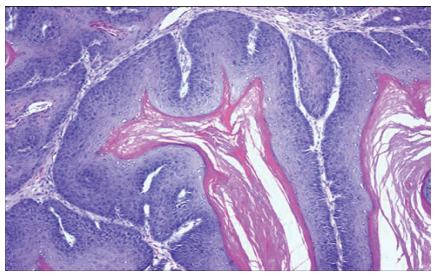

ABSTRACTS

4th Annual

Graduate Student Research Symposium

Wednesday
March 18, 2009

McKimmon Center

NC STATE UNIVERSITY

4th Annual
Graduate Student Research Symposium
NC State University

SYMPOSIUM ORGANIZERS

Graduate School

Dr. David Shafer, Assistant Dean for Outreach and Diversity

Todd Marcks, Fellowships and Grants Administrator

Darren White, Webmaster

Patricia Sullivan, Cover Design and Abstract Book

University Graduate Student Association (2008-2009)

Cat Dieck, Genetics (Chair)

David Crist, Computer Science

Elke Feese, Chemistry

Eric Miller, Microbiology

Rupesh Nawalakhe, Textiles

Vishwesh Pai, Electrical Engineering

Sharolyn Wynter, Operations Research

Cover Photo (left): Christopher Sistrunk, 2008 Symposium winner from Agriculture and Life Sciences

AGENDA

12:00 pm - 1:00 pm	Poster Set Up	Area 1
1:15 pm - 1:30 pm	Welcoming Remarks and Symposium Overview	Room 6
	Ali Kefeli, UGSA President	
	Dr. Duane K. Larick, Dean of the Graduate School	
	Dr. David Shafer, Assistant Dean for Outreach and Diversity	
1:30 pm - 4:00 pm	Poster Session and Competition	Area 1
4:15 pm - 5:00 pm	Announcements of Awards.....	Room 6
	Dr. Terri L. Lomax, Vice Chancellor for Research and Graduate Studies	

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ABSTRACTS

Denise M. Aslett, Christy Smith, and Alan House
Graduate Program: Microbiology
Advisor: Michael R. Hyman

Oxidation of MTBE by the ubiquitous soil nitrifying bacterium, *Nitrosomonas europaea*

Nitrosomonas europaea is a nitrifying bacterium that obtains all of its energy for growth from the aerobic oxidation of ammonia (NH_3) to nitrite (NO_2^-). *N. europaea* and other closely related ammonia-oxidizing bacteria are ubiquitous in the environment and can be found in soils, sediments and water systems. Previous studies with *N. europaea* have shown this bacterium oxidizes a wide range of environmental pollutants including trichloroethylene, chloroform, and polyaromatic hydrocarbons, as well as ethers such as dimethyl ether. In each case the biodegradation of these compounds has been attributed to the activity of a single key enzyme, ammonia monooxygenase (AMO). In this study we have characterized the biodegradation of MTBE by *N. europaea*. In the presence of ammonia, resting cells immediately oxidized MTBE to *tertiary* butyl alcohol (TBA). Short-term kinetic studies indicate MTBE is a weak competitive inhibitor of ammonia oxidation and suggest ammonia and MTBE directly compete for oxidation by AMO. This conclusion is also supported by our observation that MTBE-oxidizing activity is inhibited by acetylene and allylthiourea, two highly specific AMO inhibitors. Studies using $^{13}C_5$-MTBE and ^{13}C-NMR indicate TBA is not further oxidized although formaldehyde (HCHO) is slowly oxidized to formate (HCOOH). Neither MTBE, TBA, nor formaldehyde is toxic towards *N. europaea* in short term assays, even at high concentrations. The results of this study have important implications for our understanding of the environmental fate of MTBE. For example, as obligate ammonia-oxidizers, aerobic nitrifying bacteria typified by *N. europaea* exhibit high levels of AMO-dependent ammonia-oxidizing activity. As these organisms are widely distributed in the environment, our current findings suggest the potential to oxidize MTBE could therefore exist in any environment in which aerobic ammonia oxidation occurs. These environments might include wastewater treatment facilities, subsurface environments impacted by septic tank drainfields and residential and agricultural areas treated with ammonium-based fertilizers.

Julien F. Ayroles[1], Mary Anna Carbone[1], Eric A. Stone[2], Faye Lawrence[1], and Trudy F. C. Mackay[1]
Graduate Programs: Genetics[1]; Statistics[2]
Advisors: Trudy F. C. Mackay and Eric A. Stone

A Systems Approach to Genetic Dissection of Complex Traits in *Drosophila melanogaster*

Understanding how variation in sets of interacting transcripts affects organismal phenotypic variation is a critical challenge in contemporary quantitative genetics. We are using a systems genetics approach to explore this problem in *Drosophila melanogaster.* We derived 40 inbred lines and quantified the magnitude of genetic and environmental variation among these lines for a large number of physiological and behavioral phenotypes, including competitive fitness. We also performed whole genome transcriptional profiling of these lines. We performed analyses of variance for each gene to partition variation in transcript abundance into components attributable to the main effects of sex and line and the sex by line interaction. We found large amounts of genetic variation in transcript abundance, with over 10,000 differentially expressed transcripts (FDR <0.001) with high levels of broad sense heritability (over 5000 transcripts show H2 > 0.5) and large sex effects (> 13,000 transcripts). We then performed transcript-specific linear regressions using fitness as a response variable. We identified 414 transcripts associated with variation in fitness. We then used the correlation structure between these phenotypically significant genes to construct gene co-expression networks, or modules of genetically correlated transcripts all associated with fitness. The clustering of the regression gene list uncovered modules associated with mating behavior, oogenesis, and a large number of genes involved in neuronal processes. We also identified putative regulatory networks within each module and identified the most highly interconnected genes as strong candidate genes for further functional analyses. This project highlights how system genetics will further our understanding of the relationship between genotypic and phenotypic variation.

Faith E. Bartz[1], David A. Danehower[2], and Marc A. Cubeta[1]
Graduate Programs: Plant Pathology[1]; Crop Science[2]
Advisor: Marc A. Cubeta

Investigation of the Metabolic Control over Plant Growth Regulator Production by the Fungus *Rhizoctonia solani*, and the Physiological Responses of a Plant Host

The soil fungus *Rhizoctonia solani* causes seedling diseases on many plants in natural and agricultural ecosystems. It has been suggested that production of the plant growth regulators phenylacetic acid (PAA) and four hydroxy and methoxy derivatives contributes significantly to the plant infection process. However, little is known about how these compounds affect host plant physiology. To determine if a PAA derivative could cause plant responses similar to those of Rhizoctonia infection, 4-hydroxy-PAA was added to Murishige and Skoog's medium in concentrations ranging from 0-7.5 mM. Four replicate vessels of each medium were sown with 5 tomato seeds, and seedlings were assessed for root necrosis over 12 days of development. The percent area of root necrosis increased from 1% on untreated control seedlings to 31% at the 7.5 mM concentration. These results demonstrate that 4-hydroxy-PAA can produce a host response consistent with Rhizoctonia disease symptoms. A second objective was to quantify the influence of carbon catabolism on production of PAA and derivatives by *R. solani*. The biosynthetic pathway for PAA production shares two metabolic intermediates with the pathway for quinic acid (QA) catabolism. To test the hypothesis that induction of the QA pathway can lead to sequestration of these shared intermediates and reduce PAA production, 11 field isolates of *R. solani* were grown in Vogel's minimal medium amended with either 25 mM QA or no QA. PAA and derivatives were quantified by gas chromatography. In support of our hypothesis, PAA production by *R. solani* was significantly reduced in the QA treatment, but varied with isolate. These results show that modifying the carbon content of this pathogen's growth environment can reduce production of PAA via metabolic regulation. Our improved understanding of this mechanism may lead to the development of novel approaches to suppress Rhizoctonia disease.

Yuqiang Bi, Dean L. Hesterberg, and Owen W. Duckworth
Graduate Program: Soil Science
Advisor: Owen W. Duckworth

Siderophore-mediated dissolution of Co-substituted Goethite

Many plants and microbes utilize siderophores, a group of biogenic chelators with high affinity and specificity for Fe(III), as an important strategy to acquire Fe(III) from Fe (hydr)oxides in oxic environments. Recent studies suggest that desferrioxamine B (DFOB), a trihydroxamate siderophore, also forms exceptionally stable aqueous complexes with Co(III). The fate, transport, and bioavailability of Co in terrestrial environments thus may also be strongly coupled to siderophores. This study was conducted to determine the release rates of Fe and Co from model soil minerals by siderophore-promoted dissolution to better understand both the biogeochemical cycling of Fe and the fate and transport of ^{60}Co, an important radioactive contaminant in the environment. Steady-state dissolution experiments were conducted using synthetic low substituted Co-goethites (Co-FeOOH) in the presence of DFOB. The rates of DFOB-promoted dissolution of Co-goethites were strongly affected by the concentration of substituted Co. Reductive Co dissolution was observed at acidic pH but not at circumneutral to basic pH, indicating pH-dependent dissolution pathways. Additionally, excessive release of Co compared with the mineral's initial Co concentration indicated incongruent dissolution of Co-goethite by DFOB. The results imply strong interconnections in the biogeochemical cycling of Co and Fe mediated by siderophores. Siderophore-mediated solubilization of Co may also pose elevated risks of mobilization of ^{60}Co to groundwater in radioactive contaminated environments.

Brooke W. Bissinger and R. Michael Roe
Graduate Program: Entomology
Advisor: R. Michael Roe

Comparative Efficacy of the Plant-based Repellent, BioUD® to Other Commercially Available Arthropod Repellents against Mosquitoes and Ticks

Repellents are the most commonly used form of personal protection against biting arthropods. DEET has been the leading repellent for over 50 years however, many people avoid DEET-based repellents due to concerns of adverse health effects. BioUD® is a botanically-based repellent whose active ingredient, 2-undecanone, is derived from wild

tomato plants and was approved by the US EPA in 2007. The repellency of BioUD® (7.75% 2-undecanone) was compared to that of DEET and other commercially available repellents against mosquitoes and ticks. In arm-in-cage lab bioassays, BioUD® was as repellent as 7% DEET against yellow fever mosquitoes and as repellent as 15% DEET against Asian tiger mosquitoes. In mosquito field trials BioUD® was as repellent as 25% DEET in North Carolina and was more repellent than 30% DEET in Ontario, Canada 6 h after application to human skin.

In choice tests between treated and untreated filter paper, BioUD® was more repellent than 98.1% DEET against lone star and blacklegged ticks and provided equivalent repellency to DEET against American dog ticks from 3-3.5 h after treatment. In choice tests on treated versus untreated cotton cheesecloth, BioUD® provided equivalent repellency to 98.1% DEET, 30% oil of lemon eucalyptus, and 19.6% IR3535® against lone star and American dog ticks from 3-3.5 h after application. In the same study, BioUD® was more repellent than 15% Picaridin and 0.5% permethrin. In a time course bioassay, BioUD® applied to cotton cheesecloth provided 93.2% overall mean repellency against lone star ticks for 7 weeks. Based on these results it appears that BioUD® is a viable alternative to DEET and other commercially available repellents for use against mosquitoes and ticks.

D.V. Bohórquez[1], A.A. Santos Jr.[2], and P. R. Ferket[1]
Graduate Programs: Poultry Science, North Carolina State University[1]; Health and Biomedical Sciences, Florida Hospital College of Health Sciences, Orlando, FL[2]
Advisor: Peter R. Ferket

Evaluation of Mucosal Development of the Small Intestine in Perinatal Turkeys by Light and Electron Microscopy

The morphology of the intestinal mucosa changes dramatically in the perinatal turkey as it shifts from a lipid-rich in ovo nutrient supply to a carbohydrate- and protein-rich diet after hatch. These changes in mucosal morphology and the associated gut function can be modified by dietary or microbial factors. To our knowledge, this is the first study that evaluates the ultrastructural changes that occurs in the small intestinal mucosa of perinatal turkeys. Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and light microscopy (LM) observations were conducted to study the morphological development of the duodenum, jejunum, and ileum mucosa from embryos at 22E, 24E, 26E, and poults at hatch, 4, 8 and 11d. SEM and TEM observations were corroborated by histomorphometrical analysis made by LM. Villi topography and size profoundly changed between 22E and 24E, which coincided with the imbibing of amniotic fluid by the embryo. At 22E, the epithelial cell lining was not well-defined and microvilli were scattered, but by 24E the cell lining was well-attached and microvilli were uniformly distributed. SEM micrographs at 26E also revealed that the colonization of protozoa and bacteria in the ileum begins prior to hatch, although well-established colonies were only observed by 11d. Some of the bacteria identified at 11d were segmented filamentous bacteria, which are autochthonous organisms known to facilitate the mucosal development as well as the establishment of other non-pathogenic bacteria including lactobacilli. There was a dramatic 6-fold increase in villi surface area from 22E to 24E. Subsequently, villi surface area continued to double at each time point (26E, Hatch, 4d) until plateau at 8d. Villi morphology changed from finger-like projections before hatch to leaf-like projections after hatch. The profound morphological changes that occur over time in the small intestinal mucosa of perinatal turkeys may favor nutrient supply and the establishment of gut microflora.

Robert A. Brown
Graduate Program: Biological and Agricultural Engineering
Advisor: Bill Hunt

Performance of Bioretention with an Internal Water Storage Zone in the Upper Coastal Plain of North Carolina

The Pamlico and Albemarle Sounds comprise one of the most productive estuarine systems in the US and have a major impact on North Carolina's coastal economy. Closed shellfish waters and fish kills have resulted in stringent stormwater regulations for the nutrient sensitive watersheds of the Neuse and Tar-Pamlico River basins and 20 coastal counties. Much of the lands impacted by these regulations are in the coastal plain, which have sandy in-situ soils. Bioretention is an infiltration-based stormwater treatment device that reduces runoff and removes nutrients. The published bioretention research in NC has occurred in the clayey soils of the Piedmont. These data were used to establish state-wide pollutant removal credits for bioretention. The objective of this research was to determine if pollutant removal credits should vary based on underlying soils and drainage configuration. In Rocky Mount, NC, two bioretention cells

with 90 cm media depth and varying vegetative covers were studied with respect to hydrology and water quality. The site lies in the upper coastal plain and has sandy underlying soils. The outlet from the underdrains was elevated to create a 60 cm deep internal water storage (IWS) layer. In January 2009, the IWS was reduced to 30 cm to measure performance at a shallower depth. This design feature had a strong effect on flow reduction. Since September 2007, outflow was only generated in each cell four times for 68 monitored events. Completely assimilated events had pollutant load removals of 100% because load is a function of volume and concentration. As a result of the hydrologic findings, NC will increase phosphorus and nitrogen removal credits for bioretention cells constructed in eastern NC with IWS and sandy underlying soil.

Lei Cheng[1], Thomas W. Rufty[2], Fitzgerald L.Booker[2, 3], Kent O. Burkey[2, 3], H. David Shew[1], and Shuijin Hu[1]
Graduate Programs: Plant Pathology[1], Crop Science[2], North Carolina State University; Plant Science Research Unit, USDA-ARS[3]
Advisor: Shuijin Hu

Mycorrhizal enhancement of soil organic carbon decomposition as a positive feedback to climate change

A great effort in global change research has recently been directed towards assessing the potential of soil as a C sink under future CO_2 scenarios. Considerable attention has been focused on the impact of elevated CO_2 on mycorrhizae, particularly arbuscular mycorrhizae (AM), assuming that stimulation of mycorrhizae by elevated CO_2 will enhance soil C sequestration through facilitating soil aggregation and reducing C losses. However, the role of AM fungi in organic matter decomposition in response to global change factors has not been carefully assessed. This study investigates the effect of elevated CO_2 on mycorrhizal mediation of organic matter decomposition in two independent, but complementary experiments. We used a novel technique based on dual $^{13}C/^{15}N$ labeling of residues (*Panicum virgatum* L.) to trace residue-derived C and N. The results showed that CO_2-enhancement of AM fungi significantly increased organic carbon decomposition, positively feeding back to atmospheric CO_2. Results from ^{15}N tracer measurements also indicated that elevated CO_2 considerably increased mycorrhizally-mediated plant N acquisition from decomposing residues. These findings directly challenge the current view that increasing mycorrhizal fungi with rising CO_2 could increase soil C sequestration. They also suggest that mycorrhizal fungi might shortcut soil N cycle by increasing plant N acquisition from decomposing residues under elevated CO_2, especially in N-poor soils, thereby alleviating N limitation on ecosystem responses to elevated CO_2.

B.J. Dorshorst and C.M. Ashwell
Graduate Program: Functional Genomics
Advisor: C.M. Ashwell

Genetic mapping of the sex-linked Barring gene in the chicken

First described as a sex-linked dominant gene by Spillman in 1908, Barring (*B*) is a very familiar phenotype to most poultry breeders and scientists. The Barred Plymouth Rock breed is the standard example, exhibiting alternating white and black bars on the feathers covering the entire body. In addition to the primary phenotype Barring has also been shown to 1) inhibit pigmentation in the dermis of the shank and beak 2) to interact with Dominant White (*I*) to more completely inhibit black spots in the feathers of *I*/*i* birds and 3) to dilute chick down color with a characteristic white spot on the top of the head. The specific mechanism and corresponding genetic mutation eliminating pigmentation from alternating regions of the feather has not been identified. Previous work using tissue grafts has shown that the microenvironment of the feather follicle and corresponding melanophores are responsible for the barring phenotype as opposed to a systemic or endocrine mediated defect. Utilizing an F_2 population derived from a single Black Polish male and a single Barred Plymouth Rock hen we have mapped the Barring gene to less than a 680 Kb region on the distal end of the long arm of GGZ. The development of the F_3 generation of this cross will enable fine mapping of the Barring gene. With the identification of the Barring variant we will have the ability to select for this potent pigmentation inhibitor which is otherwise undetectable in the Dominant White (*I*) and/or Recessive White (*c*) genetic background of today's typical commercial flock.

Robert S. Fry, Melissa S. Ashwell, Stephanie L. Hansen, and Jerry W. Spears
Graduate Program: Animal Science
Advisors: Jerry W. Spears and Melissa S. Ashwell

Effect of copper deficiency on gene expression profiles of copper transporters and chaperones in the intestine and liver of steers

Data from rodent models has provided an understanding of how copper (Cu) transporters and chaperones function in Cu metabolism. These transporters and chaperones have been found to regulate Cu entry into the cell (CTR1), deliver Cu to cytochrome c oxidase (COX17), and to the trans-golgi network (ATOX1) for Cu export into cuproenzymes (ATP7A and ATP7B). The effect of Cu deficiency on these pathways has not been evaluated in cattle. In the present study, Angus calves (n = 14) were born to cows fed one of the following dietary treatments for 410 days prior to calving: 1) Cu-adequate (+Cu; 10 mg supplemental Cu/kg dry matter) or 2) Cu-deficient (-Cu). Copper deficiency was produced by providing no supplemental Cu and supplementing the Cu antagonist molybdenum at 2 mg/kg dry matter. After weaning, calves remained on the same dietary treatments as their dams and were harvested on day 493. Duodenal scrapings and liver samples were collected from steers and flash frozen for Cu content and gene expression analysis. Plasma Cu and liver Cu on day 490 was lower ($P < 0.001$) in –Cu steers compared to +Cu steers. Duodenal expression of *Ctr1*, *Atox1*, *Cox17*, and *Atp7b* was not different due to Cu deficiency. However, there was a trend ($P = 0.12$) for duodenal *Atp7a* to be up-regulated in –Cu steers. Liver expression of *Ctr1* and *Atox1* was not different; however, *Cox17*, *Atp7a*, and *Atp7b* were differentially expressed. Copper deficiency markedly ($P < 0.01$) reduced the relative expression of *Cox17* and tended ($P \leq 0.10$) to reduce relative expression of *Atp7a* and *Atp7b*. Results from this study indicate that Cu deficiency decreases expression of certain Cu transporters and chaperones in cattle. Furthermore, it appears that Cu transporters in the liver are affected to a greater extent than duodenal Cu transporters.

Nathaniel Grubbs
Graduate Program: Genetics
Advisor: Jim Mahaffey

Head or Leg: Which is the conserved role of *disco* in insect development?

The fruit fly, *Drosophila melanogaster*, is a long established genetic model organism, with many tools useful for genetic studies. *Tribolium castaneum*, a member of the insect order Coleoptera, is a more recently established genetic model organism, and shares many of the same benefits and tools as Drosophila. However, Tribolium embryos develop differently from Drosophila, including growing larval limbs, as compared to the limbless Drosophila maggot larvae. Hox genes are important in establishing anterior-posterior (head to tail) segment identity in all animals, including Drosophila and Tribolium. In this capacity, each functions by binding DNA and turning on genes critical to establish the identity of its specific segments. However, every Hox gene binds a similar DNA sequence. It is believed that other DNA binding factors work with Hox genes to create the specificity needed to establish segment identity. The Drosophila gene *disconnected* (*disco*), has been identified at the genetic level to function as such a factor, important in larval head segment identity in conjunction with the head Hox genes. A similar gene, *disco-related*, was also discovered and found to serve in a redundant capacity in this role. However, subsequent research indicates that the *disco* genes are also necessary for proper development of the ventral limbs of the adult fly. To determine which role (head segmentation or limb development) is conserved in evolution, we examined the role of the single Tribolium *disco* homolog, *Tc-disco*. We used *in situ* staining to examine the expression pattern of *Tc-disco* in Tribolium embryos, and a process called RNA interference was used to reduce *Tc-disco* RNA, simulating a loss of the gene function during development. Together, these experiments provide evidence that the limb development role of *disco* genes is the conserved role in insect development.

Wanda J. Hardison and Mary Helen Jones
Graduate Program: Human Development and Family Studies
Advisor: Karen Debord

Children Know When Their Parents Are Fighting!

Research clearly indicates the sensitivity of children, even those less than a year old, to parental conflict. The potential for the negative impact of familial discord on child development includes externalized problems such as conduct issues,

internalized symptoms such as anxiety and depression, reduced social competence, and lower academic achievement. Although a substantial body of research has accumulated supporting these findings, little of that research has been translated into formats friendly to use by parents or Family Life Educators (FLE). The objective of this project is to translate the recent research into user-friendly formats to increase parental awareness of the potential negative effect of familial conflict and suggest strategies for reducing the negative impact on child outcomes. A curriculum was developed for both a train-the-trainer event with Parents As Teachers (PAT) educators in Harnett County, NC and a two-hour workshop for parents in Vance County, NC. PAT educators will present three lessons to at least ten families during home visits in February and March, 2009. At least ten parents will participate in a two-hour workshop for parents in the general public and a workshop for Head Start parents in Vance County. A pre-test to determine frequency and severity of conflict will be administered to parents at the initial meeting and a posttest will be administered in the home of PAT clients or by mail for workshop attendees in early April. Workshop attendees will be mailed three reader-friendly bulletins to remind and encourage them to reduce harmful conflict. Researchers anticipate that parents who become aware of the harmful potential of hostile conflict will reduce that conflict. In addition, more positive results are anticipated from those parents receiving intense in-home instruction than a onetime group workshop.

Monica N. Iglecia and Jaime A. Collazo
Graduate Program: Zoology
Advisor: Jaime A. Collazo

Occupancy modeling methods to utilize the North American Breeding Bird Survey, explore landscape pattern and process, and inform conservation planning

The Brown-headed Nuthatch (BHNU, *Sitta pusilla*) is a common but declining endemic southeastern species with close habitat associations to endangered longleaf pine (*Pinus palustris*) savannas in the coastal plain of the U.S. (Bent, 1948). We test *a priori* predictions based on published reports regarding landscape level variables that may influence BHNU occupancy, local colonization and extinction rates. We view these vital rates as quantitative criteria to build decision-support tools and inform conservation planning. We illustrate the application of this approach with the BHNU because it is well represented in the North American Breeding Bird Survey (BBS) dataset and landscape variables derived from satellite imagery and ancillary data can be associated with its life history traits. BBS surveys extend throughout the United States and Canada following a standardized sampling protocol, and as such, constitute an exemplar landscape-level avian dataset. We divided the 50-stop BBS routes into four, eight-stop sections by removing 18 stops. We estimate vital rates using the program Presence. Support in the data for the best model is determined using Akaike's Information Criterion. The top model estimates higher rates of local extinction on the periphery of BHNU distribution. Low estimates of local colonization support observations of short dispersal distances.

BBS conducts over 4,000 yearly breeding bird surveys. The approach we present is statistically sound and allows for the estimation of vital parameters. These methods are well-suited to inform conservation planning and development of decision-support tools for conservation design for multiple avian species in the southeastern United States.

