performed immunohistochemistry assays on E15.5 brain sections (14-20 µm) from both mutant and control animals in order to measure cortical thickness. Future work includes performing cell counts to follow up on the results of our immunohistochemistry assays and cortical thickness measurements.

Poster Number: 112
Progesterone Control of Phagocytosis by Porcine Luteal Macrophages
Emily Teague, Biochemistry, NC State University
Mentors and/or Co-Authors: John Gadsby
Macrophages (MAC) are critical components of the innate immune system and have crucial immune functions in host defense, wound healing and immunoregulation via the production of cytokines. Furthermore, it appears that phagocytosis by tissue-resident MAC is critically important in maintaining the viability and health of tissues, by facilitating removal of dead or dying cells. MAC are present within the corpus luteum (CL) and are known to play critical roles in the development, function and regression of the CL in many species including the pig. Little is known of their regulation by the primary CL hormone, progesterone, although in view of the potential role of MAC phagocytosis in supporting tissue health, we hypothesized that progesterone would be stimulatory to phagocytosis. For this study we examined the phagocytic responses of CL MAC following 24h treatment with progesterone (P4 – non selective agonist), and two P4 agonists, R5020 (selective for genomic progesterone receptor, PGR) and Bovine Serum Albumin conjugated to Progesterone (BSA-P; selective for membrane progesterone receptors, mPR). Phagocytosis was monitored by adding fluorescently-labelled particles to P4 agonist-treated MAC for 2h, and analyzed by fluorimetry. The data obtained show that MAC phagocytosis was significantly stimulated by P4 and R5020 and not by BSA-P, indicating that this response to P4 is mediated by PGR. We conclude that stimulation of MAC phagocytosis by progesterone is critical physiological mechanism to ensure optimal production of this important hormone during the estrous cycle and pregnancy.
Genetics of resistance to Salmonella enterica infection in Drosophila melanogaster

Dana Truempy, Genetics, NC State University

Mentors and/or Co-Authors: Johanna Elfenbein, Trudy MacKay

Salmonella enterica causes hundreds of millions of cases of diarrhea world-wide each year and malnourished individuals are at high risk of death from systemic spread. The full complement of mechanisms needed resist lethal Salmonella infection are only partially described. We chose Drosophila melanogaster as a model system to take advantage of 1) a library of mutants with maximal heterozygosity and 2) the capacity to utilize large numbers of animals to establish the genetics of survival. However, the only studies of Salmonella infection in Drosophila have used injection, rather than feeding, which is the most common method of transmission in humans. Because of this, our aim was to develop experimental conditions to assay Drosophila survival during Salmonella infection. Flies were segregated by sex and grown on media with various forms of nutrition. Flies were fed 10⁹ colony-forming units of Salmonella suspended in sucrose and compared with flies fed sucrose alone or killed Salmonella. Flies grown on agar without other nutrients died within 3-4 days, regardless of Salmonella exposure. When flies were grown on agar with added yeast extract, infected flies showed significant loss of viability as compared with flies without Salmonella exposure or fed killed Salmonella. This experimental design will be used in future projects to ultimately sequence the genomes from infection-resistant flies and determine the complement of genes needed to withstand lethal Salmonella infection. This experiment has the potential to advance our understanding of how certain individuals can resist Salmonella infection with future applications to individualized treatments in human medicine.

Milk leukocyte response to topical phytoceutical administration in cows with mastitis

Carrisa Womble, Animal Science, NC State University

Mentors and/or Co-Authors: Kevin Anderson, Keena Mullen

In U.S. organic dairy production, synthetic antibiotic use is prohibited. As an alternative, some producers treat mastitis with plant-derived phytoceutical products. Milk leukocytes typically increase when foreign materials are introduced into the gland, therefore monitoring these cells can help to assess immune system stimulation and mammary irritation caused by these products. While a topical phytoceutical product (Uddersol,Ralco Animal Health, Marshall, MN) did not provoke significant leukocyte responses in healthy cows, the responses in cows with clinical mastitis were unknown. The objective of this study was to evaluate how the administration of Uddersol affected the number and types of leukocytes present in the milk of cows with experimentally induced clinical mastitis. Following intramammary inoculation with Streptococcus uberis and evidence of clinical mastitis, nine Holstein x Jersey cows were administered two topical doses of Uddersol 12h apart. Quarter milk samples were collected before dosing, 12h after the first dose, and 12, 24, 48, 72, and 96h after the second dose. Changes in total leukocytes, neutrophils, macrophages, and lymphocytes were measured (QScout Milk Leukocyte Differential, Advanced Animal Diagnostics Inc., Durham, NC) and analyzed using the MIXED procedure to obtain least squares means (SAS 9.3, SAS Institute, Cary, NC). We concluded that Uddersol did not elicit significant leukocyte changes in cows with clinical mastitis, suggesting that this topical phytoceutical product is not excessively irritating to the mammary gland and that infection status of the treated cow does not alter the milk leukocyte response.
Division of Academic and Student Affairs
Poster Number: 2

A Practical Exploration of the Intersection of Arts and Technology in a Contemporary Production of 1984

Meredith Biechele, Mechanical Engineering, NC State University
Mentors and/or Co-Authors: Mia Self

The ultimate goal of this project was to combine elements of technology and theater in a relevant production to help bridge the gap between the arts and sciences at NC State. As an independent, interdisciplinary research project, themes of theatrical production were explored and applied in a practical setting with a scientific, technological approach. For this project, a modern version of 1984, adapted by Michael Gene Sullivan, was produced in the Teaching and Visualization Lab in Hunt Library. Over an 18 month long period, this show was researched, designed, casted, rehearsed, and performed. The methods to complete this project were exploratory and constantly referred back to the relationship between technology and theater. This creative research project included a technical study of directing, theatrical design, and performance production. The final product was a series of performances that incorporated projection screens, lights, and sound in a non-traditional space. Major themes that were explored were the use of suspense, environmental immersion, and a digital reimagining of reality. The minimalist set design and props allowed for a dynamic, smooth performance that allowed the interaction between the projections carry the majority of the storytelling weight. The usage of technology also punctuated social themes of 1984 such as control, liberation, and government surveillance.