Kimberly Johnson and Andrew Behnke
Graduate Program: Human Development and Family Studies
Advisor: Andrew Behnke

Juntos Para Una Mejor Educacion

The Juntos program was designed with Latino youth and their families in mind. There is a high prevalence of high school drop out among Latinos in North Carolina. Juntos aims to provide valuable information to keep youth in school to obtain their high school diploma and to help them achieve their higher education goals. The objectives for this program include: to increase youth's abilities to succeed in high school, to discover the benefits of higher education, and to become aware of how to attain a college education; to expand family-school-college partnerships and capacity in North Carolina to address Latino dropout prevention and access to higher education; to engage college students in Extension program development, evaluation, and dissemination; to position our interdisciplinary team to secure external funding to replicate and evaluate the educational program across NC and in other states. Juntos evaluates the effectiveness of the program by giving a pre-test to participants at the beginning of the 6 week sessions to gauge their current knowledge on topics. At the end of the 6 week sessions, a post-test is given to participants to gauge their

current knowledge on topics covered throughout the sessions. Key findings of the program include parents and youth demonstrating significant increases in understanding how to apply for and finance college, and increased communication about school. Implications for future programming and suggestions for future research will be provided.

W. Miller Johnstone III[1], Andrew D. Baltzegar[2], and Russell J. Borski[1,2]
Graduate Programs: Physiology[1]; Biology[2]
Advisor: Russell J. Borski

Characterization of Serum and Glucocorticoid Induced Kinases (SGK) in a teleost fish, the Mozambique tilapia (Oreochromis mossambicus)

Serum and glucocorticoid kinase (SGK) is a Serine/Threonine kinase belonging to the AGC [cAMP-dependant protein kinase (PKA), protein kinase G, protein kinase C (PKC)] kinase family. SGK is an immediate early response gene inducible by a plethora of stimuli including, but not limited to glucocorticoids, mineralcorticoids, cell shrinkage, cell swelling, various growth factors, DNA damage, stress, and p53. The structure and regulation of SGK has yet to be characterized in teleost fishes. We have cloned the full transcript of the SGK1 (1296 bp) isoform in the euryhaline Mozambique Tilapia. Using CLUSTALX alignment, we show that tilapia SGK1 shares 98% and 92% homology with the human and mouse isoform at the transcript and protein level, respectively. Classic structures associated with the AGC family of kinases, including a conserved ATP binding domain and active site have also been identified. We also cloned a 510 and 535 bp partial coding regions of two other isoforms identified as SGK2 and SGK3, respectively. We show that the gene for SGK1 is expressed in the teleost gill, heart, kidney, posterior intestine, brain, and pituitary. It is our hypothesis that SGK and its downstream mediators are integral in the ability of euryhaline fish to osmoregulate when faced with environmental salinity fluctuations.

Kristen M. Kostelnik and Thomas R. Wentworth
Graduate Program: Plant Biology
Advisor: Thomas R. Wentworth

What determines persistence? How biology, the environment, and population status model affect rare species conservation

It is widely accepted that small, spatially isolated biological populations or those with altered disturbance regimes are at higher risk of extinction because of limitations in general fitness, genetic heterogeneity, and dispersal events. Choice of the model used to characterize population status (as persistent or extinct) can also affect our interpretation of risk. We have access to a thrice replicated population census (1991, 1999, and 2008) and associated fire histories for seven rare, threatened, or endangered vascular plant species endemic to the sandhills region of the inner coastal plain physiographic province of North Carolina. These data provide a unique opportunity to examine both environmental/spatial factors and choice of status model on assessment of extinction risk. For each species, we visited all known subpopulations on the Fort Bragg and Camp Mackall Military Reservations, recorded presence or absence, and, when species were present, determined number of individuals and spatial extent. We also conducted surveys to document the establishment of new subpopulations. We are applying multiple population status models to these data to classify each subpopulation at each census as either extinct or persistent, then using logistic regression and structural equation modeling to explain the variation in extinction or persistence as a function of fire frequency, time since last fire, distance to nearest conspecific neighbor, subpopulation density, and subpopulation area. Preliminary results suggest that previous population density, population area, fire frequency, and time since last fire are important predictors of species persistence and extinction risk. However, results vary depending on which status model is used to determine persistence or extinction. Our results can help in making predictions about the consequences of increased rarity or increased habitat loss/fragmentation on already rare species and assist in defining success for those species of conservation concern.

Edward E. Large
Graduate Program: Genetics
Advisor: Laura Mathies

C. elegans Ikaros-Like Family Member Interacts With Members of the SWI/SNF Complex to Control Early Reproductive System Development

The Ikaros family of C2H2 zinc finger transcription factors are important regulators of hematopoiesis in vertebrates. Immune system lineage progression is facilitated by the ability of Ikaros to interact with chromatin remodeling complexes such as SWI/SNF & NuRD. This affects the position of nucleosomes and, in turn, activates or represses genes responsible for hematopoiesis.

Ikaros family members have been identified in vertebrate lymphocytes ranging from mammals to the lymphoid-like cells of hagfish and lampreys. Animals lacking adaptive immune systems, such as asicidians and sea urchins, have also been found to have Ikaros orthologs. Despite this deep conservation, Ikaros-like family members have not been discovered in *D. melanogaster* or *C. elegans*.

We find evidence for both the presence and expansion of *C. elegans* Ikaros-like family members involved in early reproductive system development. We further provide genetic evidence that one family member, *ehn-3* (enhancer of hand), associates with various members of the SWI/SNF chromatin remodeling complex. This provides a potentially conserved mechanism for the activation and repression of genes responsible for the lineage progression of undifferentiated cells in mammalian immune systems and the *C. elegans* reproductive system.

Sang-Yoon Lee[1], Pei-Lan Tsou[2], Heike Winter-Sederoff[1], and Dominique Robertson[1]
Graduate Programs: Plant Biology, North Carolina State University[1]; Cellular and Molecular Biology, Grand Valley State University[2]
Advisor: Dominique Robertson

Plants Expressing an ER-Targeted Calcium Binding Peptide Maintain Proper Cytosolic Calcium Levels During Prolonged Stress

Ca^{2+} supplementation reduces the deleterious effects of NaCl in many plant species. To test if we could mimic this effect, and therefore increase NaCl tolerance, we generated transgenic Arabidopsis lines that constitutively express a low affinity, high capacity Calcium Binding Peptide (CBP) localized to the endoplasmic reticulum (ER). The CBP-transgenic lines contained up to 10% more total calcium than GFP-control and wild-type plants. Each of the CBP lines also showed increased K^+ compared to controls, which was balanced by a decrease in Na^+ accumulation. Furthermore, ER-CBP transgenic plants exhibited better salt and osmotic tolerance. It has been demonstrated in plants that cytosolic Ca^{2+} changes in response to specific stimuli, which leads to differential gene regulations. One member of the *CIPK* (CBL-Interacting Protein Kinase) gene family, *CIPK6*, showed higher transcript levels in CBP-transgenic lines. *CIPK6*, along with two other drought-associated genes (*DREB1a* and *rd29a)*, were significantly up-regulated, even under non-stress conditions. To determine whether $[Ca^{2+}]_{cyt}$ was altered in the CBP-transgenic plants, we used two methods, confocal ratio imaging of Indo-1 and the cytosol targeted aequorin luminescence to measure transient changes in $[Ca^{2+}]_{cyt}$. There were no significant differences between CBP-transgenic plants and control plants in response to a short-term salt treatment (~ 20 min) when measured by either method. However, after a three day incubation on 100 mM NaCl, ER-CBP-transgenic lines had significantly higher steady-state levels of $[Ca^{2+}]_{cyt}$ than control plants. In addition, after seedlings were grown on Ca^{2+} depleted media for 5 days, CBP-transgenic plants had Ca^{2+} peak heights that were similar to non-stressed plants, while control plants showed a significant decrease. Together, these results demonstrate that ER-CBP-transgenic lines maintain tight control over cytosolic Ca^{2+} levels but, under prolonged stress, have access and can use the extra Ca^{2+} reserves associated with transgenic expression of CBP in the ER.

Lloyd Liwimbi, Alexandria Graves, Daniel Israel, and Bradford Robinson
Graduate Program: Soil Science
Advisor: Alexandria Graves

Microbial Source Tracking Based On The Distribution Of Antibiotic Resistance Genes

The use of antibiotics in animals is suspected to be a major route for transfer of antibiotic resistance genes (ARGs) to human pathogens, although different antibiotics are used in animals than in humans. North Carolina has the second largest swine production industry in the USA which is concentrated in a small geographical area in the southeastern part. This may increase the risk of antibiotic resistant bacteria reaching nearby surface waters. The goal of this study is to identify host sources of fecal pollution found in Six Runs Creek, Sampson County NC based on the distribution of antibiotic resistance genes recovered from *E. coli*. ARGs in *E.coli* isolates from swine feces, lagoon effluent, cattle, wildlife, and ground and surface waters from a commercial swine facility. *Escherichia coli* isolates were recovered from manure and water samples by basic microbiological culture and IDEXX Colilert methods, respectively. Antibiotic resistance genes were identified from the isolates using the polymerase chain reaction (PCR) method. A total of 1,016 *E. coli* isolates from swine feces, lagoon effluent, cattle, wildlife and nearby ground and surface waters (n=238, 234, 144, 200, and 200, respectively) were recovered. All the *E. coli* isolates were evaluated for phenotypic expression of resistance to various concentrations of the following antibiotics: erythromycin, neomycin, oxytetracycline, streptomycin, tetracycline, cephalothin, apramycin, trimethoprim, and rifampicin. All the isolates displayed multiple antibiotic resistances. Genotypic evaluation indicated the presence of aadA, strA, strB, tetA, tetB, tetC, sul1, sul2, sul3, and aac(3)IV ARGs in all the sources of isolates. The number of ARGs in *E. coli* isolated from swine feces and lagoon effluent were not significantly different, while those from lagoon effluent were significantly ($p \leq 0.05$) fewer than from ground and surface water. The host source of the *E. coli* recovered from ground and surface waters were primarily associated with the livestock sources.

Rotua Lumbantobing
Graduate Program: Economics/Agriculture and Resource Economics
Advisor: Mitch Renkow

Household Location Decisions With Respect To Water Availability: Evidence of Sorting Equilibrium in Southwestern Sri Lanka

This research addresses the economic questions related to how households make choices of where they live and the relative importance of housing prices and infrastructure availability, especially water infrastructure. Answering these questions requires analyzing the spatial distribution of income, housing prices and access to water infrastructure using an equilibrium sorting model. The model defines a distribution of preferences of households or individuals in making a location choice. In this choice process, households care about specific attributes of location related to the local provision of public goods, and make location choices with regard to these attributes. The model has been used extensively in public economics in the U.S. However, few studies have addressed the role of public infrastructure in enhancing the value of a house in a neighborhood, especially in developing countries. The model is implemented using household data from three regions in Southwestern Sri Lanka. Households in the study area obtain water from three sources: public wells, private wells or a public water service provided by the local government through a water network, where households pay a fee in exchange for a certain level of water service. The estimation strategy follows the two-stage approach used in Bayer et al. (2006), with the main benefits of isolating neighborhood fixed effects by controlling for observed household characteristics and house attributes, while using estimation techniques that are widely available through most statistical software. Finally, household's marginal willingness to pay for proximity to water network and for tap water access can be computed to quantify the effect of water infrastructure on housing value. In summary, this paper offers a valuation technique of water infrastructure in a developed country using an equilibrium sorting model.

Gerald L. Miller, Jr.
Graduate Program: Plant Pathology
Advisors: Lane Tredway and Larry Grand

Isolation and Identification of Basidiomycete Fungi Associated with Fairy Rings in Golf Putting Greens

Over 60 different basidiomycete fungi are associated with fairy rings in turf, but it is unknown which are specifically prevalent in putting greens. Identification of these fungi is done based on morphology of the basidiocarp, which are only produced under certain conditions and often do not reach maturity due to agronomic practices. Basidiocarps and soils were sampled from five bermudagrass and four creeping bentgrass putting greens exhibiting fairy ring symptoms in NC, SC, FL, TX, CA, and HI. Morphology of five mature basidiocarps (puffballs) was examined. Three of these samples were identified as Vascellum curtisii and two as Bovista dermoxantha. Mycelium was cultured from basidiocarps or isolation was attempted from infested soil. DNA was extracted from 44 isolates and 5 soil samples prepared with a commercial kit. PCR amplification and sequencing of rDNA regions ITS1, 5.8S rRNA, and ITS2 was performed using the basidiomycete-specific primers ITS1f and ITS4b. Phylogenetic analyses included construction of parsimony trees among similar sequences and calculation of bootstrap values based on 1000 replicates. ITS sequences from six soil isolates, where no basidiocarps were present, were most similar to Genbank accessions of two mushroom-forming species, Coprinus bisporus and Marasmius sp. However, a greater majority of ITS sequences from isolations showed high similarity to accessions of Vascellum curtisii or Bovista dermoxantha (66% and 22%, respectively). Similarly, 4 of the 5 sequences amplified from soil DNA extracts showed highest sequence similarity to these two puffball species, which have been characterized and associated with fairy rings in Japan.

Ramon Molina-Bravo, Bryon R. Sosinski, and Gina E. Fernandez
Graduate Program: Horticultural Science
Advisors: Bryon R. Sosinski and Gina Fernandez

Development of a Protocol to Assess Heat Tolerance in a Segregating Population of Red Raspberry (*Rubus idaeus* L.) for Quantitative Trait Analysis

There are no major producers of raspberries (*Rubus idaeus*) in the southeastern U.S. due in part to the lack of cultivars adapted to warm summer temperatures. Breeding for heat tolerance in raspberries at North Carolina State University is a primary goal in order to achieve adequate plant vigor and production. Screening germplasm for heat tolerance thus far has been done only by visual assessment over a number of years in the field. Here, we describe the development of a method that measures heat tolerance using a chlorophyll fluorometer, and the application of such method onto a field-grown mapping population of raspberries for genetic and quantitative analysis. We established that diurnal effects occur after leaf temperature reaches 28°C, the critical temperature of *Rubus* is 43.7°C, dark adaptation minimum is 5 minutes, and heat shock duration is optimal at 30 minutes. The mapping population (n=196) was screened using the above parameters to measure the Fv/Fm (defined as the ratio of variable fluorescence by the maximal fluorescence). A significant difference in Fv/Fm was found between heat tolerant and non-heat tolerant genotypes (averages of 0.632 and 0.363, respectively). We have established a method to measure heat tolerance that is non-dependent on visual assessment for *Rubus*. Although samples can be screened relatively quickly using this method, the screen is not practical for very large populations in a breeding program. Segregation for heat tolerance is normally distributed and will be used for quantitative trait loci analysis for mapping of the trait. Future work involves fine mapping of the QTL regions, and development of EST markers for screening heat tolerance in the greenhouse.

R. Qiu, W. J. Croom, G. Wu, R. A. Ali, and M. D. Koci
Graduate Program: Poultry Science
Advisors: Matthew D. Koci and Warren J. Croom

Effects of the DFM on Crop Development in Broilers

Direct fed microbials (DFM) have been reported to promote health by helping to stabilize the gastrointestinal (GI) micro-environment. Our previous studies have demonstrated that DFM can enhance the development of the lower GI physiology of broiler chicks. Few studies, however, have examined the effects DFM have on the pre-gastric regions of the digestive tract. The objective of the current study was to investigate the effects of DFM on the structure and physiology of the broiler chick crop, which is an important pre-gastric component of the avian GI tract. Day-old male

broilers were allocated to two diet groups: control starter diet (CSD), or DFM diet (CSD plus Primalac®, 0.3% w/w). At day 7, 14 and 21, the crop was sampled from 6 birds per group and the effects of DFM were assessed by scanning electron microscopy (SEM). As expected, the crops from animals fed DFM were observed to have more bacteria than animals fed CSD. Interestingly, several lesions, erosion, were noted in the crops from CSD fed animals; however these lesions were not observed in the DFM treated birds. Additionally the crops from DFM treated birds were observed to have increased and more-continuous microfolds on squamous epithelial cells. These data suggest DFM, specifically Primalac®, affects the physiological development of the pre-gastric as well as post-gastric regions of the GI. Further investigation is needed to better understand the effects of Primalac® and other DFM have on crop structure and function and their role in promoting animal health.

Cary Rivard
Graduate Program: Plant Pathology
Advisor: Frank J. Louws

Grafting with inter-specific rootstock provides novel applications for host resistance in tomato

Due to the phaseout of methyl bromide and demand for local and organic produce, tomato growers in NC require environmentally-sustainable soilborne disease management strategies for organic and conventional systems. Tomato grafting is popular worldwide, but it's practical and economic relevance for US production is unknown. A research and extension program was initiated in 2005 to identify potential rootstock for US growers. Field research trials were carried out in the 2005-2008 seasons that included on-farm collaborations in organic and conventional systems. In addition, a key question was to elucidate the physiological response to grafting. 'Maxifort' rootstock had complete resistance to *Fusarium oxysporum* f.sp. *lycopersici* and was tolerant of infection by *Meloidogyne* spp.. 'Big Power' was highly effective at reducing *Meloidogyne* spp. reproduction beyond non-grafted, fumigated, and other hybrid rootstock containing the *Mi* resistance gene. Inter-specific rootstock also provided host resistance against pathogens where commercial tomato hybrids are highly susceptible. 'Beaufort' and 'Maxifort' showed complete resistance to *Sclerotium rolfsii* whereas control treatments had 45-50% disease incidence. 'RST-04-105' rootstock was completely resistant to *Ralstonia solanacearum* and control treatments suffered 75-100% plant mortality. Furthermore, research at the Center for Environmental Farming Systems indicated that grafting and high tunnels provide complementary IPM strategies, and 'Maxifort' increased yield by >50% with little pressure from soilborne pathogens. In order to determine the physiological state of induced resistance associated with grafting, a quantitative PCR protocol was developed to monitor defense gene expression in tomato. Grafting elevated the expression of proteinase inhibitor II (*PIN II*), a defense gene related to the jasmonic acid pathway, and quantitative expression of *PIN II* was altered by rootstock genotype. Grafting is a highly effective management strategy that is now being readily adopted by NC tomato growers, and further clarification of induced resistance will enhance our application of host genetics in the field.

Jessica T. Roberts and Gregory D. Jennings
Graduate Program: Biological and Agricultural Engineering
Advisor: Gregory D. Jennings

Field Assessment of Culvert Impacts on Stream Channel Morphology

Culverts are an integral part of the transportation network and are becoming unavoidable in the stream network. As the regulations for culvert design have advanced, the tools used to examine culvert performance must evolve. Required regional channel stability assessments are often preliminary, due to time and money and don't address culvert impacts to the stream. Due to the volume and cost of culvert design and installation there is a need to increase the frequency and efficiency of channel stability assessments.

Channel stability near culverts not only poses concern for structural stability but for negative impacts to native species (including habitat loss), conveyance of sediment, and loss of stable channel morphology. Researchers, designers, regulators, and contractors can benefit from an assessment tool that correlates culvert design parameters with quantitative and qualitative stream characteristics. A comprehensive, field-tested, rapid culvert and channel assessment tool has been developed to relate the cause of instability of culverts with their design characteristics, specifically culvert cross sectional area and slope, to the observed channel stability or lack thereof. The Culvert Assessment Tool (CAT) uses small teams to characterize properties of streams and culverts in Wake County, North Carolina. The study captures a range of urban and rural watersheds, culvert and stream types; using the CAT score,

comprised of qualitative parameters such as presence of armoring, channel geometry and characteristics, obtained from surveyed cross sections and pebble count data and culvert characteristics, such as diameter and length. The CAT also identifies and rates the cause(s) of instability at each location. Results show that most culverts in Wake County are round, reinforced concrete pipe culverts in urban settings. The assessment confirms that cross sectional area and slope impact CAT score. Culverts with cross sectional area less than 25 ft^2 and steep slopes have higher CAT scores, indicating increased instability.

Juan B. Rosario
Graduate Program: Genetics
Advisor: James W. Mahaffey

Disco from the eyes to the legs

Appendage development has intrigued scientist for many decades. My research goal is to understand the role of the disconnected (disco) gene during development of the leg in the fruit fly, Drosophila melanogaster. Disco, was first characterized as a gene involved in neural migration, recognition and binding of the Bolwig's nerves to their receptors in the brain during Drosophila embryogenesis. Later studies demonstrated that disco is expressed in other areas of the fly embryo, larvae and adult. Much like metamorphosis in butterflies, during pupation, Drosophila develops and differentiates the structures characteristics of the adult. The disco genes are needed for development of the medial to distal portion of all adult ventral appendages. Expressing disco in the dorsal imaginal discs, transforms them to ventral fate; for example, the wing can be transformed to a leg identity. I am studying how disco interacts with other genes that specify leg development. We are examining the effect of expressing disco in the domains of other appendages genes trying to understand how these genes combine to regulate pattern formation. Since the disco genes are conserved in all animals, as are many of the other genes of the appendage network, understanding how these genes direct development in the fruit fly provides information about development in all animals.

Elizabeth E. Rueschhoff, Heike Winter-Sederoff, and Margaret E. Daub
Graduate Program: Plant Biology
Advisor: Margaret E. Daub

Investigation of the roles of Vitamin B6 in carbohydrate metabolism in *Arabidopsis thaliana*

Vitamin B6 is a required coenzyme for many cellular processes, including amino acid metabolism, carbohydrate metabolism, ethylene and chlorophyll synthesis, and response to both biotic and abiotic stress. There are six different forms, or vitamers, of vitamin B6: pyridoxine (PN), pyridoxal (PL), pyridoxamine (PM) and their phosphorylated derivatives, pyridoxine 5'-phosphate (PNP), pyridoxal 5'phosphate (PLP), and pyridoxamine 5'-phosphate (PMP). PLP is the active form of the vitamers. In most organisms, PLP is synthesized by the "de novo pathway. " This pathway is found in most organisms. Animals, however, are unable to synthesize vitamin B6 and therefore must obtain this important nutrient from their diet. Another pathway of vitamin B6 metabolism is found in all organisms, including animals. This pathway, termed the "salvage pathway", is responsible for the interconversion of the six different vitamer forms. Deficiency of vitamin B6 in humans has been linked with gestational diabetes, depression and epilepsy.

My work is focused on two different mutants of vitamin B6 synthesis, *pdx1.3* and *sos4*. These are mutants of the de novo pathway and the salvage pathway, respectively. The *pdx1.3* mutant is deficient in vitamin B6 synthesis, while the *sos4* mutant has increased vitamin B6 content. Even though these two mutants have widely different levels of vitamin B6, they share a slate of common phenotypes, including chlorosis, stunted growth, root sensitivity to sucrose, altered sugar accumulation, altered starch structure and altered chloroplast ultrastructure. These phenotypes cannot be explained by known roles of vitamin B6. Currently, I am investigating the mechanism(s) which allow both mutants to display the same phenotypes even though they have very different levels of vitamin B6. Understanding these mechanisms may allow us to develop crops that are more resistant to biotic and abiotic stress, such as plant pathogens or drought, and to develop crops with higher nutritional value.

Amanda Saville, Rose Grinnan, and Alexander Krings
Graduate Program: Plant Biology
Advisors: Alexander Krings and Jenny Xiang

From despair to hope? Delimiting species boundaries in the *Dichanthelium dichotomum* complex (Poaceae)

Dichanthelium dichotomum (L.) Gould (Poaceae) is a complex of diploid grasses, all found within the eastern United States. This widely encountered species complex is an important component of the eastern North American flora, but our current understanding of it is chaotic at best. Taxonomic difficulties in this group are exemplified by Godfrey and Wooten's apology: "We admit that our failure to distinguish the several named taxa…was born of despair!". The dramatically different taxon limits proposed by various authors and the difficulties for identification generated therein highlight the need for an empirical and quantitative evaluation of species limits in the complex. The objective of this study is to analyze taxonomic limits in the *D. dichotomum* complex, using, for the first time, multivariate analyses of morphological characters. Morphological data comprised of 12 quantitative and 24 qualitative characters were captured from 138 herbarium specimens spanning the complex's range. Preliminary results from cluster and principal coordinate analyses (PCoA) show two distinct groups: One referable to *Dichanthelium annulum* (Ashe) LeBlond—which, historically, has not been uniformly accepted—and the other including all other OTUs sampled. Structure was evident in the clustering of remaining OTUs, although these varied in overlap, suggesting that names have either been based on various extremes of a morphological cline, or that the characters analyzed are insufficient to completely discern underlying relationships. Ongoing research seeks to resolve remaining issues in the complex.

Kristin Stair
Graduate Program: Agricultural and Extension Education
Advisor: Gary Moore

Are We Making the Grade? Identifying Confidence Levels and Instructional Strategies of High School Agriculture Education Teachers When Working with Students with Special Needs

In Agricultural Education, teachers are experiencing increased student diversity within their classrooms. The purpose of this study was to identify the confidence levels of high school agriculture teachers and to determine what strategies they are using when working with students with special needs. The objectives of this study were to: identify if agriculture teachers are utilizing recommended practices when working with students with special needs, to determine how often these practices are being used, to determine what strategies teachers believe are effective when working with learners with special needs, and to determine the confidence levels of teachers when working with these students. The population of this study consisted of agriculture teachers within the six National Association of Agriculture Educator (NAAE) regions. One state was randomly selected from each region and a stratified random sampling method was used to ensure representation from all states. A random sample size of 333 was selected with a total response rate of 60%. Participants completed a survey instrument that measured teacher confidence, identified which strategies they used most often, how effective they felt those strategies were and collected demographic information. Analysis of the collected data showed that teachers are using recognized practices in their classes though they are more likely to use techniques associated with good teaching practices rather than strategies that are specifically designed to benefit students with special needs. The data also showed that teachers are confident in their abilities, however they generally disagreed that their teacher training program prepared them to work with students with disabilities. Teacher training programs should focus on providing opportunities to work with students and to learn specific strategies for teaching students within this population. This research also suggests that there may be an opportunity for increased collaboration and co-teaching with special education.

Matthew Taggart and Josh Heitman
Graduate Program: Soil Science
Advisor: Josh Heitman

Do Surface Shading and Water Table Depth Significantly Affect Soil CO_2 Efflux in a Carolina Bay Histosol?

North Carolina has over 1.5 million acres of Histosols (organic soils) located in poorly drained areas along the lower coastal plain, Carolina bays, and pocosins. Restoration of hydrology and native plant communities in agricultural fields occupying Histosols will potentially result in net soil carbon sequestration and provide an economic incentive for

wetland restoration. Poor understanding of soil carbon sequestration (or continuing carbon loss) as hydrology is restored and floral succession proceeds is a chief hindrance to the sale of carbon credits, especially in organic soils. We hypothesized that average daily soil temperature will decrease with floral succession, as canopy density and surface shading increase, leading to a net reduction in microbial respiration and CO_2 efflux, especially when hydrology is restored and soils become reduced. An experiment was designed to test the combined effects of soil moisture and surface shading on carbon loss from a Carolina bay Histosol (Ponzer series). Intact soil cores were first placed on imposed water tables under three conditions of sunlight reduction: 0% (unshaded), 70%, and 90% for 60 d. Thereafter, shading treatments were maintained for an additional 30 d with water tables removed. CO_2 efflux was measured periodically with a portable photosynthesis analyzer using a soil respiration chamber. Redox potential and soil temperature were measured for the duration of the experiment. Preliminary results indicate CO_2 efflux differed significantly among shading treatments, $p < 0.0001$. CO_2 efflux of columns with imposed water tables differed significantly from those where no water table was present, $p = 0.0041$. There was no interaction between the two factors, $p = 0.4106$. Our results suggest that soil carbon loss will decrease as primary succession proceeds and hydrology is restored. Potential future research may investigate the degree of surface shading required to significantly reduce soil CO_2 efflux.

J. B. van Kretschmar, L. C. Magalhaes, J. Zhu, A. C. Cohen, and R. Michael Roe
Graduate Program: Entomology
Advisor: R. Michael Roe

Feasibility of a Novel Feeding Disruption Test (FDT) Bioassay Kit for Rapid Insecticide Resistance Detection of Sucking Pests of Cotton

With the eradication of the boll weevil, the development of narrow-spectrum insecticides for whitefly control, and the widespread adoption of Bt cotton in the last decade, several species of plant bugs (Miridae) and stink bugs (Pentatomidae) have become major pests of cotton. Reports of tarnished plant bug *Lygus lineolaris* (Palisot de Beauvois) resistance to several classes of cotton insecticides, and of variable insecticide susceptibilities of stink bug species that damage cotton, highlight the need for assays to monitor resistance. Assays in current use have several limitations. Topical assays used for plant bugs and stink bugs are limited to testing insecticides with contact activity. Except in the case of neonicotinoids, vial assays in current use for plant bugs require the addition of plant material as a food source and are limited to contact insecticides. Vial tests for stink bugs are limited to testing insecticides with contact activity. All of the topical and vial assays for these sucking pests rely on a mortality endpoint which is often not easy to read (requires probing the insect and/or discriminating between knockdown versus death) and un-necessarily extends the time to the assay endpoint. Feeding disruption test (FDT) bioassays circumvent these limitations. In FDT assays, insects feed on insecticide in rehydrateable artificial diet mealpads containing a blue indicator dye to mark feeding on the artificial diet. The assay endpoint is the dose-dependent amount of blue feces produced, usually within 24 hours. The objective of the work described in this paper was to determine the feasibility of developing FDT assays for plant bugs and stink bugs. Lab-strain adult tarnished plant bugs, *Lygus lineolaris* (Palisot de Beauvois), fed different concentrations of β-cyfluthrin and thiamethoxam in rehydrateable NI diet mealpads containing food-grade blue dye in FDT plates showed a dose-response in production of dyed feces for both insecticides. Lab-strain adult brown stink bugs, *Euchistus servus* (Say), fed different concentrations of thiamethoxam in nectar also showed a mortality dose response. Brown stink bugs fed NI diet containing food-grade blue dye produced dyed feces; this approach should also be applicable to resistance monitoring as was the case for the plant bug.

Jason R. Wilson, Paola Florez de Sessions, Megan Leon, and Frank Scholle
Graduate Program: Microbiology
Advisor: Frank Scholle

West Nile Virus Nonstructural Protein 1 Inhibits TLR-3 Signal Transduction

The innate immune response is the first line of defense against foreign pathogens. The recognition of virus-associated molecular patterns, including double and single stranded RNA (dsRNA and ssRNA), by pattern recognition receptors (PRRs) initiates a cascade of signaling reactions. These result in the transcriptional upregulation and secretion of proinflammatory cytokines that induce an antiviral state. Many viruses have evolved mechanisms to antagonize these responses in order to help them establish a productive infection. We have previously shown that West Nile virus (WNV)

is able to inhibit TLR3-mediated activation of IRF3 (Scholle F., and P.W. Mason. Virology 342 (1) November 2005, p77-87). In the present study, the WNV non-structural proteins were analyzed individually for their ability to antagonize signal transduction mediated by TLR3. We report that expression of WNV NS1 inhibits TLR3-induced transcriptional activation of the IFN-β promoter and of an NFkB responsive promoter. This inhibition was due to a failure of the TLR3 ligand pIC to induce nuclear translocation of IRF3 and NFkB. Furthermore, NS1 expression also inhibited TLR3-dependent production of IL-6 and the establishment of an antiviral state. The function of NS1 in flavivirus infection is not well understood. NS1 is required for viral RNA replication and is also secreted from mammalian cells but not from insect cells. Here we identify a previously unrecognized role for NS1 in the modulation of signaling pathways of the innate immune response to WNV infection.

Ryan J. Winston and William F. Hunt
Graduate Program: Biological and Agricultural Engineering
Advisor: William F. Hunt

Field Evaluation of Level Spreader – Vegetative Filter Strip Systems as a Tool for Low Impact Development

Urban stormwater management is critical for protecting North Carolina's water resources. Urbanization causes imbalances in the water cycle, including decreased groundwater recharge and evapotranspiration, and increased stormwater runoff. Low Impact Development (LID) incorporates innovative stormwater designs to reduce runoff volumes from impervious surfaces. This study quantifies the hydrologic and water quality benefits of one LID stormwater practice, the level spreader – vegetative filter strip (LS-VFS). To enhance the efficiency of a VFS, level spreaders are employed to distribute flow evenly across the width of the upstream end of a buffer. A field study of four LS – VFS systems was conducted at two small, urban watersheds in Louisburg and Apex, NC. At each site, stormwater was routed over two level spreaders and into either a 25 ft long grassed buffer or a 50 ft long, half grassed, half wooded buffer. Hydrology measurements and composite, flow-weighted water quality samples were taken at the inlet and outlet of each buffer. Water quality samples were analyzed for TKN, NO_3+NO_2, TN, NH_3, TP, Ortho-P, and TSS. To date, 57 storm events have been monitored for hydrology in Louisburg. Median flow volume reductions were 82.9% and 81.5% for the 25 ft and 50 ft long buffers, respectively. Median peak flow reductions were 83.1% and 85.2%, respectively. Thus far, 20 and 19 storms have been monitored for water quality at Louisburg and Apex, respectively. For all buffer treatments, reductions in median pollutant concentrations were observed for TKN, TN, and TSS, while other pollutants had mixed results. Median percent mass removal for the Louisburg buffers was greater than 65% for all pollutants studied due to large reductions in flow volumes. These results show that a carefully selected and designed LS – VFS can be an effective LID tool for controlling stormwater flow and its associated pollutants in small, urban watersheds.

Jiele Xu[1], Jay J. Cheng[1], Ratna R. Sharma-Shivappa[1], and Joseph C. Burns[2]
Graduate Programs: Biological and Agricultural Engineering[1]; Crop Science[2]
Advisor: Jay J. Cheng

NaOH Pretreatment of Switchgrass for Ethanol Production

Lignocellulose-to-ethanol conversion is a promising technology to supplement corn-based ethanol production. Switchgrass is regarded as a potential lignoncellulosic feedstock because of its high annual yield, adaptation to various soil and climate conditions, and low fertilizer, herbicide, and pesticide requirements for cultivation. To improve the enzymatic digestibility of lignocellulose, pretreatment is necessary as it breaks up lignocellulosic matrix, thus making the carbohydrate (cellulose and hemicelluloses) more accessible to cellulase enzymes in the following hydrolysis. In this study, NaOH was used as an alkaline reagent for the pretreatment of switchgrass. The impacts of temperature, NaOH concentration, and residence time on the pretreatment effectiveness were investigated. Raw switchgrass biomass at a solid loading of 10% was pretreated for 0.25-1h at 121^{o}C, 1-48h at 50^{o}C, and 1-96h at room temperature at different NaOH concentrations (0.5, 1.0, and 2.0%, w/v). Enzymatic hydrolysis of the pretreated biomass was conducted for sugar production and the total reducing sugar yield was used to determine the pretreatment effectiveness. The results showed that NaOH pretreatment could remarkably improve the enzymatic digestibility of switchgrass at all temperatures studied. Under the recommended conditions, the total reducing sugar yields reached 415.0, 433.4, and 411.7 mg/g raw biomass respectively at 121^{o}C, 50^{o}C, and room temperature, which were 3.27, 3.53 and 3.21 times as

much as that from untreated biomass. With the decrease of temperature, the NaOH concentration and/or residence time required for high sugar yields increased.

Saba Kawas
Graduate Program: Art and Design
Advisor: Patrick Fitzgerald

Hyper-Learning in 3D Virtual Worlds, Experimental Interface Design for Cobalt, A Croquet Metaverse

With today's increased interest in advanced digital networking and social online communities, many higher educational institutes have been exploring online three-dimensional virtual environments as a new medium for distance learning. These technologies provide: multiple features for online interaction and collaboration, a visual cyberspace for text and voice communication, the ability to stream real-time audio and video for a group of individuals, and the opportunity to link users to internal or external websites.

"Cobalt " is an emerging open-source, multi-platform, virtual environment established for those who are interested in creating sharable virtual world technologies supporting the need of education and research. It is built through a community-based effort. Cobalt is a highly collaborative multi-user cross-platform, and it provides flexible framework in which user interface concepts can be prototyped and deployed. There is, however, no current user interface or content, and it currently lacks hyper-linking metaphors.

The objective of this project is to conceptualize a user interface design for the "Cobalt metaverse" that will help to create a prototypical 3D navigational toolkit for effective distance learning. The theoretical framework is Influenced by the constructivist theories of Papert, and the inferential role theories of Pinker.

The hyper-learning project proposal is based on two core concept pillars:

The "Media Explanation Generator" essentially generates artificial intelligent 3D visual (with audio) explanations from a dynamic database. These explanations are manifested by the role of natural language generation, negotiated understanding and the use of shared knowledge and context.

"Contextualized Hyper Linking" is a means of creating visually organized links in order to help users select and filter information in an efficient manner. Influenced by Bruner's Categorization theory and by Wurman's LATCH organization system (location, alphabet, time, category, or hierarchy) our CHL system is represented by visually customizable hierarchical arrangement of icon and media to relate categories and content.

Marty Maxwell Lane
Graduate Program: Graphic Design
Advisors: Denise Gonzales Crisp and Meredith Davis

Online tools that assist high school students in determining credibility when researching online

According to research by the Massachusetts Institute of Technology (MIT), teens tend to rely on the look and feel of the presentation of information online to determine the content's credibility. As design technology has become more available, average users can create content and websites that look just as "professional" or "trustworthy" as traditional expert sources.

Many teens utilize the Internet for academic research because they desire the multiple perspectives it can provide. My current investigation seeks to develop online tools that assist high school students in critically sorting through the complexity of the visual presentation of online information. *How can online collective research teach students to analyze, interpret and judge visual language and attribute it to the source and the credibility of information?*

MIT researchers state four types of credibility assessment used in the online environment: experienced (relationship over time), reputed (third party recommendations), presumed (cultural or media based assumptions) and surface (look and feel of information). One of the goals of my investigation is to incorporate these assessments into the design of online environments.

This investigation seeks to explore ways in which high school students can be prepared to critique the multiple perspectives that the Internet provides. While this project focuses on high school students, the development process ensures transferability to other age groups and scenarios.

Alberto Rigau
Graduate Program: Graphic Design
Advisors: Meredith Davis and Martha Scotford

In what ways can design address consumption induced behaviors and provide a set of tools to help consumers manage, control, and personalize fiscal activities?

Credit cards have become an essential financial tool for individuals and families. In 2004, the Census Bureau reported that there were more than 1.4 billion credit cards for 164 million cardholders—*an average of 8.5 cards per cardholder, out of which 115 million carry a balance at the end of the month*. In the pre–credit card era, households used a pay–as–you–go accounting system. Today, if there is no cash to fill up the car, there is always the credit card. Such a reliance on this payment method generates experiential patterns, more than often translating into family debt. This investigation studies behaviors and patterns associated with credit card use to identify moments in which design intervention can bring about reflective thought about spending habits.

Yiannis Gabriel and Tim Lang, in *The Unmanageable Consumer*, argue that our actions and experiences as consumers cannot be detached from our actions and experiences as social, political and moral agents. They claim that the fragmentation and contradictions of contemporary consumption are part of the fragmentation and contradictions of contemporary living. It is not the case that at one moment we act as consumers and the next as workers or as citizens, as women or men or as members of ethnic groups. We are creative composites of simultaneous social categories, with histories, presents and futures. The authors see consumers as central characters of stories, many times exhibiting varied behaviors, such as those of explorers, choosers, communicators, identity-seekers, hedonists, victims, rebels, activists, or citizens.

This research focuses on evaluating some of the ways in which design can address these consumption induced behaviors and on proposing a set of tools to help consumers manage, control, and personalize fiscal activities.

Kimberly D. Royal and Robin Moore
Graduate Program: Landscape Architecture
Advisor: Robin Moore

Designing for Active Living: Can Landscape Design Provide an Environment that Promotes the Recommended Physical Activity levels

Landscape and planning design concentrated on vehicular travel to the increasingly sprawling suburbs. Residential areas became disconnected from work environments and essential businesses; there has been an astonishing rise in obesity with its related health diseases, a decrease in physical activity, also excessive land use and an increase in vehicular traffic. The solution is to plan and design on multi-levels our natural and urban environments for sustainability. Human behavior is an essential consideration when designing for sustainable urban environments. We have shaped our environment and in turn, it has shaped us. Currently, planners, public health departments and researchers are tackling the repercussions of built design one variable at a time Design changes can be ineffective and wasteful a multilevel interrelated variables that influence physical active behaviors are considered. Planners implement on a large scale for long-term city growth. Public health departments provide programs and countywide projects. The integration of the multi-levels of design can be addressed by Landscape Architecture. This design study focuses on (1) gathering the research on physical activity, behaviors, and active living design principles. (2) Recommend design elements for pedestrian travel and indicate the possibility of increasing physical activity levels for each element referencing the existing research. A town in the Southeastern United States that posses the base qualities of a town center and a multitude of houses built prior to 1973 was used as the basis for location of this study. These two factors have been found to contribute to physical activity levels, yet the level of their effect on physical activity would not be measurable in this type of study. This design study is in preparation for multi level active living design.

Jennifer Salazar and Evan Rogers
Graduate Program: Landscape Architecture
Advisor: Robin Moore

Designing dog parks for the people who use them: A case study of parks in Raleigh and Durham, NC

As the number of dog-owning households in the U.S. nears 45 million, the recent proliferation of off-leash dog parks has reflected this trend. While dog parks are primarily built to function as a space for pets, they also serve the owners who visit them, however, their design seldom addresses this important fact. The aim of this study was to understand why people use dog parks and to explore whether dog parks are adequately designed as spaces for people. A standardized questionnaire was developed and administered face-to-face in the field to a total of 133 park users. The factors investigated included the frequency and purpose of dog park visits, the distance traveled to the parks, the features of the space enjoyed by the users and suggested improvements to park design. Observations were also made to determine the average number of pet owners present during times of peak use. Data was collected over a series of four visits to each of the two dog parks. Analysis showed that most users visited the dog parks on a regular basis, at least once a week, and usage was not dependent on lack of access to a fenced yard at their residence. Many users were willing to travel more than five miles to visit well-liked parks. While the majority of individuals primarily used the park to exercise and socialize their pets, the data also indicates that friendship with other owners was an important benefit to dog park visits. These results suggest that improving dog park design by providing key features, such as adequate seating and shaded areas, will enhance the park users' experience and increase social interactions among pet owners.

Meredith J. D. Adams
Graduate Program: Educational Research and Policy Analysis
Advisor: Bonnie Fusarelli and Malina Monaco

Technology in the Classroom: Student Perceptions of Their Environment

As educational institutions strive to update their resources for teaching and learning in classrooms, they spend thousands of dollars trying to keep up with the ever-changing technologies. This study addressed the perceptions and preferences of students in technologically rich and technologically poor environments. Their perspectives were explored in two Spanish 101 courses during the Fall 2008 semester at a local four-year private college, where students were exposed to different classroom teaching methodological stimuli. One class met in a language laboratory in a one-to-one computer environment, and the second in a classroom without computers, projectors, or any other teaching and learning technologies. At the end of the semester, students anonymously completed an online survey, employing both closed and open-ended questions, to communicate their perspective on the topic to the researcher. Specifically, this poster examines the results in relation to the facilitation of the participants' language acquisition experience. Analysis of the data is preliminary; however, initial results point to the students' ability to adapt to and be comfortable in whatever environment they are assigned.

Frim Ampaw, Toni Cerbo, Kerri Mercer, and Dion Terry
Graduate Program: Adult and Higher Education
Advisor: Leila Gonzalez Sullivan

Best Practices for Improving Community College Climate: The Role of Leadership

In the field of higher education, community colleges have unique organizational climate challenges based on their three-fold missions, large numbers of part-time employees, and limited involvement of faculty and staff in institutional decision-making. Developing a healthy, positive climate requires deliberate action on the part of the college leadership and this research study seeks to understand how colleges achieve this goal. This study uses a mixed methods approach with a collective case study of several community colleges to determine the different ways colleges have pursued a healthy organizational climate. The quantitative section utilizes the Personal Assessment of the College Environment© (PACE) to measure the changes in college climate over time. Likewise, the qualitative section analyzes comments made by the employees, interviews with personnel at the institutional research office, and document analysis to answer the research questions.

Kim Bowen
Graduate Program: Curriculum and Instruction
Advisor: Ruie Pritchard

Reflective Judgment and Conceptions of Teaching and Learning English Language Arts

Describing the "knowing-doing gap," Reeves (2006) states "One inescapable conclusion from school reform research, however is that evidence alone is not enough….Leaders and teachers give intellectual assent to the research and …*nothing happens*" (emphasis in the original, p. 90). In high school English language arts classrooms, daily activities appear little different than those of 50 years ago; the students and the world may have changed, but in most cases, the teaching has not.

This research study explores North Carolina HS ELA teachers' beliefs and understanding about knowledge, teaching, and learning. Specifically, the overarching research question is *How and to what extent do ELA teachers' beliefs about the nature of knowledge correspond to their conceptions of teaching and learning?* Embedded within this study are questions about relationships between teacher demographic attributes and experience factors and their beliefs. Use of concurrent triangulation strategy, with both qualitative and quantitative measures, adds depth to the exploration of teacher beliefs and increases validity.

A convenience sample of 149 North Carolina HS ELA teachers completed the Reasoning about Current Issues Questionnaire (RCI), an instrument designed to assess personal epistemology. A subset of the initial sample completed a follow-up exercise responding to the Teacher Belief Q-Sort (TBQ), which assesses teacher beliefs and priorities about (1) discipline and behavior management, (2) classroom practices, and (3) students. Additionally, subjects constructed a metaphor about their teaching philosophies.

Person product moment correlation tests will be used to examine relationships between RCI scores and each of the TBQ factors. Constant comparative coding process will be used to explore possible themes emerging from the metaphor construction, which may further illustrate the teachers' epistemology and/or conceptions of teaching and learning.

Matthew P. Campbell
Graduate Program: Mathematics Education
Advisor: Hollylynne Lee

Mathematics Teachers and Professional Learning Communities: Understanding Professional Development in Collaborative Settings

As a result of the recent increased emphasis on mathematics professional development (MPD), studies have attempted to identify a set of features that are commonly part of successful MPD programs. While recommendations that professional development should be collaborative, sustained, and practice-based are common across all subjects, MPD is often highlighted by activities that address the specific needs of mathematics teachers. Professional learning communities (PLC) are also considered valuable for the growth of teachers. However, PLCs only provide a general guideline for how teachers can make meaningful changes to instruction, regardless of subject. In order for PLCs to be used as a form of MPD, more work needs to be done to identify the extent to which mathematics teachers in PLCs engage in the activities that improve their content and pedagogical knowledge and, ultimately, improve student achievement.

The study described here consists of an investigation of two teams of teachers attempting to implement principles of PLC as part of a district-wide intervention. The goal of this study was to discover both teams' success in implementing these principles and to what extent they engage in activities that are commonly found in effective MPD. To do this, the teams were observed during their set meeting time and individual teachers took part in interviews and surveys to further explicate the team dynamic as well as individual dispositions and values. Based on the findings, the role of PLCs as the sole source of professional development for mathematics teachers is questioned and other factors that could be attributed to a group of teachers' inclination to engage in activities found in effective MPD are highlighted. From this, the author offers suggestions for future research on collaborative MPD and how findings from such research could be used to inform the development and replication of MPD.

Cyndi Edgington
Graduate Program: Mathematics Education
Advisor: Allison McCulloch

Kindergarten Teachers' Mathematics Teaching Cycle: Attending to Issues of Culture and Student Understanding

The purpose of this study is to examine the mathematics teaching cycle of two kindergarten teachers with respect to culturally relevant pedagogy (CRP) and teaching mathematics for understanding. The study aims to address the lack of research on how teaching mathematics for understanding and attending to students' cultural backgrounds can effectively be incorporated into teachers' planning practices. The present study also examines if and how the teachers' enacted math lessons are consistent with the ideologies associated with CRP and teaching for understanding.

The participants for this study were two kindergarten teachers who participated for one year in a three-year professional development project. The data consisted of a lesson planning interview, lesson planning observation, video-taped math lessons, and a post-lesson reflective session.

The conceptual framework for this study considers Simon's (1995) mathematics teaching cycle as a way to describe the planning and teaching process. Within the mathematics teaching cycle, Ladson-Billings' (1995a) tenets of CRP and Hiebert, et al.'s (1997) dimensions of classrooms that support teaching for understanding are used as a lens to examine the participants' teaching cycles.

The findings from this study suggest that the teachers attend to many things during their lesson planning, including classroom activities and their students' backgrounds. Aspects of their enacted lessons were consistent with the ideologies associated with CRP and teaching for understanding, such as providing contexts that were meaningful for their students. Although the teachers encouraged students to develop their own strategies for solving problems, they did not value all of the strategies suggested by their students. If a goal of mathematics instruction is create a learning environment that is accessible to all students and where academic success is experienced by all students, the mathematics education community can learn from studies such as this how to make this goal a reality.

Grant E. Gardner
Graduate Program: Science Education
Advisor: Gail Jones

An Analysis of Science Instructors' Risk Perceptions: Implications for Science and Technology Education

Developing scientifically literate students is an important objective for science education at all levels. Although complex, one component of science literacy is an understanding of the interactions between science and technology and their interdependence on society (STS). Student attitudes about STS formed during their formal education greatly influence future behaviors. In the context of emergent technologies, such as biotechnology, perceptions of the risks associated with these technologies are a particularly critical polarizer of attitudes affecting consumer behavior, management of personal and social risks, and willingness to participate in discourse and decision-making about risk. Current research has examined attitudes of students toward emergent science and technology but has failed to address teacher attitudes beyond the pre-service level. Teacher attitudes are equally important to examine because they will shape the direction of STS pedagogy from which students will construct their own learning. The research describes a study in which four groups of science teachers; pre-service science teachers, in-service science teachers, science graduate teaching assistants, and science professors (n = 91) completed a survey and card sort task to determine their perceptions of the risks of biotechnology. Instruments assessed perceptions of risk and also factors that might contribute to the formed perceptions based on established risk perception research frameworks. The survey consisted of both Likert and open-ended items. For the card sort, participants were given cards containing examples of biotechnology applications and asked to sort them by how risky they felt each was. Collectively, the participants did not perceive high levels of risk from biotechnology applications. Factors shaping perceptions included severity of the risk, how potential risks would be regulated, public acceptance of research and development of the technology, fear, a balance of the benefits associated with the risk, whether the applications would impact humans or the environment, and whether the applications were intended for social betterment. Factors determining risk perception included personal worldviews, trust in communicating institutions, and personal experiences with biotechnology. Implications are discussed in the context of the role of attitudes and perceptions on STS pedagogy.