Poster Number: 78

Protecting North Carolina State University's Hallowed Places - Lake Raleigh Woods

Taylor Gregory, Biological Sciences, NC State University
Mentors and/or Co-Authors: Scott Schneider

Lake Raleigh is considered to be one of the “hallowed places” on North Carolina State University’s campus. Even with this distinction, the future protection of Lake Raleigh remains uncertain because it lies in an up and coming metropolitan area. A variety of methods were considered to aid in the long-term protection of the lake, but this project focused on increasing access and awareness of Lake Raleigh to the university community. These methods included protecting the area as bald eagle habitat, increasing the accessibility of the trails surrounding Lake Raleigh, and organizing a clean-up of the lake to help maintain the ecosystem that is currently present. It was decided that increasing the accessibility of Lake Raleigh would have the most impact on the future of the lake because it would increase the number of individuals who visit the lake and affirm its status as a “hallowed place”. In order to increase the accessibility of Lake Raleigh, the Lake Raleigh Woods trails needed to be condensed, improved, and maintained. In order to complete this, GPS surveys of the land were taken and that data were used to come up with a plan of how to improve both the visibility and functionality of the trails without harming the ecosystem.

Poster Number: 129

Study of Incoming Transfer Student Success at a Large Research Institution

Kristen McCaffrey, Statistics, NC State University
Mentors and/or Co-Authors: Emily Griffith, Stephany Dunstan

Educational data can be analyzed to understand the success of students that transfer to large research institutions. The success of transfer students can depend on a multitude of variables. This study explored transfer student success using deidentified transfer student enrollment data from a large university, with a focus on students’ geographic origin (rural or urban) using Rural-Urban Density Codes. The Rural-Urban Density Codes (Isserman, 2005) is a system in which counties are classified based on their rural/urban makeup. In this study, success can be defined as whether or not the student earned a degree in 6 years after transfer and student GPA after their first semester at a large research institution. Using SAS, the statistical models measuring success were broken down by significant variables. These individual variables provide information on trends among the differences between rural and urban transfer students success.

Poster Number: 115

Applying Logistic Regression to Student Data to Determine Retention of Rural Students at a Large University

Reema Thakkar, Statistics, NC State University
Mentors and/or Co-Authors: Emily Griffith, Stephany Dunstan
The findings of this presentation will assist the understanding of factors that influence retention and graduation for college students from rural areas. This presentation describes the analysis of the retention and postsecondary pathways of rural students who attended a large research institution between the years of 2010 and 2016. This project used de-identified enrollment data from a large, urban research institution and the National Student Clearinghouse. These data were analyzed to reveal the similarities, differences and outcomes for students who were but are no longer attending a large research institution, with a focus on students originally from rural areas. The National Student Clearinghouse data provides information on student transfers to another institution and if applicable, their performance (if they were retained or graduated) at the other institution(s). Particular attention was paid to the performance of urban versus rural students, which is determined by the Rural-Urban Density Codes (Isserman, 2005). Descriptive statistics, logistic regression and visual plots are used to communicate results from the data.
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<td>Simulation Aided Design Of Long Term Cooling In A Submerged Nuclear Power Plant</td>
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<tr>
<td>Younger, Samantha</td>
<td>College of Agriculture &amp; Life Sciences</td>
<td></td>
<td>63</td>
<td>Development Of Alumni Career Profile Videos For Nutrition Research, Communication, And Careers Course</td>
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<td>Yourcheck, Joseph</td>
<td>College of Humanities &amp; Social Sciences</td>
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<td>16</td>
<td>Gambling On Football: How Lula's Piece De Resistance Became His Coup De Grace</td>
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<td>Zhao, Hanqing</td>
<td>College of Agriculture &amp; Life Sciences</td>
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<td>44</td>
<td>Development Of Method For Reduction In Bitterness Of Bioactive Compounds Using Aggregation</td>
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<td>Zimmerman, Jacob</td>
<td>College of Engineering</td>
<td></td>
<td>19</td>
<td>Film Property Variations Based Upon Drying Conditions</td>
</tr>
</tbody>
</table>
Overall Symposium Summary

Total Registered Projects = 285
Total Registered Presenters = 421

Summary of Presenters’ College
College of Agriculture & Life Sciences = 131
College of Design = 2
College of Education = 1
College of Engineering = 111
College of Humanities & Social Sciences = 36
College of Natural Resources = 14
College of Sciences = 116
College of Textiles = 6
Division of Academic and Student Affairs = 1
Poole College of Management = 3
Total = 421

Project Summary by Lead Participant’s Classification
Freshman = 15
Sophomore = 30
Junior = 81
Senior = 159
Total = 285