Erin Horne[1], Dina Walker-DeVose[1], and Tyrone Washington[2]
Graduate Programs: Curriculum, Instruction, and Counselor Education[1]; Mathematics Education[2]
Advisors: Alan J. Reiman and Hollylynne Lee

Novice Teachers' Perceptions of Their Preservice Programs

Beginning teachers' often report feeling abandoned by their preservice preparation programs. At the same time, they report feeling as if they are expected to do the same job as an experienced teacher when they first enter the classroom. For those reasons, the perception of novice educators about their preserivce program is valuable in filling the gap between preservice education and classroom teaching. The researchers in this study sought to understand novice teachers' perceptions of their preservice programs. For the purposes of this study, novice was defined as less than three years of professional teaching experience. The question guiding this study was: How do novice teachers perceive their preservice preparation program? Using qualitative methodology, the researchers conducted multiple case studies of novice teachers who had completed at least one year of teaching. These case studies were compiled using interviews of the novice teachers, observations of their classrooms, and document analysis of their preservice program transcripts. Findings included a need for congruence between theory and practice in coursework and the value these teachers placed on their field experiences. The results of the study contribute to creating a body of knowledge useful to preservice preparation institutions, school based teacher educators and administrators, as well as policy makers.

Sarah E. Ives
Graduate Program: Mathematics Education
Advisor: Hollylynne S. Lee

Preservice Teachers' Understanding of Teaching Probability: A Look at the Relationships between Beliefs, Content Knowledge, and Pedagogical Content Knowledge

In the past decade there has been a growing body of research pertaining to the teaching and learning of Probability and Statistics in grades K-12. There have been studies done on teachers' understanding and students' understanding, however there is a need for research on preservice teachers' understanding of the teaching and learning of probability and statistics. This research investigates the beliefs, content knowledge, and pedagogical content knowledge of 5 preservice secondary mathematics teachers. In particular this research aims to answer the question – what are the relationships between these three aspects and how does that impact teacher education? An exploratory multiple case study methodology was employed by selecting preservice teachers from a fourth year mathematics methods course on teaching mathematics with technology. The preservice teachers participated in three task-based interviews. Some of the tasks included analyzing student work, critiquing a video-taped teaching episode, and analyzing probability tasks. The interviews were then coded for themes among beliefs and orientations, content knowledge, and pedagogical content knowledge. Four orientations were found among the preservice teachers: statistical, mathematical, subjective and personal. Findings regarding the relationships between these orientations and the preservice teachers' content knowledge and pedagogical content knowledge are important for teacher educators to consider when preparing future teachers. These findings can be used in future research to discover ways to increase preservice teachers' knowledge of teaching and learning probability.

Sheryl Long
Graduate Program: Curriculum and Instruction
Advisors: Carol Pope and Carl Young

Enhancing Language Instruction through *Voices of North Carolina in the Classroom*

Voices of North Carolina in the Classroom was a joint effort of the College of Education and the College of Humanities and Social Sciences at NC State University and the local school system. This professional development initiative was funded through a grant from NC Quest (Quality Educators through Staff Development and Training across North Carolina). This initiative was built upon the language curriculum *Voices of North Carolina: Language and Life from the Atlantic to the Appalachians*, a research-based curriculum focusing on dialect and language variation. The project also implemented use of emerging technologies to enhance language instruction. Through a series of workshops, close

examination of the *Voices of North Carolina* curriculum, support in the use of newer technologies, and inquiry-based projects conducted with their students, teachers were given the opportunity to examine their personal beliefs about language, both the language they employ and that spoken by their students, and to implement instructional strategies that promote an awareness of language variation. Drawing from both quantitative and qualitative data, this project explored how a research-based curriculum, new literacies, and emerging technologies affect teachers' perceptions of language and language instruction. Research methods included quantitative analysis of descriptive statistics and comparative survey data and qualitative analysis of open-ended survey questions, participant reflections, site visit reports, and the external evaluator's report. Data analysis is ongoing, but current results suggest that this professional development initiative increased teachers' appreciation of language variation and that teachers needed direct support in order to integrate new technologies with language instruction.

Maura J. Murphy
Graduate Program: Adult and Higher Education
Advisor: Alyssa N. Bryant

Contingent faculty: What impacts their organizational commitment?

Since the 1980s, the percentage of non-tenured faculty has increased on college campuses. However, while contingent faculty are often hired to address short-term staffing issues, the long-term impacts are not assessed. Institutions need a better understanding of how institutional practices impact the job performance of contingent faculty. The purpose of this study is to examine what institutional practices predict organizational commitment among contingent faculty, compared to tenured/tenure-track faculty. While several studies conclude that contingent faculty are less committed than tenured/tenure-track faculty, there is little data to suggest how institutional practices may be impacting the organizational commitment of contingent faculty. Using ANOVA and OLS regression this study seeks to understand how do part-time contingent faculty and full-time contingent faculty each compare to tenured/tenure-track faculty in their level of organizational commitment at four-year institutions. Additionally, what institutional practices, particularly relating to recognition, support, compensation, and shared governance, predict organizational commitment among full- and part-time contingent faculty? While the findings are somewhat mixed, there is evidence to support the hypothesis of the study that institutional practices relating to recognition, support, compensation, and shared governance will build the organizational commitment of contingent faculty.

Fadhel Azeez
Graduate Program: Chemical and Biomolecular Engineering
Advisor: Peter Fedkiw

Lithium Bis(Oxalato)Borate (LiBOB)-Based Electrolyte for Lithium-Ion Batteries

The need for compact, light-weight rechargeable batteries offering high-energy densities has become necessary in the 21st century especially for portable electronic devices, hybrid electric vehicles, and load leveling in electric power generation /distribution. Among rechargeable batteries, lithium-based systems are capable to fulfill these needs. The current state-of-art electrolyte for lithium-ion batteries, which consists of $LiPF_6$ dissolved in organic-carbonate solvents, has disadvantages in low- and high- temperature environments.

In order to improve the performance and enhance the safety of current lithium-ion batteries, a candidate electrolyte for these batteries is investigated. The electrolyte consists of lithium bis(oxalato)borate (LiBOB) salt dissolved in a mixture of organic solvents consisting of γ-butyrolactone (GBL), ethyl acetate (EA), and ethylene carbonate (EC). In addition, fumed silica is included to improve mechanical properties of the electrolyte.

Results show that LiBOB in a mixture of GBL/EA/EC yields a technologically acceptable conductivity, and upon adding fumed silica, a 3-D network structure (solid-like structure) is formed that improves the rheological properties of the electrolyte and safety of Li-ion batteries without greatly affecting conductivity. In addition, results show that LiBOB-based electrolyte can be used with other cathodes (beside $LiCoO_2$) such as $LiMn_2O_4$ and $LiFePO_4$ and give excellent performance unlike $LiPF_6$-based electrolyte, which can be used only with $LiCoO_2$. Based on all of the above, Using LiBOB-based electrolyte may lower the cost, enhance the safety and improve the performance of the current lithium-ion batteries.

Byung-Chull (Leo) Bae
Graduate Program: Computer Science
Advisor: R. Michael Young

Prevoyant: A Planning-Based Computational Model of Flashback and Foreshadowing for Surprise Arousal in Narrative

This research describes work to develop a planning-based computational method for generating flashback and foreshadowing, specifically targeted at the evocation of surprise in the mind of a reader. While surprise plays an important role for attention focusing, learning, and creativity, less effort has been made to build a computational method for surprise arousal in narrative. In our model, flashback provides a backstory to explain what causes a surprising outcome, while foreshadowing provides an implicit hint about the surprise before it occurs. In this work we focus on the arousal of surprise as a cognitive emotion which is based on a reader's cognitive appraisal of a given situation.

Prevoyant, the proposed system, consists of three main components – the generator, the evaluator, and the implementer. The generator takes as input a story – defined by a plan data structure – and produces foreshadowing and flashback content to be added to the story. Flashback content is selected based on causal relationships between events in the story plan. Foreshadowing content is selected to give an implicit hint about the flashback. The evaluator tests each potential flashback or foreshadowing produced by the generator to determine if it will contribute to evoking surprise in the reader's mind. To this end, the evaluator checks unexpectedness and emotional valence using a reader model. Given a temporally reconstructed story plan with flashback and foreshadowing, the implementer manifests it in a specific medium. The current implementer uses a template-based approach in which plan steps are mapped to sentences in text. In near future, we plan to use a 3D game engine to convert the story plan into a script that can be executed as a series of actions in an interactive virtual environment.

Maria Vicente Bonto-Kane and Robert St. Amant
Graduate Program: Computer Science
Advisor: Robert St. Amant

Probabilistic, Computational Modeling and Empirical Approaches Help Guide Design Efforts for Usability

This research describes the innovative approach of using a combination of probabilistic, computational, and formal modeling techniques to guide design efforts for usability. We demonstrate the utility of a not so often used approach, the use of probabilistic models to impact design. This was done by monitoring frequency of use of operations and rearranging the layout of an application interface so that it is optimized around more frequently accessed operations. A candidate interface was then designed around the computational, probabilistic model recommendations for what would be most facilitative for this activity. The result was an interface that performed optimally per model predictions. Additionally, live user testing was done to verify or refute model predictions. Empirical observations supported model predictions. This research shows that formal modeling techniques (i.e. GOMS, Fitts Law) remain a viable path but that supplementing it with probabilistic and computational methods leads to better more systematic techniques in designing and evaluating of interfaces. What is more, these methods are quick and inexpensive compared to the more time-consuming and costly method of live user testing.

Gheorghe Bunget, Stefan Seelecke, and Thomas J. Place
Graduate Program: Mechanical Engineering
Advisor: Stefan Seelecke

BATMAV – A Biologically-Inspired Micro-Air Vehicle for Flapping Flight

In the past decade Micro-Aerial Vehicles (MAVs) have drawn a great interest especially for applications where maneuverability in confined spaces is necessary, as in internal inspection of pipes, exploration in collapsed buildings and surveillance of indoor environments. Due to the availability of small sensors, MAVs can be used for detection missions of biological, chemical and nuclear agents. Traditionally these devices used fixed or rotary wings, actuated with electric DC motor-transmission, a system which brings the disadvantage of a heavier platform. The overall objective of the BATMAV project is the development of a biologically inspired bat-like Micro-Aerial Vehicle (MAV) with

flexible and foldable wings, capable of flapping flight. This poster presents the flight platform that features bat-inspired wings with a number of flexible joints that allow mimicking the kinematics of the real mammalian flyer. The bat was chosen after an extensive analysis of the flight physics of small birds, bats and large insects characterized by superior aerodynamic performance and maneuverability. The kinematic analysis of flight platform showed that a 3-DOF kinematic engineering model can mimic the flapping flight of the natural flier. Bat skeleton measurements were taken, modeled in SolidWorks that accurately reproduced bones and the bat body via rapid-prototyping machines. The flexible joints of the bat wing were modeled using smart materials like superelastic Shape Memory Alloy (SMA) wires. The bat flight muscles that have a significant contribution in flapping motion were identified and modeled using 50 microns Nitinol wires. The attachment locations of these 'artificial-muscles' and their routes along the bones were optimally chosen in order to generate wing trajectories similar to the natural flier.

Hyung-Wook Choi[1], H. Christopher Frey[1], Ewan Pritchard[2], and Josh Lawrence[3]
Graduate Program: Civil, Construction, and Environmental Engineering, North Carolina State University[1]; Advanced Transportation Energy Center[2]; Advanced Energy[3]
Advisor: H. Christopher Frey

In-use Measurement of the Activity, Energy Use, and Emissions of a Plug-in Electric Hybrid Vehicle

The purpose of this study is to demonstrate methodology for characterization of a plug-in hybrid electric vehicle (PHEV), taking into account gasoline and electricity consumption and emissions associated with each. Field measurements were made of a Toyota Prius with 1.5 liter gasoline engine, Hybrid Synergy Drive (HSD) system with an original battery, and retrofitted Hymotion plug-in system with a second battery. The PHEV initially operates in charge-depleting mode (CD) until the Hymotion battery charge reaches a set point, after which it operates in charge-sustaining mode (CS) using only the original battery. Three systems were used for in-use monitoring of the PHEV: (a) electronic download from the hybrid control system interface for factors such as battery charge, voltage, and current, and on-board diagnostic (OBD) data such as engine RPM, manifold absolute pressure, intake air temperature, road speed, and others; (b) portable emission monitoring system (PEMS) measurement of exhaust gas concentrations; and (c) GPS monitoring of coordinates and of altitude using a barometric altimeter. These data were used to characterize the activity of the PHEV, the energy flow associated with the batteries and diesel engine, and the tailpipe emissions. Results are presented based on in-use data collection for real-world driving cycles, in order to demonstrate methodology for integrated analysis of a plug-in hybrid system. Fuel economies for CD and CS modes were approximately 60 and 40 mpg. The indirect electricity emission factors were estimated based on EPA eGRID and National Emission Inventory data. An engine load-based model based on vehicle-specific power (VSP) was developed to explain variation in battery current, fuel use and emission rates based on the real-world data.

David French
Graduate Program: Aerospace Engineering
Advisor: Andre P. Mazzoleni

Diversion of an Earth-Threatening Near Earth Object Using a Long Tether and Ballast

To date, NASA's "Near Earth Object Program" has discovered over 5500 comets and asteroids on trajectories that bring them within "the neighborhood" of Earth's orbit. Nearly 1000 of these objects are classified as "potentially hazardous," passing within 0.05 astronomical units (about 20 times the distance from the Earth to the Moon) of Earth's orbit. Discovery rates of such threatening bodies increase each year. Given this multitude of threats, in addition to evidence that the planet has absorbed many impacts over its history, it is reasonable to assume that another object will strike the Earth at some point in the future. Consequently, researchers have studied and proposed several mitigation techniques for such an occurrence. This study seeks to determine how effectively the attachment of a tether and ballast mass would divert the trajectory of such threatening objects. Specifically, the study analyzes the effects over time of such a system on objects of varying orbital semimajor axis (orbit size) and eccentricity (orbit shape), using various tether lengths and ballast masses. This numerical study was conducted using MATLAB to propagate equations of motion that simulate the motion of an asteroid-tether-ballast system and compare the results to the same asteroid when untethered. It has been determined that the technique is most effective for NEOs with high eccentricity and small semimajor axis, and that system performance increases as tether length and ballast mass increase.

Sumit Gangwal[1], Olivier J. Cayre[1], Martin Z. Bazant[2], and Orlin D. Velev[1]
Graduate Programs: Chemical and Biomolecular Engineering, North Carolina State University[1]; Department of Mathematics and Institute for Soldier Nanotechnologies, Massachusetts Institute of Technology[2]
Advisor: Orlin D. Velev

Dielectrophoretic and electrokinetic behavior of "Janus" particles in AC electric fields

Anisotropic "Janus" particles with two hemispheres of different polarizability or charge demonstrate a multitude of interesting phenomena in external fields. Janus particles were prepared by coating dielectric microspheres with a conductive metal layer on one hemisphere. The phase space for AC electric field intensity and field frequency was explored for these particles on a glass surface between two electrodes. A rich variety of structures and dynamics were uncovered, which are different than the ones in the directed dielectrophoretic assembly of plain dielectric or plain conductive particles. The application of low frequency (100 Hz–10 kHz) AC electric fields in aqueous suspensions of the Janus particles leads to unbalanced liquid flows and nonlinear, induced-charge electrophoretic motion. The electrokinetic motion is perpendicular to the field axis and persists after particles are attracted to a glass wall. At AC field frequencies above 10 kHz, the metallodielectric particles assemble into new types of chain structures, where the metallized halves of neighboring particles align into lanes along the direction of the electric field, while the dielectric halves face in alternating direction. The staggered chains may assemble in various orientations to form different types of two-dimensional metallodielectric crystals. The experimental results on the formation of staggered chains were interpreted by means of numerical simulations of the electric energy of the system. The assembly of Janus metallodielectric particles may find applications in liquid-borne microcircuits and materials with directional electric and heat transfer. The electrokinetic motion of the particles may find applications in microactuators, microsensors, and microfluidic devices.

Arif O. Gozen[1], Richard J. Spontak[1,2], and Jan Genzer[1]
Graduate Programs: Chemical and Biomolecular Engineering[1]; Materials Science and Engineering[2]
Advisors: Richard J. Spontak and Jan Genzer

Effect of Block Length on Interfacial Structure and Segregation of Diblock Copolymers at Immiscible Polymer/Polymer Interfaces

We investigate the interfacial partitioning of poly(styrene-b-methyl methacrylate) (SM) diblock copolymers at interfaces between thin planar films of polystyrene (PS) and poly(methyl methacrylate) (PMMA) homopolymers. When copolymers with constant PS and varying PMMA block lengths are incorporated into the top PS layer, the resulting dewetting kinetics decrease by reducing the length of the PMMA block and increasing the molecular weight of the host PS homopolymer. Similar behavior is observed when the SM copolymers are added to the bottom PMMA homopolymer. The dewetting kinetics of systems with equimass mixtures of asymmetric copolymers added in the PS homopolymer lie between those of the individual copolymers. Systems incorporating SM copolymers possessing short PS blocks and long PMMA blocks, exhibit dewetting rates that are higher than those of the copolymer-free PS/PMMA bilayer This behavior is attributed to the segregation of SM micelles that segregate to the free film/air interface and destabilize the film.

Sarah Heckman
Graduate Program: Computer Science
Advisor: Laurie Williams

Model for Identifying Actionable Code-Based Static Analysis Alerts

Static analysis tools automate the inspection of source code and find common coding problems, like null pointer accesses and unclosed streams, early in the development process. Alerts of potential coding problems generated by static analysis tools require inspection by a developer to determine if the alert is a problem worth fixing (actionable) or not (unactionable) Unactionable alerts may be due to incorrect analysis or identification of an unimportant coding problem. Static analysis tools may generate an overwhelming number of alerts, the majority of which are likely to be unactionable. The goal of my research is to improve product quality and programmer productivity by increasing the rate of actionable alert removal when using static analysis tools in process by creating and validating an actionable alert

identification model. Machine learning techniques applied to the historical usage of static analysis can build models that may predict which alerts are actionable. A case study on two open source applications found that characteristics about software artifacts (e.g. the alert's location, static code metrics like size, and time metrics like the age of the alert) are predictive of actionable alerts. Additionally, the key characteristics for an actionable alert identification model and the selected models themselves vary by project; therefore, actionable alert identification models should be project specific. The models built on the two open source projects identified actionable and unactionable alerts with an average of 88-97% accuracy, 89-98% precision, and 83-99% recall. On average, fewer than three actionable alerts were incorrectly classified as unactionable and fewer than two unactionable alerts were incorrectly classified as actionable out of 37-38 and 79-80 alerts tested for the two projects.

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Advisor: Edward Grant

Design of a Closed-Loop Compression System to Improve Circulation in the Lower Extremities

Compression stockings are used to treat a number of vascular conditions ranging from tired, aching legs to lymphedema, ulcer and would care, and prevention of deep venous thrombosis (DVT). Owing to the diverse nature of these pathologies, significantly different treatment protocols are required. In order to account for this, a closed-loop control system has been proposed that would alter the amount of compression delivered based upon measured physiological variables. Furthermore, this system is expected to allow researchers to gather information related to the performance of the vascular system outside of the clinic.

This project, which is still in the preliminary stages of development, has been divided into two modules: (1) a pneumatically-regulated compression stocking (Carolon Company, Rural Hall, NC) and (2) a sensing sleeve (Center for Robotics and Intelligent Machines, North Carolina State University). With respect to the stocking, small diameter silicon tubing will be knitted into the fabric, and micro-pumps will be used to supply the needed pressure. The sensing sleeve will incorporate physiological sensors designed around the CRIM-Mote technology developed at the Center for Robotics and Intelligent Machines. The CRIM-Mote consists of a generic wireless communication module that can be paired with custom sensors. This platform will be used to measure relevant variables such as leg volume, skin temperature, etc.

To date, a leg volume measurement system has been tested on a limited set of participants. This platform was able to resolve small changes in leg volume. An acoustic array to monitor flow velocity was also built and tested, however this system was unable to measure venous blood flow. As a result, a portable ultrasound system is currently being developed to better measure blood flow velocity. Upon completion of this device, large-scale testing will begin.

Stuart Heinrich
Graduate Program: Computer Science
Advisor: Wesley Snyder

Finding Image Correspondences for 3D Reconstruction

Given images from multiple views of the same scene, it is possible to reconstruct 3D scene structure, camera parameters and camera motion, but only if reliable correspondences between the images can be found. The ability to recover this 3D information has many interesting applications, such as machine learning and recognition of objects based on shape, navigation and collision avoidance, 3D compositing, camera tracking and stabilization, to name a few. However, computing reliable dense correspondence maps remains an extremely challenging and computationally intensive process. Until this problem can be solved in a reliable and efficient manner, the applicability of reconstruction is limited. Towards that end, a new segment-based framework for computing dense correspondence maps is proposed that improves accuracy, precision, and dramatically reduces computational cost of state of the art dense stereo correspondence algorithms. This opens up new possibilities by making these same algorithms computationally practical when the true epipolar geometry is unknown, and without relying on error-prone estimation of the epipolar geometry.

Alexander C. Hummel
Graduate Program: Mechanical Engineering
Advisors: Kevin Lyons and Roger Barker

Flame and Thermal Threats to Soldiers in the Field and Protective Gear Characterization

The increase in Improvised Explosive Devices (IED's) and other more sophisticated munitions devices in the Iraqi and Afghan theatres has led to significant thermal injuries to Soldiers in the field. Soldiers can be exposed to flash fire conditions at any given moment and therefore must be equipped with the proper protective gear to prevent serious burns. All protective garments must be analyzed with a variety of thermal tests, many of which are located on the campus of North Carolina State University's College of Textiles. These test methods include, but are not limited to: Thermal Protection Performance (TPP), Radiant Protective Performance (RPP), Pyroman®, and the newly created Pyrohands®. These tests will provide a basis of information on the performance of different materials and ensembles when exposed to high heat conditions. The Pyroman® test facility in particular tests uniform ensembles for flash fire conditions between 4 and 12 seconds, and provides important feedback on not only what the Soldiers wear, but how they should wear it for maximum protection. With nearly 75% of the burn injuries in the Iraqi and Afghan wars resulting in burns to the hands, a set of model hands (Pyrohands®) were developed to be used in the same chamber that houses Pyroman®. All of these tools make it possible to characterize the performance of thermal protective equipment issued to Soldiers, and further research is currently being performed to improve both the accuracy and realism associated with these exposures. It is anticipated that this research will lead to guidelines for better protective gear and improved models of flame threats and characterization of skin burns.

Jordan W. Hutchinson
Graduate Program: Biomedical Engineering, North Carolina State University/University of North Carolina, Chapel Hill
Advisor: Charles C. Finley

Speech-Evoked Brainstem Responses in Cochlear Implant Patients

A system for recording and analyzing speech-evoked potentials from the auditory brainstem of patients with a cochlear implant (CI) was developed. The system is used to assess complex speech signal encoding by enabling linear measurements of CI generated electrical artifact and biological signals from the scalp of CI subjects. These signals are processed in the frequency domain in order to isolate the low-level biological responses from the high-magnitude, confounding electrical artifact signals. Analysis of the biological responses will provide a better understanding of the basis of the variability in speech perception performance in CI subjects. Harnessing the combined power of the LabVIEW™ graphical programming language via a PC and a high resolution (24 bits), high bandwidth (2.5 MHz) analog-to-digital converter (A/D), an integrated environment has been created. The speech stimulus signal is generated by an external arbitrary waveform generator and fed to the subject's CI speech processor. Auditory evoked potentials in response to speech stimuli are recorded via scalp electrodes, amplified, filtered and fed to the A/D. All hardware handshaking is done via an external trigger to ensure the speech stimulus presentation and biological response recording begin synchronously in time. The auditory brainstem response to speech mimics the acoustic characteristics of the speech signal. Using a /da/ syllable to elicit the brainstem response, which consists of transient and periodic neural activity, we assess the speech encoding accuracy of multichannel, vocoder-based, speech processing strategies in individual CI subjects. Overall, the auditory brainstem response to speech provides a way to access subcortical auditory processing mechanisms and has been shown useful as a biological marker of deficient sound encoding associated with learning and auditory processing disorders. The technique will be especially valuable as an objective measurement tool for programming speech processors for very young children.

Fatih Irdem and Baris Kacar
Graduate Program: Industrial and Systems Engineering
Advisor: Reha Uzsoy

Comparison of Iterative Simulation-Optimization Algorithms for Production Planning of A Semiconductor Manufacturing Line

It is well known from queueing and simulation models that cycle times in capacitated production systems increase nonlinearly with resource utilization, which poses considerable difficulty for the conventional linear programming (LP)

models used for this purpose. Hung and Leachman (1996) propose a highly intuitive iterative approach where a detailed simulation model of the production facility is used to estimate flow time parameters used in an LP model. In another study, Kim and Kim (2001) use a similar iterative approach as Hung and Leachman in which they identify the actual workload of the jobs and utilization from the simulation. These parameters are passed to the LP model to obtain the capacity-feasible production plan. We examine the convergence of these algorithms under different experimental conditions, and make a comparison between these two algorithms for a semiconductor manufacturing line.

Aaron C. Johnston-Peck, Junwei Wang, and Joseph B. Tracy
Graduate Program: Materials Science and Engineering
Advisor: Joseph B. Tracy

Synthesis and structural and magnetic characterization of Ni(core)/NiO(shell) nanoparticles

Ferromagnets in contact with antiferromagnets can experience enhanced magnetic anisotropy through pinning caused by exchange bias (EB), which is routinely employed in spintronic devices and may be useful for future magnetic media. Magnetic property measurements in dimensionally- confined systems contribute to a greater understanding of EB. We have synthesized a size series of Ni(core)/NiO(shell) NPs by first performing solution-phase preparation of Ni NPs and then oxidizing them by bubbling air into NP solutions at elevated temperatures, which leads to the formation of amorphous, antiferromagnetic NiO layers that are ~2-3 nm thick. Structural and magnetic property measurements were performed before and after oxidation with transmission electron microscopy and SQUID magnetometry to give a comprehensive assessment of the magnetic properties: The magnetocrystalline anisotropy increases significantly with decreasing size for samples with native and purposeful oxidation. The NiO layer is too thin to give rise to substantial EB. Unlike layers of CoO on Co NP cores of similar thickness, no exchange shift and only a weak enhancement of the coercivity were observed for purposefully oxidized Ni(core)/NiO(shell) NPs, which is consistent with the lower magnetocrystalline anisotropy of NiO as compared with CoO.

Ali Kefeli and Reha Uzsoy
Graduate Program: Industrial and Systems Engineering
Advisor: Reha Uzsoy

Overhead Allocation in Health Care via Congestion Prone Mathematical Planning Models

With the recent economic downturn, understanding the sources of the different costs of goods and services and managing them appropriately has become even more crucial to business success. Now more than ever, a hospital needs to know how much a certain patient costs to serve or a plant manager needs to know how much introducing a new product is going to cost the firm. Accurate information on the costs of providing goods and services is critical to many aspects of the firm, including operations management, efficient resource allocation, and pricing, among many others. Different types of cost reporting may, for example, be mandated by law, or be useful for motivating and incentivizing employees and managers to act in the firm's best interest. Determination of costs is also important since many firms set prices on products or services based on their full costs. Although body of literature on cost accounting is extensive, research that has focused on mathematical programming models are of particular interest as they are derived from a rational model of maximizing a particular objective for the firm and they implicitly model all feasible production opportunities. However, some interesting accounting research conducted in the past does not incorporate recent developments in these types of production planning and resource allocation models. In particular, the incorporation of nonlinear congestion effects into classical linear programming models of production and service systems has significant implications for cost allocation schemes that utilize simple capacity constraints.

In this preliminary work, we use a simplified health care delivery system model that incorporates congestion and show the advantage of improved dual prices, provided by those enhanced planning models, in allocating overhead costs to patients.

Matthew R. King, Christopher J. Oldham, Jenna R. Puckett, C. Richard Guarnieri, and Jerome J. Cuomo
Graduate Program: Materials Science and Engineering
Advisor: Jerry Cuomo

"Acid on Demand": An Environmentally Sound Solution for Printed Circuit Board (PCB) Production

The utility of atmospheric pressure plasmas is well known within the research community; however, relatively few applications have made their way into the public domain. One well known device is the plasma arc, which is primarily used for welding and cutting metal. Past research has focused mainly on arc performance in these applications, with less attention to its chemical properties. The current work exploits a modified version of this versatile device for synthesis of nitrogen dioxide (NO_2) from air. Although this has been previously demonstrated, we have developed a more efficient process for NO_2 synthesis. By optimizing the relevant process variables for NO_2 synthesis, we developed a system for production of nitric acid (HNO_3) called "acid on demand". Multiple process variables were studied—gas composition, applied power, driving frequency, gas temperature, plasma temperature, radical chemistry, and reaction kinetics. The production of NO_2 was found to depend predominately on the temperature differential between the plasma and ambient gas. The extent to which the NO_2-forming reactions proceed also depends on the availability of atomic oxygen (O) and nitric oxide (NO).

As a result of this research, we find the "acid on demand" system can be successfully implemented in the microelectronics industry. Copper etching is a critical process in the production of printed circuit boards (PCB's), and the "acid on demand" system is found to be extremely effective at copper removal. Conventional processes can involve significant consumption of water, acid and energy, and can also lead to high transportation and waste disposal costs. We find the "acid on-demand" system can be an energy efficient and environmentally sound process that lives up to the high demands of the electronic systems field.

James Kribs, M. Sean June, and Kevin M. Lyons
Graduate Program: Mechanical Engineering
Advisor: Kevin M. Lyons

Effects of Geometry in Electrostatic Air Flows

It has been discussed that electrostatic and plasma assisted devices have a wide variety of uses in the future as methods of control of flows, previously controlled by only mechanical means. To create an ionic or electrostatic flow within atmospheric air, the high voltages are created by the coronas, which ionize the particle around them, resulting in a flow towards a grounded object. While the effects of voltage, current, and separation distances are well documented, the effects of multiple corona discharges and the alteration of parameters, such as the collection plate area, in ionic or electrostatic flows have not been as thoroughly investigated. In experiments with a focus on the viability of applying the ionic wind as a cooling mechanism, using a short annulus as the grounded collection plate for the corona discharges, it was found that there is a relationship between the size of the grounded ring and the velocity of the flow caused by the corona discharge, finding that maintaining voltage as a constant, a smaller ring provides higher efficiencies, while larger rings provide high flow rates at larger static pressures. Further research is being conducted on the interacting influence of multiple corona discharges on the velocity and the effects of static pressure in air as well as combustible flows.

Kyoung O. Lee
Graduate Program: Nuclear Engineering
Advisor: Mohamed A. Bourham

Plasma Parameters and Energy Balance in an Atmospheric Pressure Discharge

Generation of atmospheric pressure plasma in a concentric Dielectric Barrier Discharge (DBD) cylindrical configuration is described and discussed in detail. The system is a capacitor-like discharge designed and developed for the continuous treatment of textile yarns and filaments. The discharge operates with helium as the seed gas with adjustable percentages of oxygen as the main reactive plasma gas. The device operates at low, audio, frequency in the range of 3~11 kHz. Plasma generation, behavior and parameters were experimentally studied, particularly the micro-streamers formed inside the plasma. Electron kinetic temperature was measured using optical emission spectroscopy (OES) and compared to a developed energy balance model for a quasi-steady-state discharge. A model was also developed to

calculate the electron number density form the measured values of the discharge current and voltage. It is determined that the plasma temperature can be controlled by controlling the input power and gas flow rates. Experiments have shown the feasibility of such system to treat textile yarns and filaments in steady-state or in continuous-feed exposures. Scanning electron microscopy (SEM) of the surface of the treated yarns show surface smoothness, which is attributed to surface etching and possible oxidation.

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Advisor: Peter L. Mente

Cerclage Wire Stabilization of Femoral Fractures During Cementless Total Hip Arthroplasty in Canines

An intra-operative fracture during an uncemented Total Hip Arthroplasty can result in an unstable implant and subsidence. This study evaluated the ability of double loop cerclage wire(s) to restore implant-bone interface stability after fracture. Nine canine femora were harvested and prepared for implantation of an uncemented femoral stem (BFX™, BioMedtrix, Boonton, NJ). Using a hydraulic load frame, the implant was driven to a clinical height using 3 seating impactions, and was then loaded axially to failure. Once a fracture occurred, the implant was extracted, the femur was repaired with appropriate cerclage, re-broached, and an implant was re-implanted. The repaired specimen was then subjected to the same test regimen. The load to initiate subsidence, and relative subsidence distance at equivalent loads were compared between intact (pre-fracture) and repaired (post-fracture) specimens using ANOVA. The wired specimens required a higher force to initiate subsidence than the intact specimens (2378.8N±656.9N c.f. 1705.1N ± 584.5N; p=0.0019). Furthermore, the difference in relative subsidence between wired specimens and intact specimens was not (1.79 ± 2.99mm c.f. 3.99 ± 2.09mm; p= 0.0907). Cerclage wiring of intra-operative femoral fractures was able to restore the integrity of the femur and enable a stable implant-bone interface to be achieved.

Jeong-Seok Na, Giovanna Scarel, and Gregory N. Parsons
Graduate Program: Chemical and Biomolecular Engineering
Advisor: Gregory N. Parsons

Real-Time Nanometer-Scale Analysis of Surface Reactions and Dopant Activation in Low Temperature Atomic Layer Deposition of Zinc Oxide and Aluminum-Doped Zinc Oxide

A transparent conducting oxide semiconductor, zinc oxide (ZnO), has attracted considerable attention due to numerous applications to transparent thin film transistor, light emitting diodes, photovoltaic devices and chemical sensors, and is also considered as one of alternatives to conventional indium-tin-oxide (ITO) owing to the cost and scarcity of indium. The extrinsic doping of ZnO film has been used to improve not only bulk conductivity, but also sensitivity to conductivity change upon adsorption of some gases. However, the mechanisms associated with dopant atom incorporation, and the relations between surface reactions and dopant atom incorporation and activation in extrinsically doped ZnO are not well known. In this work, intrinsic and extrinsically doped ZnO films are fabricated using atomic layer deposition (ALD) technique, which allows the resulting film thickness and composition to be controlled with near monolayer precision. In situ analysis tools such as quartz crystal microbalance and conductance measurements are utilized to examine surface reaction mechanisms during low temperature ALD of ZnO and aluminum doped ZnO. Conductance measured in situ during ZnO ALD is observed to oscillate with species surface adsorption, consistent with surface potential modulation and charge transfer during surface reaction. Dopant introduction using trimethyl aluminum results in a decreased growth rate and a decrease in the net material conductance, followed by growth rate recovery and conductance increase. The trends in growth and conductance are ascribed to excess surface Al–O bonding after TMA exposure, followed by doping development as dopants transition to the film bulk. A non–uniform dopant atom distribution in the direction of film growth is observed and supports the doping model. The results expand fundamental understanding of doping-associated changes in film deposition and conductivity.

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Advisors: Gregory Buckner and Denis Cormier

A Shape Memory Alloy Annuloplasty Band for Robot-Assisted Mitral Valve Repair

Due to physical limitations, commercial semi-rigid annuloplasty rings cannot be deployed through the 8 mm trocar used in minimally invasive, robot-assisted surgeries. Instead, less-effective flexible rings are utilized. An *in vitro* study using explanted porcine hearts was conducted to evaluate a novel annuloplasty band, reinforced with a two-phase shape memory alloy, designed specifically for robot-assisted mitral valve repair. In its rigid (austenitic) phase, this band provides the same mechanical properties as commercial semi-rigid bands. In its compliant (martensitic) phase, this band is flexible enough to be introduced through an 8 mm trocar and is easily manipulated within the heart. In its rigid phase, the prototype band displayed similar mechanical properties to commercially available semi-rigid rings. Dynamic flow testing, performed in a custom designed left heart pulse duplication system, demonstrated no statistical differences in the reduction of mitral valve regurgitation between the prototype band and commercially available semi-rigid rings. In its flexible phase, the band was easily deployed through an 8 mm trocar, robotically manipulated and sutured into place. Experimental results suggest that the prototype NiTi core band is a viable alternative to flexible and semi-rigid bands in robot-assisted mitral valve repair.

Suresh Thummalapenta and Tao Xie
Graduate Program: Computer Science
Advisor: Tao Xie

Mining Exception-Handling Rules as Sequence Association Rules

Programming languages such as Java and C++ provide exception-handling constructs to handle exception conditions. Applications are expected to handle these exception conditions and take necessary recovery actions such as releasing opened database connections. However, exception-handling rules that describe these necessary recovery actions often do not exist in practice. To address this issue, we develop a novel approach that mines exception-handling rules as sequence association rules of the form "(FC1c ...FCnc) Ù FCa ⇒ (FC1e ...FCme)". This rule describes that FCa should be followed by a sequence of function calls (FC1e ...FCme) when FCa is preceded by the sequence (FC1c ...FCnc). Such form of rules is required to characterize common exception-handling rules. We show the usefulness of these rules by applying these rules on five real-world applications to detect violations. In our evaluation, we show that our approach detects 294 real exception-handling rules in five benchmark applications including 285 KLOC and also detects 160 defects, where 87 defects are new defects that are not found by a previous related approach.

Gina M. Agostini
Graduate Program: Anthropology
Advisor: Ann Ross

The Effect of Weight on the Human Skeletal System: Compensatory Remodeling of the Femur

Obesity has increased steadily and rapidly during the last twenty years in all age and sex categories among European and African Americans, and Hispanic individuals of Mexican origin. Biomechanical literature is replete with evidence of compensatory adaptations made by overweight individuals to cope with adiposity in daily life, yet aside from correlations between weight and arthritis frequencies, little attention has been paid to the effect that obesity has on the human skeleton. Because a key goal of forensic anthropology is to elicit a positive identification, more research is needed to investigate skeletal implications of obesity, a condition which clearly affected how an individual appeared to others in life. The goal of this project was to assess diaphyseal cross-sectional geometry of the femur on the basis of body mass index (BMI) in a population of males of European ancestry. Cross-sectional properties of long bones are known to be influenced by both load and mechanical action due to stress-induced remodeling responses at the cellular level. Results of multivariate statistics show significant ($p\text{-value} < 0.05$) elongation of the mediolateral dimension of the proximal and midshaft femur in overweight individuals, presumably due to increased sagittal pressure. These findings correlate well with biomechanical gait analyses, which show that overweight individuals display significant increases in

step width and hip abduction, disproportionately large mediolateral ground reaction forces, and longer periods of stance during the walking cycle when compared to normal weight controls.

Erin Rasheedah Banks
Graduate Program: Psychology in the Public Interest
Advisor: Craig C. Brookins

Being Healthy Counts to H.I.M.: An examination of health behavior among participants in a diabetes prevention and health promotion program.

This study employed a non-random, quasi-experimental design to assess the impact of a diabetes prevention and health promotion program on the health behavior of older African American adults in a church setting. Social Cognitive Theory (SCT) (Bandura, 1986, 1977) and Socio-ecological (McLeroy et al., 1988) and PRECEDE- PROCEEDE Planning (Green & Kreuter, 1999) models were utilized as guiding frameworks. A modified curriculum from the Lifestyle Balance: Healthy Eating and Being Active Diabetes Prevention program was used. Significant decreases were found in fasting blood sugar over the eight-week period for both program participants and the comparison group. However, there was not an increase in diabetes knowledge, daily moderate-vigorous exercise levels or self-efficacy for physical activity for individuals who participated in the program from Time 1 to Time 2. The findings of this study contribute to the health-related research and interventions literature for African Americans and the role of African-American churches as a conduit for health messages and behavior change.

Kelley Bishop
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Advisor: James Michnowicz

Forms of address in Chilean Spanish: voseo, tuteo, and ustedeo

The varied use of second-person singular pronouns –principally *tú*, *vos*, and *usted* – with their corresponding verbal conjugations, is characteristic of the Spanish of Chile (Lipski 1986). In addition to authentic *voseo* –the *voseo* verb conjugation used with the pronoun *vos* – there exists a mixed verbal *voseo* – the *voseo* verb conjugation used with the pronoun *tú* or in the absence of any pronoun. Previous studies have shown that while the authentic *voseo* is still stigmatized by Chile's middle and upper classes, the mixed verbal *voseo* is gaining ground among all sectors of the population (Torrejón 1986, 1991). The present study examines the frequencies of verb conjugation choices among speakers in Chile, in an attempt to measure and evaluate the trends posited in earlier studies. In the present study, the researcher administered 81 linguistic surveys in the city of Santiago, Chile. The participants identified the verb conjugation choice they would use when addressing a variety of interlocutors, and also commented on their opinions and perceptions on the use of the verbal *voseo*. Additionally, each participant provided personal demographic data, including age, occupation, level of education, residential neighborhood, and foreign residence. Results confirmed that the mixed verbal *voseo* occurs most frequently with friends and family members, such as siblings and spouses. The overall reported usage of the mixed verbal *voseo* (11%), was lower than frequencies of actual use as observed by the researcher and in previous studies. An examination of variation by age group and social class may provide a possible explanation for this phenomenon. The youngest and the oldest subjects admit to using the mixed verbal *voseo* more often than those of middle age group report. Also, the subjects from the lowest social classes and the highest social classes report a higher usage of the mixed verbal *voseo* than their middle-class counterparts do. This difference in frequency may indicate that these intermediary groups feel more pressure to conform to the linguistic norm (standard *tuteo* or *ustedeo).* The current study also discusses further data examining variation based on gender, foreign residence, and verb frequency.

Sarah R. Brown
Graduate Program: Communication
Advisor: Joann Keyton

Exploring Social, Geographical, Institutional, and Interdisciplinary Collaboration

This study seeks to explore the role of publication citations as communication artifacts of networks. Bibliometric analyses are used to assess the scientific production and innovation of scholarly output from a large, NSF-funded multidisciplinary research center in 3 ways: (a) number of peer-reviewed publications in professional journals was used as a measure of the creation and dissemination of new knowledge, (b) the number and quality of external and internal collaborative interactions was used as a metric for the Center's collaboration between institutions, industry leaders, and government, (c) the number of cross-disciplinary groups and publications was used to evaluate the center's influence on cross-disciplinary research. Network analyses are applied to the communication artifacts (articles and authors) to explore the foundations of institutional collaboration, geographic collaboration, cross-disciplinary collaboration and social networks.

Jon Burr and Karla Lyles
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Jeremy Packer

Access to Art Offline and Online: Who Looks at Art, Where, and Why

This study explores access to art in physical museum spaces and online environments. For the first part of this project, we surveyed 100 individuals at the North Carolina Museum of Art and 74 students at North Carolina State University on the advantages and disadvantages of accessing art online and in museum spaces and the degree to which they do or do not access art in each of these spaces. The results suggest that individuals prefer viewing art in-person due to the sense of authenticity possible in the physical museum and the benefits of viewing art in a peopled space. At the same time, participants recognized the advantages of viewing art online such as accessibility for those who cannot visit the museum space and manipulation. In order to explore online art museum environments in-depth, the second part of this study took place in North Carolina State University's Usability Research Lab and investigated general usability issues with art museum websites and the degree to which art museum websites do or do not create a space for manipulating and accessing art. Data was collected from 10 participants who completed a pre-test questionnaire regarding their expectations of art museum websites, a set of tasks on three different art museum websites, and a post-test questionnaire. The results of this part of our study suggest that individuals expect art museum websites to provide general information necessary for visiting the physical museum, showcase art present within the museum, and raise public awareness of art. This two-part study makes clear the significance that individuals place upon interactivity in physical spaces by viewing art from different perspectives and in online environments through manipulative tools, search features, and components of general organization.

Stephanie Crayton
Graduate Program: Communication
Advisor: A. Celeste Farr

The Influence of Media Images of Black Females on Audience Perceptions during Prime Time Television Viewing

Portrayals of black women on television have gone through an evolution over the last two decades. A number of scholars have examined film and television representations to determine if the advancements have helped or hurt racial bias against minorities specifically black men and women. However, little research has focused on media images of black women and whether those images add to existing positive or negative stereotypes. A number of studies have also fallen short of measuring how viewed impressions of black women influence audience members' perceptions, attitudes, and behaviors. The purpose of this study is to examine whether the manipulation of aggressiveness (high, medium, low) impacts perceptions relative to various dependent variables (liking, credibility, feminism, similarity and attractiveness). With that, a number of hypotheses were proposed, in brief: as aggressiveness in the black female character increases, perceptions of attractiveness, credibility, similarity, femininity, and liking decrease; as the aggressiveness in the black female character decreases, perceptions of credibility increase (perceptions of aggressiveness significantly predicts ratings of liking, similarity and attractiveness, which significantly predict credibility

ratings); perceptions of credibility increases as liking, similarity, and attractiveness increases; and as perceptions of attractiveness decreases, the perceptions of femininity decrease (there is a strong positive correlation between attractiveness and femininity such that as attractiveness increases, perceptions of femininity increase). To test these hypotheses, a sample of undergraduate students from predominately white universities in North Carolina was selected. Students were randomly assigned to a group then completed a pretest to measure exposure to and perceptions of black females. Next they viewed a video clip from the popular 1990's prime-time television program, *Martin*, which focused on the main black female character, Gina. Finally, after viewing the clip, they completed a survey in which they evaluated the dependent variables. Data collection is presently in process and is expected to be completed by the end of February.

Sarah L. Cunningham and Scott A. Kirkland
Graduate Program: Anthropology
Advisor: Anne Schiller

Determining row versus ray development through adult hand correlation

Some research has shown that the skeletal structures of the human hand may be organized by fields which determine the sequence and timing of development. In a study of the hands of adult skeletons it may be possible to discern patterns of row and ray development by a correlation analysis of the right and left individual skeletal elements. Rows consist of skeletal elements organized in a medial-lateral relationship, where rays consist of elements organized from proximal to distal. To analyze row versus ray development, previously collected measurements of the metacarpals, proximal phalanges and intermediate phalanges were compared between the left and right hand. The skeletal sample used consisted 164 European-American individuals from the Terry Collection at the Smithsonian Institution were gathered and left and right skeletal elements underwent correlation analysis. Research completed thus far seems to demonstrate that the hand is organized, by developmental fields, into three rows with a strong correlation between the metacarpal and proximal phalanx rows.

Katherine Fargo
Graduate Program: Communication, Rhetoric, and Digital Media
Advisor: Jeremy Packer

Recuperating Sound: Bringing Listening Practices and Auditory Rhetoric into the First Year Composition Classroom

The field of composition studies has become increasingly aware of the need to teach students visual rhetoric, or how to make successful choices when using images and visual information in compositions. However, the teaching and study of how sound may also be employed is often overlooked. This research seeks to address how to introduce auditory rhetoric and listening practices in the composition classroom. Students in an English 101 course were exposed to a unit on interpretation and visual rhetoric and then a unit on musical in-groups, listening practices and auditory rhetoric. In the latter assignment students selected a musical identity group (such as punk rock, indie music, or death metal) and completed an ethnographic study on the group based solely on its musical production. Then the students were asked to consider how one might adopt the listening practices unique to that group and authentically enter into the in-group. At the end of the course students were surveyed for their perceptions of the usefulness in being exposed to ideas of visual and auditory rhetoric. Their responses to how they might use auditory rhetoric in their future ranged from a perception that the unit was useful solely pertaining to music, useful in strengthening their listening practices in a wider range of situations, useful to their writing and analysis of other non-sound specific situations, and useful in helping them to create speeches or music in the future.

John D. Gerlach, II
Graduate Program: Public Administration
Advisor: Dennis M. Daley

An Examination of Factors That Explain the Use of Data in the Natural Resource Policy Process

Natural resource policy-making agencies seek to make decisions based on "best available science." However, the sources of biological information available to decision makers have multiplied significantly over the past several years. This study identifies key factors which predict why natural resource professionals choose one data source over another. The findings of this study may be used by researchers and practitioners to better understand the use of science in making natural resource policy. The study draws upon neo-institutional literature to pinpoint potential organizational factors which influence data selection, as well as diffusion theory literature to identify environmental factors. These factors form a causal research model, which is tested through the collection of original data. Data were collected using a web-based survey, which asked questions pertaining to field office data use, characteristics, and decision-making practices. 557 U.S. Fish & Wildlife Service field offices were surveyed, representing all eight regions of the agency. 204 Service field offices completed the survey, a response rate of 36.6%. Multiple analysis of variance / covariance (MANOVA / MANCOVA) procedures are being run to assess the main and interaction effects of several organizational and environmental independent variables on dependent variables representing data selection (federal, state or local, and non-governmental sources) and data newness. Preliminary results indicate that U.S. Fish & Wildlife Service field offices overwhelmingly view data collected by federal agencies as most important to their decision-making processes, but use federal, state or local, and non-governmental data often. Additionally, having a close working relationship with a non-governmental data supplier (i.e., a nonprofit organization or academic institution) appears to have a significant impact on the use of non-governmental data sources in making ground-level management decisions.

Jamie Lynn Gilbert
Graduate Program: Communication, Rhetoric and Digital Media
Advisor: Melissa A. Johnson

Interactivity and the content conundrum: An analysis of college radio Web sites

With the development of the Internet came a unique opportunity for college broadcasters to expand their signals from a few miles off campus to across the world. Colleges without broadcast signals were able to create new, Internet-only radio operations. The Internet promised enormous possibilities for radio stations to introduce themselves to broader audiences, making their online presence – and presentation – of vital import. While some data exists on commercial radio and television's use of the World Wide Web, studies on college broadcasters online are almost nonexistent. This research investigates how college radio stations use the Internet through a content analysis of college radio Web sites, identifying common features, examining the use of interactivity on the sites and exploring content differences between Web sites for college radio stations with a terrestrial signal and Internet-only stations. The most common features across college radio Web sites include the presence of an audio stream of station programming, identification of the affiliated school and an email contact. While stations were making good use of their Web sites as a virtual information space, they made minimal use of the site for virtual promotion, distribution, communication, sponsorship or transaction.

Emily J. Gomez
Graduate Program: Anthropology
Advisor: D. Troy Case

Does Status Matter?: A Skeletal Analysis at Hawikku

Hawikku was a pre- and proto-historic Puebloan settlement associated with the Native American Zuni culture, located in the Zuni Mountains near the Arizona-New Mexico border. Archaeological excavations by the Hendricks-Hodge Expedition began in 1917 and continued until 1923. Distinct burial areas are thought to represent related groups of individuals, including males and females who held leader or authoritative positions during life. Historically, the first encounter between Spanish explorers and Puebloan peoples took place at Hawikku and it has been proposed that this settlement was the location of an attack by Francisco Coronado, the legendary explorer.

Data from previous health studies on the Hawikku skeletal population show health was generally poor and neither sex

nor social status insulated a person from poor health. A study of pathological lesions was undertaken to determine whether social status had an effect on osteoarthritis development. After a comprehensive analysis for osteoarthritis prevalence, there was not evidence to suggest that high status individuals had significantly different levels of osteoarthritis relative to the low status individuals. The mortuary behavior practiced at Hawikku implies that leaders probably participated in similar daily activities relative to the general population, but performed special religious rites or rituals at particular times of the year. This study contributes valuable information to our knowledge of the relationship between social organization and arthritis prevalence in the past.

L. Allison Harrell
Graduate Program: English
Advisor: Mike Grimwood

"not knowing which, less or more:" Misconstructions of Southern Honor in William Styron's The Confessions of Nat Turner

William Styron's novel, The Confessions of Nat Turner, is a fictionalization of the life of preacher, slave, and self-proclaimed prophet Nat Turner. The bulk of literary criticism on the text addresses Styron's alleged mischaracterizations of Nat and his manipulations of the known facts of Nat's 1831 insurrection. Examination of Nat's character often includes an exploration of his suppressed desire for Margaret Whitehead, a seventeen-year-old white debutante. However, current criticisms fail to fully interrogate the motives behind Nat and Margaret's actions and choices. An analysis of three pivotal scenes reveals their struggles to infiltrate the closed and patriarchal code of Southern honor. In antebellum Southern society, Nat was considered incapable of honorable behavior; as a slave he was unable to be respected and trusted, since the word of a slave was little better than a lie. Margaret, as a young, unmarried woman, was defined by the honor (or dishonor) of her male relatives, and the perceived authenticity of her purity. Therefore, Nat and Margaret, ostracized due to his race and her gender from this system of social conduct, create individual frameworks of honor, largely constructed from different types of literature. Nat relies on Old Testament readings to shape his perception of honorable action; he uses these constructs to justify his plans for freedom and vindication for his fellow slaves. Similarly, Margaret, exposed through her education to religious narratives and British Romantic poetry, reaches beyond the control of her brother's household to create her own political and social ideology. Their self-styled honor allows for their independent liberations, through death, at the novel's conclusion.

Sheena M. Harris
Graduate Program: Anthropology
Advisor: D. Troy Case

Size Variation between Males and Females in the Ankle Bones

The accurate estimation of sex is essential to physical anthropologists working in forensic and bioarchaeological contexts. The correct estimation of sex is of particular importance because methods of determining the age and stature of an individual are based on accurate sex determinations. Accurate assessments of sex in human skeletal remains are dependent on the state of preservation of the remains and the amount of sexual dimorphism present in the skeleton. Although physical anthropologists mainly rely on visual features of the skull and pelvis and metric measurements of these and the long bones in their assessment of sex, metric measurements obtained from other bones of the human skeleton can also be useful for correctly determining the sex of an individual, particularly when the more commonly used bones are unavailable or badly damaged. This study evaluates the levels of sexual dimorphism between males and females in a modern human skeletal sample to determine which ankle bones exhibit the most size variation, and therefore, are best suited for sex determination. Metric measurements of length, width and height were obtained from each ankle bone using a mini-osteometric board. The measurements were subjected to logistic regression analysis to determine which bones and dimensions exhibited the most variation in size between the sexes. The results demonstrate that all bones of the ankle exhibit size variation between the sexes. Length and height measures show greater size variation between the sexes than breadth measurements. The talus and first cuneiform are the most dimorphic bones and are likely to produce the most accurate estimations of sex.

Amy Heishman
Graduate Program: English
Advisor: Carmine Prioli

"Carrying the Fire in all that Dark": An Archetypal Explanation of Fire Imagery in the works of Cormac McCarthy

A particular symbol can sometimes have its own arc in the breadth of an author's work. The image of fire is consistent through all stages of Cormac McCarthy's career. The function such imagery plays, however, changes from novel to novel. This study evaluates McCarthy's fire imagery, using Northrop Frye's theory of symbols in his *Anatomy of Criticism*. Frye defines the first phase of symbols in the distinction between sign (outward directed) and motif (inward directed). Frye also classifies three other phrases of symbolism: the formal, the mythical (archetypal), and the anagogic (mystic). It can be argued that Cormac McCarthy uses fire initially as a formal image in *Blood Meridian*, primarily as an intellectual allegory. Later in his career, fire will develop into a mythic symbol, the embodiment of which is explored in the text of *No Country for Old Men*. In *The Road,* fire is an anagogic symbol of the infinite. This study will track the evolution of fire imagery in the scope of the author's selected works.

Dawn X. Henderson
Graduate Program: Psychology
Advisor: Pamela Martin

Destigmatization: Understanding its role in the relationship between racial discrimination and psychological well-being among African American adolescents

African American youth interact with racist symbols and messages that present a variety of risk factors associated with developing negative psychological functioning (DeBois, Burk-Braxton, Swenson, Tevendale, & Hardesty, 2002; Nyborg & Curry, 2003; Simons et al., 2002). Despite the risks associated with racial discrimination, research suggests that some African American adolescents possess characteristics that promote resilience and counter these negative effects (Miller, 1999; Miller & MacIntosh, 1999). A new concept introduced to the literature is subjective stigmatization, where high subjective stigmatization (destigmatization) has positive implications for Africa American adolescents (Brega and Coleman, 1999). Destigmatization can serve as a promotive factor for African American adolescents by providing them with the ability to not internalize negative messages they receive as it relates to their ethnicity/race. To investigate the role subjective stigmatization (destigmatization) plays in the relationship between racial discrimination and psychological well-being, this study employed a resilience framework (Fergus & Zimmerman, 2005). The resilience framework guided the study and allowed the researcher to test whether destigmatization served as a protective or compensatory factor in the relationship between perceived racial discrimination and psychological well-being among a sample of African American adolescents. Using a series of hierarchical regressions to test direct and interactive effects, findings suggest that high subjective stigmatization (distigmatization) has a strong association with a positive psychological well-being. Thus, destigmatization acts as a promotive factor in predicting a positive psychological well-being and may be an asset for African American adolescents in countering the negative messages they receive from racial discrimination.

Felysha L. Jenkins
Graduate Program: Psychology
Advisor: Mary Wyer

What Makes Women Stay? Examining Variables Related to Career Commitment of Female African American Undergraduate Students in the Sciences

This study aims to expand the understanding of how African American women succeed in obtaining baccalaureate degrees in science, technology, engineering, and mathematics (STEM) despite the obstacles and barriers they face. Specifically, through surveying students from multiple institutions of higher learning, this study examines how African American, undergraduate female students' career commitment, self-efficacy, gender, ethnicity, and college climate interact to lead to degree attainment. Whereas substantial information exists on the circumstances of women in STEM and on increasing minority representation in STEM, a paucity of research exists about the interaction of race and gender for African American women obtaining STEM degrees.

Eleni V. Lobene, Jennifer London and Daniel S. Stanhope
Graduate Program: Industrial/Organizational Psychology
Advisor: Bart Craig

Personality and Training Effectiveness: Predicting Utility through Interests and Individual Differences

Training programs possess the potential to improve an individual's commitment and job satisfaction (Iaffaldano & Muchinsky, 1985) while increasing productivity and company profit margins (Arthur, Bennett, Edens, & Bell, 2003). While training evaluations may be done many different ways (Goldstein, 1993; Kraiger, Ford & Salas, 1993), the most common method of evaluation is through trainee reactions (e.g., Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997). The role of individual differences in determining reactions must be better understood, and personality predictors of individuals' evaluations of training effectiveness have not received adequate research attention. This study investigated the relationship of the Big 5 personality traits (McCrae & Costa, 1987) and perceived training effectiveness while simultaneously assessing the role of the relevance of the training to one's professional field of interest. Participants were surveyed in conjunction with a professional language assessment training program. The results of this study indicate that personality does not influence perceived training effectiveness. This suggests that trainees' reactions to the training do not differ based on personality differences. This finding is encouraging since other factors, including actual training characteristics, may account for variability in ratings.

Rebecca O'Connell
Graduate Program: Technical Communication
Advisor: A. Nancy Penrose

A Survey of Note Taking Practices in English Classes

The purpose of this study is (1) to get an overview of the ways that students in English classes are using current technologies to further, or even move beyond, traditional note taking techniques and (2) to get a sense of English students' goals in note taking and of the ways in which the technologies currently in use may be holding them back. To do this, I will seek answers to the following questions:

- What note taking practices are students currently engaging in and what technologies are they using? What, if any, non-traditional note taking techniques are in use?
- How satisfied are students with their current note taking practices? What are they dissatisfied with?
- What are students' goals in taking notes? What requirements do they have to meet? What are they trying to accomplish?
- What relationship is there between a student's note taking goals and his or her note taking practices?
- What relationship is there between a student's educational background and level of technology experience and his or her note taking practices?

Data will be collected using a survey of the note taking practices of graduate and undergraduate students taking at least one English course during Spring 2009. The data will be evaluated both qualitatively and quantitatively in order to answer the questions listed above.

The answers to these questions will be of interest to English instructors for two reasons. First, this study will promote an increased understanding of what students are actually doing in class. Second, knowing their students' current note taking practices will provide instructors with a starting point from which to help students learn more effectively by using more effective note taking strategies.

Virginia K. Proffit[1] and Richard J. Nagle[2]
Graduate Program: School Psychology, North Carolina State University[1]; School Psychology, University of South Carolina[2]
Advisor: Richard J. Nagle

Concurrent Validation of the Stanford-Binet Intelligence Scales – Fifth Edition (SB5) – to the Wechsler Adult Intelligence Scales – Third Edition (WAIS-III)

Since the introduction of the Stanford Binet Intelligence Scales-Fifth Edition (SB5) in 2003, there has been surprisingly little research aimed at evaluating the measure's validity, this is especially true with the college student population.

Because of the strong reputation of the Wechsler Scales, it is important to understand how the SB5 compares to the Wechsler Adult Intelligence Scales-Third Edition (WAIS-III). The only available study comparing the two measures is presented in the SB5 *Technical Manual* and includes participants older than the average age of traditional college students. Therefore, this study aimed to examine the comparability between the SB5 and WAIS-III with the college population. The participants were 30 Appalachian State University students enrolled in undergraduate psychology courses. Paired sample t-tests were used to examine the comparability between like IQ scores. To examine individual differences, the absolute differences were calculated between the Full Scale Intelligence Quotients (FSIQ). Inter-correlations between scales were also calculated. The results indicated that although IQ scores across the two measures were significantly correlated, the mean difference between scores was also significant.

Avril A. Smart
Graduate Program: Psychology
Advisor: Pamela P. Martin

Passing on the Message: Exploring Racial Identity, Perceived Discrimination and Religiosity as indicators of African American parents' Racial Socialization Practices

When investigating messages transmitted from parent to child, racial socialization among African Americans represents one of the most frequently researched topics in psychological literature. Specifically, several scholars conclude that the racial socialization is an integral part of the parenting process among African American parents. Some researchers have uncovered links between several specific variables and the concept of racial socialization to include discrimination (Scott, 2003), racial identity (Anglin & Wade, 2007), religion (Martin & McAdoo, 2007) and demographic factors (Thornton, Chatters, Taylor and Allen, 1990). However, few scholars have explored the relationships of these variables in combination given the empirical links highlighted in previous research on the racial socialization practices of African American parents. The purpose of this study is to explore the direct links between African American parents' racial identity attitudes, experiences with perceived discrimination, religiosity and demographic differences and racial socialization practices in the child rearing process. In addition to exploring direct relationships, this study will examine the potential moderating effect of religiosity and racial identity attitudes in the relationship between perceived discrimination and racial socialization practices.

John Strange
Graduate Program: Technical Communication
Advisor: Carolyn Miller

Reporting Change: An American Metropolitan Newspaper Covers its Own Decline

The year 2008 may one day be seen, in retrospect, as the beginning of the end of the American print newspaper. For discourse analysts and journalists, *The News & Observer* presents a near perfect case study for how a news organization deals with and reports its own changes, cutbacks and layoffs. For the Raleigh newspaper, change came piece by piece, in chronological, measurable segments. More than 150 people lost their jobs in a five-month period.

A grammar-level analysis of the *News & Observer*'s public texts reveals five characteristics depicting uncertainty, conflict and change in the newsroom.

*New & Given: Construction of Cuts as Old Information***.** Through theme-rheme constructions and the use of the definite article over the indefinite, *News & Observer* writers construct over time "change" as a known and expected commodity.

Synoptic versus Dynamic Sentence Construction. The more intricate a sentence, the more clauses and phrases embedded within the construction, the more dynamic and uncertain the sentence. In four news stories studied, for example, dynamic sentences outnumbered synoptic sentences by about two to one.

Present Tense vs. Future Predictive. The dynamic and unstable future predictive tense is a common feature in the majority of the texts. Further, the use of the future tense drops over time as change becomes a "given" fact.

Agent & Agency – Altering the Subject of Change. Short readers' alerts, appearing in the newspaper at various times during the study period to alert readers to coming changes, shift the subject of the texts from the newspaper to the reader. Emphasis is on the reader, not the newspaper and its difficulties. (continued on next page)

Textual Silences. The newspaper rarely acknowledges the personal loss of former staffers, or the loss that those who remain in the organization may feel.

John D. Willingham[1] and Mike Cobb[2]
Graduate Program: International Studies[1]; Political Science[2]
Advisors: Bill Boettcher and Mike Cobb

Explaining Evangelicals' Support for the War in Iraq

Recent studies that examine the religious foundations of foreign policy attitudes among the public find that Evangelical Christians are more likely to support a hawkish foreign policy toward the Middle East and Iraq (Smidt, 2005; Baumgartner et al, 2008). This paper builds on prior research to explain why Evangelicals are more supportive of the war in Iraq. Using data from two different polls recently conducted in North Carolina, we show that Christian dispensationalist beliefs are more accurate predictors of public support for U.S. policy in Iraq than simply being identified as an Evangelical. Our finding supports the argument that religion plays a profound role in shaping public opinion toward U.S. foreign policy, but it also implies the need to rethink how Evangelical beliefs are measured within the literature because there are distinct religious beliefs among Evangelicals as well.

Timothy W. Nichols
Graduate Program: Management
Advisor: Paul K. Bergey

MBAs and the Modern Street Gang

This paper considers the unregulated internal business practices of the contemporary street gang that are associated with instilling gang loyalty. Through this optic, one can better understand the key influences designed to enhance and prolong organizational loyalty. Subsequently, the author interprets whether or not the influences can be transferred into the modern business paradigm. Using observations through existing research and reporting, the author intends to identify key influences, provide analysis, and suggest whether these influences may, in some form, be relevant to modern, legitimate businesses. Surprisingly, the research draws substantial parallels between the practices of both legitimate and illegitimate businessmen. First, both enterprises place substantial emphasis on the indoctrination of key workers—teaching organizational values—in hopes of solidifying loyalty. Next, both enterprises employ substantial leverage on employees in order to aggrandize profits at the highest level; in doing so, the concept of loyalty is purposely conflated with the concept of organizational hierarchy. Finally, the "recruit-rebuff" paradigm exists in both enterprises in order to entice extra effort while limiting substantial promotion. In this regard, organizational loyalty appears more of a multi-faceted device rather than a corporate value. The remainder of the paper incorporates modern examples of the aforementioned analysis in order to draw out interestingly similar comparisons. This paper uncovers topics for further research. The conclusions, in short, show that, despite one organization being significantly regulated by external influence, and the other organization being only internally regulated the behavioral tendencies, the operational techniques, and the organizational exhibit surprising similarities.

Christopher R. Ayers[1], Christopher S. DePerno[1], Christopher E. Moorman[1], Fred H. Yelverton[2], Suzanne Kennedy-Stoskopf[3], and Huixia Wang[4]
Graduate Programs: Fisheries and Wildlife Sciences[1]; Crop Science[2]; College of Veterinary Medicine[3]; Statistics[4]
Advisors: Christopher S. DePerno and Christopher E. Moorman

Chemical control of resident Canada geese and a survey of fecal contaminants

Urban Canada goose (*Branta canadensis*) populations are increasing in the Southeast as humans create ideal habitats with ponds and lakes surrounded by managed turfgrass. Subdivisions, parks, and corporate facilities are attractive to Canada geese because they lack predators, have a constant supply of grass to eat, and are safe for raising a brood. Year-round residency of geese may cause feces build-up, disease, spread of turf weeds, and nutrient loading. No non-lethal deterrent has proven completely effective.This study tested mowing effects on the avian digestive irritant FlightControl Plus. From 2007 to 2008, four field sessions were conducted at eight sites, each consisting of a

pretreatment week of observations and 30 days of post treatment observations. Each site was divided into four ¼ acre plots containing a 6x70ft transect for daily fecal collection. Each plot was either treated or untreated and mowed every four or every eight days. Droppings were counted and weighed daily from each transect and the percent of treated grass was measured daily. Fecal samples were collected and tested for *Giardia*, nitrogen, and phosphorous. Goose use of treated plots decreased for two weeks following treatment with FlightControl PLUS. Over the 30 day period, chemical coverage was similar between four and eight day plots and blade coverage decreased steadily from 90% to 10%. *Giardia* was not found in any of the 135 samples tested. On average, 1335 dry grams of feces were deposited per acre/day and contained 26.7g of N and 4.3g of P. FlightControl PLUS worked inconsistently and mowing regime did not appear to affect efficacy of the chemical. Fecal nutrient levels are high and may contribute to aquatic eutrophication and turfgrass fertilization. These results provide facility managers with useful information regarding FlightControl Plus and fecal contaminants.

Kevin M. Bigsby
Graduate Program: Forestry
Advisor: Erin O. Sills

Anthropogenic drivers of gypsy moth dispersal

Gypsy moth (*Lymantria dispar*) is a non-native forest pest introduced to Massachusetts in 1869. It has since spread as far south as North Carolina and as far west as Wisconsin. Gypsy moth is responsible for defoliating 100,000 hectares of forest annually, resulting in mortality in a small percentage of trees, averting behavior by recreators, and creating a nuisance to the general public. Limiting the spread of gypsy moth is beneficial because it delays the onset of costs and losses associated with quarantine, tree defoliation and mortality, and nuisance. Gypsy moth is believed to disperse naturally up to 2.5 km/yr (e.g. early instar ballooning) but has been observed to disperse much greater distances. The scientific consensus is that this longer distance dispersal occurs through anthropogenic vectors (e.g. egg masses on firewood). Despite the resources that federal and state agencies dedicate to eliminating infestations resulting from long distance dispersal, there has been limited empirical research on the relationship between the dispersal of gypsy moth and the movement of people. This thesis develops a conceptual framework of the anthropogenic factors that could affect dispersal, measures these factors with secondary data, and estimates the presence or absence of gypsy moth using logistic regression models. The dependent variable is drawn from trap catch records archived by Slow-the-Spread in areas distal to the 1 moth/trap line between 1999 and 2007. Through step-wise regression and estimation with sub-models that include variables representing anthropogenic factors, a final empirical model is specified. The model variables are estimated independently for each year, resulting in a mean Pseudo R square of 0.568. Consistently significant ($\alpha < 0.05$) anthropogenic variables are the number of households using wood for heating fuel and mean household income in the county. One key implication is the continual importance of raising awareness about the risk of moving firewood.

Caitlin A. Burke
Graduate Program: Forestry and Environmental Resources
Advisor: Toddi A. Steelman

Grassroots Environmental Groups Show Varied Response to Collaborative Decision-making in the West

In recent years forest policy has moved toward decentralized, collaborative decision-making. Representing a break from traditional, centralized government control of public forests, this alternative governance structure could provide enhanced opportunities for grassroots interest group influence, a subject under-explored in existing research. Collaboration is increasingly presented as a normative ideal, but positive outcomes require adequate representation of stakeholders, and there is little empirical evidence of local environmentalists' perspectives on and participation in this decision-making approach. This research examines the attitudes and behaviors of grassroots environmental organizations in the western United States toward collaboration and local decision-making for national forest policy. Survey Monkey was used to conduct an online survey of 100 grassroots organizations that focus on forest policy in the west. Questions addressed organizations' perspectives on collaboration and local decision-making, the strategies they use to influence policy decisions, and their issue priorities. The majority of groups indicated a mixed response to collaboration and local decision-making. While recognizing the potential for collaboration in some contexts, there is concern about power imbalances in collaborative forums, poor representation of interests, and unsatisfactory

outcomes. Similarly, groups support the concept of localized decision-making to ensure local input, but question how the process is carried out, and the advantage given to local economic interests over national environmental interests. Analysis of group behavior, in terms of strategic efforts and issue choices, indicates relationships between groups' experiences, values, and perspectives. These findings suggest grassroots groups will limit their use of collaboration as a strategy of influence to certain circumstances, but that improving local collaborative decision-making and strengthening the political framework within which it is applied could increase the prevalence of such circumstances. Subsequent case study research on a sub-sample of the respondents will examine in greater depth the factors that influence grassroots organizations' perspectives on collaboration and local decision-making.

M. Colter Chitwood, Christopher S. DePerno, M. Nils Peterson, and Richard A. Lancia
Graduate Program: Fisheries and Wildlife Sciences
Advisor: Christopher S. DePerno

Understanding Dog Hunting Culture

With increased pressure to restrict or ban white-tailed deer (*Odocoileus virginianus*) hunting with dogs (hereafter, dog hunting), motivations of hunters choosing to hunt with dogs need to be evaluated. Animal rights groups believe that dogs and deer are stressed by this type of hunting, and hunters using other hunting methods consider wayward dogs a nuisance and a form of trespassing. However, in some areas dog hunting may be deeply rooted in local culture and be well suited to habitat conditions. The purpose of this research is to qualify the historical, traditional, and ethical motivations of dog hunting on Hofmann Forest, North Carolina. Hofmann Forest is a 78,000 acre tract of private land intensively managed for timber and dog hunted by nine clubs. The hunters on the Hofmann are a good sample of eastern NC dog hunters because the property has been hunted in this manner since the late 1800s, and the vast majority of the hunters are local. We will conduct 30 semi-structured interviews with dog hunters in summer and fall 2008. Our results will include why they hunt with dogs, their views on other hunting methods, their perception of risk concerning the dogs and deer, and their opinion about public perceptions of dog hunting. The results will provide insight into the culture of dog hunters, which will facilitate communication among stakeholders. Understanding dog hunting culture will allow rational dialogue among dog hunters, other hunters, and animal rights proponents, perhaps replacing the emotional, contentious debate that currently predominates.

Kunsheng Fang
Graduate Program: Parks, Recreation and Tourism Management
Advisor: Robin Moore and Hugh Devine

The Association Between Park Environment and Children's Physical Activity

Improving children's physical activity levels has been identified as one of the top public health priorities. It is known that the natural and built environment can affect people's physical activities. Yet, research on the association between park environment and children's physical activities has been lacking. This research explores the relationship between park environment characteristics and children's physical activities in different parks and recreation settings. Two survey instruments have been used: 1) a new survey instrument called Children And Families Park Audit Tool (CAFPAT) was developed to measure different aspects of park facilities and park environment characteristics; 2) System for Observing Play and Recreation in Communities (SOPARC) tool was used to collect children's physical activity data. Two surveys were conducted separately in 20 parks in Durham, North Carolina. The surveys yielded two zone-level data sets. Principal component factor analysis was conducted to reduce the dimension of the CAFPAT dataset and produce six latent variables. By joining the two data sets, park facilities and environment characteristics that correlated with the use/non-use of the parks were identified. Park facilities and environment characteristics that correlated children's moderate-to-active level behavior were also identified. The results will inform policy makers, park designers, and landscape architects of the role that public parks play in fostering children's physical activity and promoting public health. The results will also help park designers and landscape architects in designing parks and recreational settings that can better promote children's physical activities.

This study identifies several park facilities and park environment characteristics that are correlated with children's use/non-use behaviors as well as their physical activity levels. The results will inform policy makers, park designers, and landscape architects about the role of public parks in combating childhood obesity and promote public health. The

results will also help park designers and landscape architects to design parks that can promote children's physical activities.

Gregory E. Frey[1], Frederick W. Cubbage[1], Hugo E. Fassola[2], Luis Colcombet[2], and A. Nahuel Pachas[2]
Graduate Programs: Forestry and Environmental Resources, North Carolina State University[1]; EEA Montecarlo, Instituto Nacional de Tecnología Agropecuaria, Montecarlo, Misiones, Argentina[2]
Advisor: Fred Cubbage

Technical Efficiency of Silvopasture in Subtropical Argentina: Differences between conventional systems and agroforestry among farms of varying scales

Silvopasture is a form of agroforestry that incorporates trees, livestock and pasture on a single parcel of land. Researchers and extension agents believe that this system can provide numerous benefits over conventional production systems such as open-air pasture and plantation forestry. In subtropical northeast Argentina, silvopasture has become moderately adopted by different types of producers. The objective of this work is multiple. First, we measure and compare the technical efficiency of silvopasture, pasture and forestry, to test whether silvopasture is truly more productive than the other options. Second, we estimate scale efficiency to test whether silvopasture has increasing, decreasing or constant returns to scale, which may make it more appropriate. Third, we identify those farmers whose specific practices are the most productive so that those practices can be passed along to other farmers. To accomplish this, we use data envelopment analysis (DEA), a non-parametric method that identifies parcels that are the most efficient, that is, those which produce maximum output for a given quantity of input. DEA is appropriate for analyzing silvopasture systems because it is easily able to incorporate multiple inputs and outputs. From our analysis, we find that silvopasture and open-air cattle-grazing systems have higher scale efficiency for small scale farmers, indicating decreasing returns to scale, whereas conventional forest plantations have increasing returns to scale. Silvopasture has higher pure technical efficiency than open-air cattle-grazing. Also, we identify efficient peer farms for inefficient farms. These peer farms can serve as models to help inefficient farms identify the specific management practices that are the most productive.

Katherine Golden
Graduate Program: Fisheries and Wildlife Sciences
Advisors: Chris DePerno, Chris Moorman, Nils Peterson, and Robert Bardon

Surveying North Carolina Private Landowners

Non-industrial private (NIP) landowners control most of the land in the southeastern United States and 95% of US endangered species require habitat located on private lands. Competing land uses such as biofuels and development threaten wildlife habitat unless landowners can find financially practicable approaches for maintaining wildlife habitat. Wildlife-related fee access operations are becoming a viable option for landowners to supplement their income, while protecting wildlife habitat on their property. Approximately 70% of the total acreage in North Carolina is owned by private landowners, providing a good opportunity for accessing landowner awareness of and participation in fee access operations. We determined revenue earned from wildlife-related fee access operations and the cost of implementing management practices through a survey addressing these topics in North Carolina. The survey was mailed (March 2008) to approximately 8,400 private landowners owning ten or more acres from twenty-eight counties in North Carolina. Section one of the survey addressed capital spent on management activities, financial incentives received in 2007 for habitat improvement, and reasoning behind why landowners did or did not lease their property for wildlife related fee-access operations. Questions in section two addressed issues such as why the property was leased for fee hunting operations, what type of operation was implemented, the amount of capital invested, and specific concerns of landowners leasing their property. Information gathered from the survey will provide current trends in the role wildlife related fee access operations play as an income source for NIP landowners in NC. Our results will help extension specialists and county agents target demographic groups among NIPs who do not take advantage of wildlife related fee access programs but are interested in doing so. Also, these efforts will help retain economic viability and wildlife habitat in rural areas of North Carolina.

Balazs Horvath, Ilona Peszlen, and Perry Peralta
Graduate Program: Wood and Paper Science
Advisor: Ilona Peszlen and Perry Peralta

Nondestructive Assessment of the Mechanical Properties of Transgenic Aspen

Forest-tree genetic engineering has a great potential to improve wood characteristics. By manipulating the lignin biosynthetic pathway with the expression of sense and antisense genes, genetic engineering provides an opportunity to change the quantity and structure of lignin in wood. Lower lignin content and changed lignin composition (increased syringyl to guaiacyl lignin ratio) improve pulping efficiency and digestibility, but also could lead to the modification of mechanical properties that are critical for solid wood applications. Advanced testing of genetically modified trees is crucial to understanding the role of lignin in the mechanical properties of wood. Traditional assessment of mechanical properties requires certain dimensions of test specimens determined by ASTM standards. However, these relatively large dimensions cannot be prepared from young transgenic trees with small diameter (10-20mm). The underlying concept of this study was to evaluate the mechanical properties of transgenic trees using micromechanical and nondestructive testing specifically developed for small diameter trees. Static modulus of elasticity was measured by three-point bending using micromechanical testing on small diameter stems; meanwhile, dynamic modulus of elasticity was determined by FAKOPP microsecond timer on the same specimens. Results suggest that a reduction in lignin content and an increase in syringyl to guaiacyl ratio resulted in a decrease in mechanical properties. In addition, moderate correlation was observed between dynamic and static modulus of elasticity.

Laszlo Horvath, Ilona Peszlen, and Perry Peralta
Graduate Programs: Wood and Paper Science
Advisors: Ilona Peszlen and Perry Peralta

Prediction of the Mechanical Properties of Young Genetically Modified Aspen Trees using Near-Infrared Spectroscopy

Genetically modified trees are becoming more and more popular in plant research. To determine how genetic modification affects the strength of standing trees and the final products, mechanical properties of these trees must be investigated at an early age. Due to the limited amount of material at this age, transmittance Near-Infrared (NIR) Spectroscopy was used to predict the mechanical properties of one and two-year-old genetically modified *Populus tremoloides* clones with altered lignin content and modified syringyl/guaiacyl ratio in green condition. The modulus of elasticity (MOE) in three-point bending and ultimate compression strength (UCS) in compression parallel to the grain were measured using modified macro-mechanical testing on small clear specimens. To obtain NIR spectra 75mg pellets were prepared and tested using a wavelength range of 600-1900nm. The UCS showed strong correlation with the NIR spectra and strong dependence on lignin content. However, the MOE exhibited only moderate correlation and dependence on lignin content. The RPD value suggests that the model for UCS can be used only for screening and the model for MOE cannot be used for accurate prediction due to high variation. The result verified the strong dependence of UCS on the lignin content. However, it also suggest, that MOE depends on other factors such as anatomy rather than chemical composition only.

Evan Keto
Graduate Program: Forestry and Environmental Resources
Advisor: George R. Hess

Analysis of the Composition and Ecosystem Effects of Trees in Parking Lots in Raleigh, North Carolina

Trees in parking lots represent a unique and poorly understood portion of the urban forest. Parking lots comprise a large and growing use of land in suburban and urban areas, and are recognized as a source of significant environmental impacts. Raleigh, North Carolina enacted a municipal ordinance in 1986 to "modify and reduce the deleterious visual, environmental and aesthetic effects" of parking lots by requiring them to contain planting areas with trees. Many cities have passed similar ordinances, but very little is known about these trees at the citywide level. To address this need, I am analyzing the composition of trees in parking lots in Raleigh and its extra-territorial jurisdiction, estimating their ecosystem effects, and identifying patterns that may warrant future research. Using GIS and multivariate clustering,

parking lots within Raleigh's planning jurisdiction were grouped into four classes: (1) small lots with few planting areas, (2) small lots with frequent planting areas, (3) large lots which are compact in shape, and (4) large lots which are long and thin. The planting areas within these lots were classified into four types based on their size and compactness of shape: islands, rows, chunks, and slivers. Parking lots were randomly selected from each class for field sampling, and planting areas within each selected lot were then selected for subsampling. In each of the selected planting areas, all trees were measured and ground cover area was estimated. Variation in composition among the four classes of parking lot and four types of planting area was analyzed. The ecosystem effects created by these trees were then estimated using models developed by the U.S. Forest Service. Preliminary results will be presented.

Corey S. Shake and Chris E. Moorman
Graduate Program: Fisheries and Wildlife Sciences
Advisor: Chris Moorman

Effects of Patch Size, Shape, and Landscape Context on Scrub-successional Birds in Conservation Reserve Enhancement Program Habitat

Populations of many bird species associated with scrub-successional habitat are declining in the eastern United States. The Conservation Reserve Enhancement Program (CREP) has potential to create habitat for scrub-successional birds in agricultural landscapes. However, the riparian buffer habitat patches created by CREP are variable in size, shape, and the composition of habitats in the surrounding landscape, and it is unclear how these characteristics affect patch occupancy and breeding productivity of birds. Our objective was to determine if patch area, shape, and landscape context would predict patch occupancy and influence nesting success of scrub-successional birds. We surveyed 42 individual habitat patches (0.8-24.8 ha) for presence of nine scrub-successional species in northeastern North Carolina, USA. We modeled individual species' occupancy relative to patch-specific covariates and found evidence of area-sensitivity for only two species, prairie warbler (*Dendroica discolor*) and field sparrow (*Spizella pusilla*). Shape index and percent forest cover within 1 km were generally not good predictors of patch occupancy. We selected a subset of 12 habitat patches and monitored focal species' nests within each patch. Nest survival was modeled in relation to patch- and nest-specific covariates. Shape index and within-patch mean shrub/sapling height were important variables for predicting nest survival of five species combined and field sparrows. Parameter estimates suggest that nest survival is lower in irregularly-shaped patches and in patches where taller trees were beginning to shade out understory vegetation. Our results provide evidence that many scrub-successional species will occupy small and irregulary-shaped habitat patches in agricultural landscapes, but they may experience lower breeding productivity in linear- and irregularly-shaped habitat patches. Natural habitat succession within a patch may also reduce breeding productivity. Efforts to restore scrub-successional habitat should consider creating sufficiently blocky or circular patches and maintain appropriate disturbance levels to benefit breeding bird populations.

Rachel M. Shellabarger, Sarah T. Warren, Erin O. Sills, and M. Nils Peterson
Graduate Program: Natural Resources
Advisor: M. Nils Peterson

Crossing Borders: Wildlife Conservation and Human Rights Responses to Undocumented Migration in the Arizona Borderlands

Wildlife conservation and human rights are currently threatened by direct and indirect effects of border enforcement practices on the Arizona-Sonora border. Increased border enforcement in urban areas has pushed migrants into remote conservation areas threatening both the vulnerable borderland wildlife habitats and the human migrants passing through them. Little is known about how conservation agencies or local communities address the under-reported environmental and social costs associated with border control initiatives. In this study we use participatory action research to assess the economic and social costs borne by the wildlife management and humanitarian aid groups attempting to address the socio-ecological crises wrought by increased border enforcement. Community partners include the Buenos Aires National Wildlife Refuge, the Coronado National Forest, and the No More Deaths humanitarian aid group, all located within 25 miles of the Arizona-Sonora border. The results of this study, carried out largely during the summer of 2008, quantify and describe the socio-economic costs to wildlife conservation agencies and No More Deaths in addressing the under-reported humanitarian and conservation side effects of border

enforcement programs in the Arizona borderlands. Results can be used to increase understanding of the consequences of border enforcement and to reinforce requests for support by both wildlife conservation and humanitarian groups.

Ning Wu, Martin A. Hubbe, and Orlando Rojas
Graduate Program: Wood and Paper Science
Advisors: Martin A. Hubbe and Orlando Rojas

Approach to equilibrium adsorption by cationic polyelectrolyte on the fine pore surfaces of silica gel

Penetration of cationic polyelectrolyte in porous media is complicated by the nature of different substrates. However, this area has been drawing much attention due to many applications in papermaking industry and enhanced oil recovery, etc. Our research concerns the interaction between high-charge density cationic polyelectrolyte molecules and the strongly negative surfaces of silica gel. Electrostatic forces and entropic effects, due to the release of counter-ions, can explain a very high affinity of adsorption, which has been observed when the polyelectrolyte interacts with external surfaces of solid silica particles. However, our earlier results have shown that the internal surface within the silica gel remain negative in net charge even at high levels of polyelectrolyte treatment. Streaming potential tests were innovatively used to detect the state of net charge within a network of pores having diameters of approximately 15nm to better understand the amount of penetration of the polyelectrolyte into such pores at the function of time and various other testing variables, such as pH, time, molecular mass of poly-DADMAC, concentration of poly-DADMAC, etc.

Jin Sherry Xiong, Steve McKeand, Fikret Isik, and Ross Whetten
Graduate Program: Forestry and Environmental Resources
Advisors: Steve McKeand and Ross Whetten

Genetic Variation of Forking in Diallel Tests of Loblolly Pine

Forking defect is a serious stem-quality problem that has been found in many conifer species. Forked stems create large knots and irregular grain in lumber; and also reduce the stem strength and timber uniformity. Forking defects greatly decrease the wood quality, timber harvest and pulp yield, correspondingly reducing the economic value of the wood. Assessing forking in elite pedigrees will enable us to more successfully breed and deploy non-forked phenotypes. In this study, forking defect was investigated in loblolly pine (Pinus taeda L.) 6-year-old diallel tests from the second cycle of breeding in the North Carolina State University Cooperative Tree Improvement Program. Data were available from 272 half-diallel series (each with 12 parents, 30 crosses, and 144 progeny per cross) over 6 geographic regions. Forking differed significantly among regions, with the highest in the region 6-Upper Gulf (34.3%) and the lowest in the region 5- Lower Gulf (15.7%). There is no relationship between forking and average test height. A subset of 123 series with average forking between 20% and 80% were used for genetic analysis. The individual-tree heritabilities were low (h2i_n=0.07, H2i_b=0.08), but the family-mean heritabilities (h2hs=0.76, h2fs_n =0.59, H2fs_b=0.7) were high enough to confirm that there is relatively strong genetic control of forking. High heritability would result in high response of selection against forking. Genetic gain estimates were based on half-sib family selection with the selection intensity of 16.6% (2 out of 12) and ranged from 23.9% to 1.1 % reduction over different series. A weak positive (unfavorable) genetic correlation (rG=0.28) was found between forking and height, and a weak favorable correlation (rG=0.33) was found between forking and straightness. To gain the maximum genetic response in stem value, the growth traits and stem form characteristics should be considered simultaneously in the selection criterion.

Mamiko Arai and Charles E. Smith
Graduate Program: Biomathematics
Advisor: Charles E. Smith

Stochastic Integrate-and-Fire Neural Models; one and two compartments, type of noise input, innervation pattern

One and two compartment stochastic integrate-and-fire neural models are investigated by simulation and by analytic approximation method for two different noise types represented by a Wiener process, representing many smaller synaptic inputs, and a Poisson process, representing a few large synaptic inputs. The models used are motivated primarily by the papers of Lansky and Rodriguez (1999 Physica D 132:267-286). One main difference is that the output

of our model is a renewal process rather than a correlated point process. Biophysically this corresponds to antidromic invasion of the action potential into the dendrite to reset the membrane voltage following an action potential.

We concentrate on two neurons, both with the same compartment (membrane electrical properties) at the site of action potential initiation; however the two compartment model includes the dendritic partition of the neuron by a second compartment. The two compartment model is to contrast spatial effects in neurons with longer thinner dendrites to those with short thicker dendrites that can be modeled as a one compartment equivalent circuit. Biophysically this means that the voltage is roughly the same in the spike initiation site and the proximal dendritic processes. The minimum function of the first passage time is used to examine the effect of innervation pattern on the first passage time. Biophysically this corresponds to the case that the only one site among the branches of the active dendrite contributes to fire the action potential and the rest of the branches are antidromically invaded by the spike (Harris and Milne 1965 J. Acoust. Soc. Amer. 40:32-42). The Euler forward method is used to simulate the Ito version of the stochastic differential equations corresponding to these equivalent circuits. The approximation methods for first passage times outlined in Smith (1992, Single Neuron Computation, Chapter 21, pp 561-588, Academic Press) were computed and compared to moments of simulated output of the neurons. For smaller noise variation and when the mean voltage crosses the threshold a heuristic explanation explains the systematic variation in the mean and standard deviation of the first passage time, namely the mean interval of the output point process and its standard deviation. The approximation is simply that expected from the delta method.

For equal firing rates or output mean intervals, the two compartment model shows a pronounced reduction of variability in firing times. Results from the Wiener and Poisson inputs are similar provided the input mean and variance are matched. The minimum function also reduces the variability but to a lesser degree than that in the two compartment model.

Jeff Bowman
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisor: Jim Hibbard

The Virgilina Sequence: A New Lithotectonic Unit in North Central, North Carolina

The Virgilina sequence has traditionally been thought to represent part of a thick conformable lithotectonic unit, in the Carolina terrane of north-central North Carolina. Lithotectonic units are a sequence of rocks that were deposited or crystallized in the same tectonic setting over a specific duration of time. They form the basis for regional correlation of crustal blocks in the Appalachian mountain chain. Recent geochronology has confirmed a major time gap of approximately 35 m.y. between the Precambrian Hyco and Aaron formations in the Carolina terrane. Previous workers thought that these units formed a conformable sequence; and used this interpretation in correlating the Carolina terrane with the northern Appalachian Avalon terrane, the two largest exotic terranes in the Appalachian orogen. However, on the basis of other geologic characteristics, this correlation has been questioned. The newly confirmed unconformity indicates that the Virgilina sequence is a distinct lithotectonic unit that includes the Aaron formation along with the interlayered Virgilina volcanics. The objectives of the study are to (1) characterize the sequence as a new lithotectonic unit and (2) determine the nature of the confirmed unconformity. My study has characterized the Aaron Formation as lithic volcanic sandstones and siltstones with a well-defined conglomerate layer near the base of the formation. The Virgilina volcanics include felsic-mafic volcaniclastics that have significant thickness near the top of the Virgilina sequence, but also outcrops discontinuously throughout the Aaron formation. The Virgilina sequence is disposed in a large-scale syncline overturned to the NW with an axial trace trending NNE. Observations taken from detailed geologic mapping at the 1:24,000 scale has suggested a disconformity between the Hyco formation and the Virgilina sequence with no deformational event prior to deposition of the sequence. Future work done in this study with U-Pb zircon age dating of the Virgilina volcanics will help constrain the absolute age of the Aaron formation and Nd-isotopic analysis will allow for comparison with other peri-Gondwanan sequences.

Molly C. Brannock
Graduate Program: Chemistry
Advisor: Christopher Gorman

Optimization of Palladium Catalyzed Coupling Reactions in the Synthesis of Electron Deficient Diaryl Cyanomethanes

The coupling of aryl halides with benzylic nucleophiles in the presence of palladium has documented difficulties when *ortho*- substituents and/or extremely electron deficient species are present on the arene. We have determined conditions that avoid these problems. The results of systematic exploration of reaction conditions will be presented, and competition between the palladium-mediated coupling and nucleophilic aromatic substitution (NAS) will be illustrated and discussed. Also the choice of base, and its comparison to the pKa values of the starting material and product will be discussed.

Laurel B. Childress[1], Elana L. Leithold[1], Neal E. Blair[2], and Benjamin R. Brulet[1]
Graduate Programs: Marine, Earth, and Atmospheric Sciences, North Carolina State University[1]; Biogeochemistry, Department of Civil and Environmental Engineering, Department of Earth and Planetary Sciences, Northwestern University[2]
Advisor: Elana L. Leithold

Use of carbon and nitrogen stable isotopes to study Late Pleistocene to Holocene environmental change in the Waipaoa Sedimentary System, New Zealand

The stable isotopic composition of organic matter in continental margin sediments provides a useful, long-term record of environmental change. The Waipaoa River watershed, New Zealand, represents a system of interest due to its very large sediment supply and well known, relatively recent history of anthropogenic disturbance. Radiocarbon measurements of three continental shelf cores taken aboard the RV Marion Dufresne in January 2006 offshore from the river mouth suggest a record extending into the late Pleistocene, dating as far back as 14,000 years. Carbon and nitrogen isotope analyses of terrestrial sources including soil profiles, sedimentary rocks and riverine sediments from within the watershed suggest terrestrial processes such as shoreline progradation, hillslope erosion and gully incision, and the capture of river tributaries are possibly influencing isotopic ratios and impacting the marine stratigraphic record. Unique isotopic signatures of soil profiles from disparate areas of the watershed could explain some isotopic variation seen in the cores as deviation in delivery volume from certain tributaries. Within the marine record in all three cores exists a distinct excursion of carbon isotopes to more positive values. Possible explanations for this include an increase in marine productivity and the increased absorption of marine organic matter onto clay particles. Increasing nitrogen isotope values also within the excursion could suggest an increase in marine organic matter, however this could be the result of increased input of degraded refractory terrigenous organic matter or contributions of inorganic nitrogen.

Edward L. D'Antonio
Graduate Program: Chemistry
Advisor: Edmond F. Bowden

Modulation of the Dehaloperoxidase Ferric/Ferrous Formal Reduction Potential Induced by Halophenol Internalization

The hemeprotein dehaloperoxidase (DHP) from the marine worm *Amphitrite ornata* is a globin having enhanced peroxidase activity. DHP converts 2,4,6-trihalophenols into 2,6-dihaloquinones when exposed to hydrogen peroxide. The quinone product is two electron equivalents more oxidized, more hydrophilic and usually less toxic. DHP has a distinct difference from common globins and peroxidases since a well defined cavity is present distal to its heme. Lebioda and co-workers (*La Count et al. J. Biol. Chem. (2000) 275, 18712 – 18716*) crystallized DHP with 4-iodophenol bound in the cavity and de Serrano and Franzen (unpublished data) have recently obtained the crystal structures for the complete para-halophenol series. Although all the para-halophenols bind in the pocket, they do not, however, show any activity through spectrophotometric assays. Crystallization of the more highly substituted and active halophenols with DHP has been unsuccessful due to their low solubility in aqueous solution. Without the crystal structure of the DHP-substrate complex, the active site location remains unconfirmed.

The objective of the current study is to determine if a substrate such as 2,4,6-trichlorophenol binds in the distal cavity by using the spectroelectrochemistry technique and we plan to address this question by observing any modulating

effect on the DHP Fe(III)/Fe(II) formal reduction potential. The DHP formal reduction potential was examined in the presence and absence of various halophenols by UV-visible thin-layer spectroelectrochemistry (SEC). The electron transfer (ET) mediators, tris(ethylenediamine)ruthenium(II) and N,N,N'N'-tetramethyl-p-phenylenediamine were employed since solution DHP ET kinetics were irreversible under mediatorless conditions. Under anaerobic conditions at pH 6, the DHP Fe(III)/Fe(II) formal reduction potential in the absence of a halophenol is +0.218 V vs NHE. Exposure to excess 4-chlorophenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol causes shifts in redox potential of -54 mV, -68 mV and -21 mV, respectively. Currently, additional studies are underway to survey more halophenols to simply aid in understanding the nature of the halophenol binding.

Joseph D. DeSousa
Graduate Program: Chemistry
Advisor: Bruce M. Novak

Structural Elucidation and Applications of Unsubstituted Polyguanides; N-enchained Guanidine Polymers

Guanidine and its derivatives are ubiquitous in chemistry and nature. The linear dimer, biguanide, is a common functional group found in many pharmaceutical products for example the antimalarial drug Proguanil HCl® and the type 2 diabetes medication Metformin. Larger linear structures of guanidine, for instance, triguanide and tetraguanide are less common and challenging to synthesize due to undesirable byproducts from side reactions such as melamine, an aromatic trimer. Therefore, few examples of a linear oligomeric or polymeric, N-enchained, polyguanide polymers have been reported. Of those few sources many contain molecular calculations describing polyguanides as potential super-bases due to both their calculated high pKa values and their absolute proton capacity. Considering the manifold usefulness of guanidine derivatives, an N-enchained, guanidine polymer would provide an avenue for many applications such as drug delivery, conjugated polymers, and biocidal coatings to name a few**.** Our objective in this work is to synthesize a linear, N-enchained polyguanide polymer and probe some fundamental properties; 1) degree of conjugation, 2) acid/base interactions, and 3) biological activity. We detail here a methodology for constructing N-enchained polyguanides from the straightforward hydrogenolysis of poly(dibenzyl carbodiimide) precursor polymer using Pd/C and H_2. Poly(dibenzyl carbodiimide) is prepared from the polymerization of dibenzyl carbodiimide monomer with an organotitanium complex following living polymerization kinetics. Deprotection was confirmed by ^{1}HNMR and FT-IR and the resulting polymer was water soluble and colored. Some initial results have exhibited interesting thermal resistance properties. The thermal resistance was determined by Thermal Gravimetric Analysis showing retention of 60 wt. % to temperatures of 600 °C under a nitrogen atmosphere while retaining characteristic chemical ID. Other studies have revealed weight retention to temperatures in excess of 1100 °C; and to temperatures of 900 °C under a pure oxygen atmosphere. Future work will involve the elucidation of the nature of the backbone, applications of the polymer, and modifications.

Carl DiCasoli
Graduate Program: Statistics
Advisors: Sujit Ghosh and Subhashis Ghosal

On an Empirical Method for a Generalised Version of the Yang and Prentice Model

In survival data analysis, the proportional hazards (PH), accelerated failure time (AFT), and proportional odds models (POM) are commonly used semiparametric models for the comparison of survivability in subjects. These models assume that the survival curves do not cross. However, in some survival applications, the survival curves pertaining to the two groups of subjects under the study may cross each other. Hence, these three models stated above may no longer be suitable for making inference. Yang and Prentice (Biometrika, 2005 92(1):1-17) proposed a model which separately models the short-term and long-term hazard ratios generalizing both PH and POM. This feature allows for the survival functions to cross. We study the estimation procedure in the Yang-Prentice model using the empirical likelihood approach. This method is extended to a regression version involving predictors, where the posterior sample is computed. After performing a simulation study, we can observe that this method works well and produces insignificant biases for both censoring cases of 30% and 50%. Finally, good properties of this method are also examined.

Janine M. Haugh
Graduate Program: Applied Mathematics
Advisor: Mansoor Haider

Modeling Cartilage Regeneration in the Extracellular Environment of a Cell-Seeded Hydrogel

Articular cartilage is a connective tissue lining the surfaces of bones in diarthrodial joints such as hips, knees, and shoulders. As a natural biomaterial, cartilage is important for load support, energy distribution, and lubrication of joints, but can become damaged due to injury or osteoarthritis. Cartilage has a limited capacity for repair and growth that is regulated by cells, called chondrocytes, that are sparsely distributed throughout the tissue's extracellular matrix (ECM). In recent years, the potential use of nutrient-rich hydrogels seeded with cartilage cells as biomaterials for tissue regeneration and repair has seen wide interest. In this study, we develop mathematical models for cartilage regeneration in the local environment of a single cell seeded in a hydrogel scaffold. A spherical geometry is employed with three concentric regions: the cell, its extracellular matrix, and the hydrogel. Radially symmetric reaction-diffusion equations are used to describe the coupling of nutrient and synthesized (unlinked) matrix concentrations in the region. Several models are considered to describe the process by which unlinked matrix proteins react with the hydrogel to form linked extracellular matrix. Numerical solutions are based on finite difference methods and capture motion of the evolving gel-tissue interface. The resulting models are used to conduct a parametric analysis that quantifies tissue regeneration times in terms of underlying biophysical parameters in the models.

Joshua Hemperly, Xin-Yu Wen, Nicholas Meskhidze, and Yang Zhang
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisors: Yang Zhang and Nicholas Meskhidze

The Evaluation of the Global Weather Research and Forecasting (GWRF) Model with Surface-Based and Remotely-Sensed Observations

The Weather Research and Forecasting (WRF) Model is the next generation of numerical weather prediction system used by both atmospheric researchers and forecasters. Global WRF (GWRF) is a global extension of the regional WRF model that was released in April 2008. GWRF presents the opportunity to provide initial and boundary conditions for mesoscale WRF as well as ensuring a self-consistency of model physics for an extended application for global-through-urban nested meteorology and/or air quality simulations. The main objective of this study is to evaluate the capability of GWRF for an accurate representation of the global atmosphere using observational data. The evaluation focuses on simulated meteorological variables that can influence air pollutants important to human health and climate change. These variables include 2-meter temperature and relative humidity, 10-meter wind speed and direction, as well as downward shortwave and long-wave radiation fluxes at the surface and precipitation. The GWRF simulation for the year 2001 is conducted at a horizontal resolution of 1° ´ 1° and a vertical resolution of 27 layers. The observational networks used in this study include the Baseline Surface Radiation Network (BSRN), Clean Air Status and Trends Network (CASTNET), and the National Climactic Data Center (NCDC). The remotely-sensed precipitation data is from the Tropical Rainfall Measuring Mission (TRMM) satellite; in-situ precipitation measurements are taken from the National Atmospheric Deposition Program (NADP). The overall performance of GWRF is evaluated in terms of spatial distribution and statistics such as the normalized mean bias (NMB) and correlation coefficient (Corr) over the global domain, the Northern and Southern Hemispheres, and the six populated continents. Preliminary surface temperature comparison for GWRF and NCDC values shows high correlations (>95%) and low NMBs (smaller than ±10%) for July and December of 2001.

Kathleen Iwancio
Graduate Program: Mathematics
Advisor: Irina Kogan

Noise Tolerant Planar Curve Matching Using Invariants

Curve matching has a variety of applications in computer image processing and image recognition. Two curves are equivalent if they lie in the same orbit. Two curves in $\mathbf{R}^2$ are equivalent under the action of the Euclidean group if one curve can be mapped to the other by a combination of rotations, reflections, and translations. Differential invariants for the Euclidean group are well known and can be used to solve the curve matching problem. The use of differential

invariants is problematic though because derivatives are sensitive to noise. We instead use integral invariants, which are much less sensitive to noise.

Justin G. Kennemur
Graduate Program: Chemistry
Advisor: Bruce M. Novak

Selective Optical Rotations of +359° to -359° from a Single Molecule: A Polycarbodiimide Tunable Polarizer

New ways of efficiently controlling and harnessing light are important for energy conservation. Of the many variables of light, polarization, the rotation of linear light has been utilized on a macro-scale by way of films and liquid crystal cells. However, at a molecular level, very little scientific discoveries have been found in which a single molecule can reversibly vary the polarization of light in a controlled fashion. The ability to achieve this over a large range of rotation values could lead to improved applications in optical display and optical sensor technologies. Polycarbodiimides are helical polymers that are capable of obtaining high single-handedness when polymerized using chiral catalyst systems. These polymers have been shown to effectively rotate light due to the chiral geometry of the helix. A specific polycarbodiimide derivative was discovered to effectively change its polarization capabilities when dissolved in toluene versus chloroform. Further investigations of this discovery revealed a low-energy conformational change was resulting from synchronous realignments of polyaryl pendant groups that project outward from the central helical backbone. These changes are responsible for the observed changes in optical rotation. Although interesting, limitations such as low solvent versatility, limited wavelengths of polarized light, and a comparatively low range of polarization values were present. Current research has been set to improve on these limitations through synthetic deviations of the polyaryl pendant groups and to potentially learn more about what factors influence these variable polarizing capabilities. Although many new polymers have been made, one polymer in particular has been found to exceed all the aforementioned limitations. This new polymer has conformational switching capabilities in a variety of solvents and can vary the polarization of light from +359° to -359° as a function of temperature and solvent. This has never before been documented on a molecular scale.

Jillian Kurek
Graduate Program: Marine, Earth, and Atmospheric Sciences
Advisor: James P. Hibbard

Implications for the Stratigraphy of the Albemarle Group in Central North Carolina

The Albemarle Group is an important component of Carolinia, one of the largest crustal blocks composing the Appalachian orogen. Recent discovery of microfossils in two formations of the group, the Tillery Formation and overlying Cid Formation, indicate younger ages for the formations than previously interpreted, therefore demanding a reinterpretation of the stratigraphy for the Albemarle Group. However, the fossil report has only been published in abstract and not replicated; thus its validity is questionable. This study will provide data towards clarifying the stratigraphy of the Albemarle Group. Three hypotheses are proposed regarding the fossil data: 1) the data represent the age of the Tillery and Cid Formations and an alternate stratigraphy must be implemented; 2) the data are correct but represent the age of rocks only in the immediate vicinity of the fossil locales; or 3) the data are incorrect, and the current stratigraphy is valid. To discriminate between these hypotheses, I am undertaking field studies aimed at the extent of strata in the quarry where the fossils were reportedly found, the nature of the contact between the Tillery and underlying Uwharrie Formations, and the original geometries of these two formations. Field methods include geologic mapping near Randleman, NC, measuring orientations of rock fabrics and folds, collecting samples for petrographic analysis, and detailed study of Tillery Formation strata in the quarry. Radiometric age dating will be conducted on a dike that intrudes the Tillery in the quarry, to further constrain the age of the Tillery Formation. To date, collaborators from the North Carolina Museum of Science are unable to replicate the purported fossil data. Field observations indicate that the contact is conformable, with the Uwharrie inter-layered with the Tillery.

Nick Luhring and Chueng-Ryong Ji
Graduate Program: Physics
Advisor: Cheung-Ryong Ji

Nontrivial Vacuum Effect in Flavor Mixing Problem

One of the most popular inquiries in particle physics today is the flavor mixing problem as we see in neutrino oscillation phenomena. Although the flavor mixing problem has been explored with the Pontecorvo formalism in quantum mechanics, more advances have been made in our understanding through quantum field theory. By taking the effects of the coherent vacuum, the quantum field theory offers more accuracy to the flavor mixing problem then quantum mechanics. In this presentation, we discuss the unitary inequivalence between the flavor vacuum and the mass vacuum in quantum field theory and describe its consequence to the flavor mixing problem in neutrino oscillations. We show the nontrivial vacuum effect as it relates to the neutrino oscillation problem and compare it with the difference in the time evolution of the two mixing pseudoscalar meson fields (e.g. η-η′ system) between the quantum field theory and quantum mechanics. We also explore an analogy between coupled harmonic oscillators and the flavor mixing problem and discuss more heuristically the difference between the trivial vacuum and the coherent vacuum.

Anita A. McCulloch[1], Daniel Kamykowski[1], John M. Morrison[2], William V. Sweet[3], Blake A. Schaeffer[4], and Stuart Banks[5]
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Advisor: Daniel Kamykowski

Phytoplankton Community Structure of the Galapagos Marine Reserve

Oceanic phytoplankton communities are critical to our understanding of the global carbon cycle and ecosystem biodiversity. Previous studies on phytoplankton communities show that dramatic shifts in species composition are associated with spatial and temporal variations in phytoplankton biomass. Ocean color monitoring, such as satellite remote sensing, has primary focused on measuring chlorophyll *a*, the most common pigment found in photosynthetic plankton. However, other pigments can be used to improve our ability to monitor phytoplankton community structure and its changes. The objective of this study was to determine the seasonal and inter-annual variations in surface phytoplankton communities in relation to the water-mass structure in the Galápagos Marine Reserve (GMR). The GMR, located along eastern equatorial Pacific, is one of the first areas to be impacted by large-scale climatic variations, such as ENSO. Surface water samples were collected on the M/V *Sierra Negra* in June 2006 (Jun06), November 2006 (Nov06), and May 2007 (May07). Phytoplankton pigments, groups and size spectra were identified with HPLC, ChemTAX, and FlowCAM analyses. Pigment analyses revealed distinct spatial patterns in chlorophyll *a* concentration and community structure with peak chlorophyll *a* concentrations and lower group diversity in the upwelling canal zone during all three cruises. Pelagophytes and Diatoms made up the greatest % relative to chlorophyll *a* in the upwelling zone in May07. Phytoplankton pigments and groups also varied inter-annually depending on the ENSO cycle. During normal ENSO conditions (June06), the overall average chlorophyll *a* concentration was significantly higher than mild El-Nino conditions (Nov06). However, no significant difference was found between the average chlorophyll *a* concentration for Nov06 and May07. This project is the first to our knowledge to characterize the phytoplankton communities throughout the Galápagos Marine Reserve. We hope that future results will further advance our understanding of these phytoplankton communities.

Mahmoud Moradi, Volodymyr Babin, Christopher Roland, and Celeste Sagui
Graduate Programs: CHiPS; Physics
Advisor: Christopher Roland

A Free Energy Study of Polyproline Peptide Folding

Polyproline peptides are known to occur in two different conformations, including right-handed PPI and left-handed PPII. Depending on the solvated environment and the peptide length, either PPI or PPII is favored. Recently, we calculated the two dimensional free energy landscapes of short polyproline peptides (length 6, 9, 13-mers) in vacuo, in implicit water, and in the solvents hexane and propanol as a function of different sets of collective variables including three different combinations of handedness, radius of gyration and two other variables, defined based on the peptide

dihedral angles. To calculate the free energies, the recently developed Adaptively Biased Molecular Dynamics (ABMD) method, which belongs to the general category of umbrella sampling methods with a time-dependent potential, was used. In agreement with experiments, PPI was favored in propanol while PPII was favored in hexane and water. The microscopics of the interconversions between PPI and PPII were discussed using the transition pathways obtained from the ABMD results while the Steered Molecular Dynamics (SMD) method was used to examine different pathways and different collective variables.

Carlos Ortiz
Graduate Program: Physics
Advisors: Karen Daniels and Robert Riehn

Jamming In Microfluidic Devices

We study the jamming of sub-micron particles in microfluidic channels by conducting parallelized experiments on lab-on-chip devices under real-time optical observation. Complex materials such as foams, emulsions, and granular materials undergo jamming, a phase transition from a flowing to a stationary state. To minimize jamming in complex devices at the micro- and nano-scales requires an understanding of jamming which currently does not exist. Experimental evidence suggests the phase transition common to these jamming phenomena depends on imposed load, temperature, and packing fraction. We pumped sub-micron fluorescent particles through a parallelized array of channels. Our device consisted of parallel rows of funnel structures made from glass pillars. The pillars allow a small fluid leakage current above them, allowing beads to concentrate at the inter-pillar gaps. We observed that bidisperse suspensions (mix of two sizes) jam more readily at a lower flow rate, whereas monodisperse suspensions (a single size) require ten times higher flow rates to jam. These results suggest that jamming transitions depend strongly on polydispersity.

Nancy M. Santagata[1], Katie M. Andrews[2], Pengshun Luo[2], Bryce F. Davis[2], Marco Buongiorno Nardelli[2] , and Thomas P. Pearl[2]
Graduate Programs: Chemistry[1]; Physics[2]
Advisor: Thomas P. Pearl

Stereochemical Effects on the Electronic Structure of the Tartaric Acid/Ag(111) Interface

Shockley-type surface states exist on several metal surfaces and are characterized by electron confinement by the vacuum barrier on one side and a band gap in the bulk on the other. The ability the tune the energy of these unique surface states could have important implications in the design of metal/organic interfaces that exhibit interesting electronic structures. We will report the observation of Shockley-type surface state energy shifts as a signature of adsorbate structure for tartaric acid (C4H6O6) on Ag(111). The adsorption of both enantiopure and racemic tartaric acid in the submonolayer regime was studied with low temperature scanning tunneling microscopy (STM) and spectroscopy (STS) and modeled with density functional theory (DFT). We find that the surface state, which is occupied on the clean Ag(111) surface (67 meV below the Fermi level), undergoes a positive energy shift and becomes unoccupied after the adsorption of both forms of tartaric acid. The magnitude of the shift differs, however, for films composed of either enantiopure or racemic domains, and we attribute these relative shifts to unique adsorbate units. DFT is used to confirm the molecular-level adsorbate arrangements that lead to the experimentally observed behavior.

Mary Scott, Derrick Stevens, Jason Bochinski, and Laura Clarke
Graduate Programs: Physics
Advisor: Laura Clarke

Molecular dynamics within self-assembled monolayers

Self assembled monolayers (SAMs) have been extensively studied and are frequently implemented as a way to modify surface properties. Such systems, which consist of hydrocarbon chains anchored by a reactive headgroup to a two-dimensional substrate, are normally thought of as static, however the dynamics within the monolayer can affect surface properties such as permeability and friction. These properties are important for common SAM applications such as liquid phase chromatography and prevention of corrosion. Our experimental physics group studies such

molecular motion within SAMs, which depends on monolayer coverage (density) and whether the film is in an ordered or amorphous state. Furthermore, the motion can be local (about a single bond) or glassy (cooperative motion of more than one molecular group). Glassy motion and glass transitions are typical of amorphous glasses and polymers, and our group employs this simple monolayer system as a model for more complicated polymers. The specific objective of this work is to study dynamics as a function of monolayer density, observing how the system transitions from local motions to the highly cooperative processes similar to that within random polymers. In this study, alkylsiloxane SAMs of varying density have been produced by vapor phase deposition to create a highly disordered, amorphous state. Dynamics within the SAMs have been studied by sensitive, temperature-dependent dielectric spectroscopy, and structural properties of the monolayer films have been measured using contact angle, ellipsometry and atomic force microscopy. A cooperative motion is observed in all samples with carbon chain lengths greater than four. This motion is similar to that exhibited by polyethylene, a very long carbon chain. As the density increases, the dynamics of the system transition from that of an isolated molecule to a more cooperative process, closer to that within a polymer.

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Althea Smith
Graduate Program: Biomathematics
Advisors: Fredrick Breidt Jr. and Charles E. Smith

Measuring and Modeling the Survival of *Escherichia coli* O157:H7 Under Acid and Salt Stress

When processing acidified vegetable products, e.g. pickles, there is a risk of contamination by microbial pathogens such as *Escherichia coli* O157:H7 *(E. coli)*. At present, the FDA does not allow the use of organic acids as primary barriers to these microbial pathogens, but current research indicates their advantages. Our objective is to quantify, by a mathematical or a statistical model, the relationship between intracellular conditions and the survival under acid and salt stress. Possible metabolic processes which affect the underlying survival of the cell include the internal pH, buffering capacity of the cell, proton pumping at the expense of ATP, organic acid concentration and ionic strength (salt). We measured one process (intracellular pH) and the corresponding temporal survival curves of *E. coli* O157:H7 under acid and salt stress. Using a Weibull approximation for the killing kinetics, preliminary results indicate that pathogen survival depends on salt concentration and perhaps intracellular pH. The five log reduction time was estimated for several salt and acid concentrations. This response measure of time for pathogen killing has been used previously to indicate optimal temperatures (Breidt et al., 2005); here temperature is fixed and a response surface for this five log reduction time as a function of both acid and salt concentration is presented. The maximum of the time versus acid concentration curve peaks at a low acid concentration and then decays exponentially. Higher salt concentrations give lower times and a later peak in this curve. The shape parameter of the Weibull approximation are all sub-linear with one exception. A two-factor ANOVA of the scale parameter of the Weibull approximation indicated that salt concentration is more significant than acid concentration. Correlations of measured intracellular pH with our response measures and factors were examined. The quantitative and qualitative results of these relationships will be presented here.

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Advisor: Daowen Zhang

Application of Logistic-Normal Models to Study the Epidemiology of White Rot in Garlic

In this work we model disease progress curves for white rot in garlic by using logistic-normal models: a logistic regression model for the disease progress curves with random coefficient(s) having normal distribution. The selected model is interpreted both in terms of subject-specific curves and population-average curves. The induced marginal curves are obtained from the conditional curves averaging out the random effects. We propose to interpret not only the mean marginal curve, but also important percentiles (Q1, median and Q3) from the marginal distribution.

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Advisor: Mette S. Olufsen

Modeling the Mechanical Properties of Large Ovine Arterial Walls using both in-vivo and in-vitro data

In this study the differences among viscoelastic properties were predicted across 7 locations along the large arteries in 11 sheep in-vitro and in one artery in 7 sheep in-vivo. For the in-vitro study, experimental data comprising measurements of blood pressure and vessel area were obtained at one frequency mimicking the resting heart rate. For the in-vivo study, a pacemaker was implanted in the sheep allowing measurements of pressure and area at heart rates ranging from 50–160 BPM. To estimate vessel properties, represented by model parameters, we employed two viscoelastic models: A 4-parameter Kelvin model and a 7-parameter extended model. Material properties were extracted from these models via solution of the associated inverse least squares problem. The latter was done using nonlinear optimization. Furthermore, sensitivity analysis was used to rank model parameters from the most to the least sensitive, as well as to compute the standard errors and confidence intervals. Results reveal that both elastic properties and the inclusion of viscoelastic behavior in the model are important for capturing the observed pressure-area dynamics. In addition, we observed that for the smaller vessels were wall deformation is dominated by viscoelastic responses, the extended model captured the pressure-area dynamics better than the Kelvin model, while for the aorta, where wall deformation is dominated by nonlinear elastic responses, the extended model did not improve prediction of pressure area dynamics. In addition, results show that data fitting using the same models vary in accuracy between in-vivo and in-vitro, which may be due to the auto-regulation of the vessels or discrepancies between the data collecting techniques.

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Advisors: Stephen Reynolds and Kazimierz Borkowski

Using Supernova Remnants as a Probe of Dust Grains in the Interstellar Medium

Interstellar dust grains play a crucial role in the evolution of the galactic interstellar medium (ISM), from catalyzing formation of H_2 molecules important in star formation to serving as the building blocks of stars, planets, and life itself. Despite its importance, however, dust remains poorly understood in terms of its origin, composition, and abundance throughout the universe. Supernova remnants (SNRs), the remains of stellar explosions, provide a unique laboratory for studying the evolution of dust grains, as they are one of the only environments in the universe where it is possible to observe dust grains being both created and destroyed. I present results from infrared (IR) and X-ray observations done with the *Spitzer Space Telescope* and the *Chandra X-ray Observatory* of several known SNRs in both the Milky Way galaxy and the Large Magellanic Cloud (LMC). Emission from SNRs in the IR is dominated by thermal emission from dust grains, collisionally heated by interactions with the $> 10^7$ Kelvin plasma created by the expanding shock wave from the supernova, which glows brightly in X-rays. Both photometric and spectroscopic observations show very little evidence for freshly formed dust from the ejected remains from the star, despite theoretical predictions that such objects should be "dust factories." Observations also show that the relative amount of dust present in the ISM compared to the amount of gas is lower by a factor of several from that inferred from extinction of starlight. Possible explanations for this discrepancy will be discussed. These results are broadly consistent for every object in our study, and do not vary considerably with simple adjustments of input parameters, suggesting that the answer likely involves a re-working of fairly well established astrophysical theory.

Stacey Wood
Graduate Program: Statistics
Advisor: Alison Motsinger-Reif

Power of Multifactor Dimensionality Reduction to Detect Gene-Gene Interactions with Known Covariates

The significance of gene-gene and gene-environment interactions in common, complex diseases is increasingly being

recognized in the area of human genetics. While many rare diseases follow simple Mendelian inheritance patterns, many common diseases are thought to exhibit complex interactions with marginal to no main effects. Many methods are currently available to detect these possible interactions in case-control study designs, including traditional statistical approaches such as stepwise logistic regression. There are many concerns with traditional statistical approaches to detect epistatic interactions, and a variety of novel data-mining methods have been developed. Multifactor Dimensionality Reduction (MDR), a data-mining method, has been shown to have higher power than logistic regression to detect interactions in the absence of main effects (Motsinger-Reif et al 2008).

Many common complex diseases have been extensively studied and some genetic covariates have already been identified. However, these covariates only explain a fraction of the heritable component of the phenotype, indicating that additionally genetic effects are present. Gene-gene interactions are hypothesized to play an important role in the genetic susceptibility of common, complex disease. The focus of the present study is to compare the power of MDR to stepwise logistic regression when both already established loci and unspecified interactive loci both contribute to disease risk through simulation. We consider models of various effect size, heritability, and number of interacting loci.

Sangwon Chung[1,2], **So Hyun Kim**[3], and Martin W. King[1,4]
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Advisor: Martin W. King

Fibrous Elastomeric Scaffolds for Vascular Tissue Engineering

One of the most severe forms of heart disease is associated with atherosclerosis, a process that causes narrowing of the arteries. Although using a synthetic graft has been moderately successful for bigger diameter vessels, on small diameter vessels (< 6mm), it has yet been successfully demonstrated clinically despite many years of research efforts, leading to the tissue engineering approach. Native blood vessels have a hierarchical configuration with smooth muscle cells and collagen fibrils oriented circumferentially in the media layer and with a monolayer of endothelial cells lining the internal intima layer [Nerem et al., *Ann Rev Biomed Eng* 2001;3]. To mimic this configuration both morphologically and mechanically, we have developed a unique hierarchal scaffold architecture using different fabrication techniques to prepare tubular scaffolds from a novel biodegradable elastomeric poly(L-lactide-co-ε-caprolactone) (PLCL) copolymer. In this study, the fabrication of the inner most layer of the hierarchical scaffold via electrospinning is reported. Small diameter tubular fibrous structures were successfully produced via electrospinning using 50:50 PLCL copolymer using 1,1,1,3,3,3-hexafluoro-2-propanol (HFIP) as a solvent. The mean diameter of the electrospun fibers in the inner layer was 960 ± 30 nm and the total porosity of the tubes was 84.38 %. The appearance of the tubes was white and film-like, maintaining both their tubular shape and their mechanical integrity. It was found that the highly elastomeric properties of the tubes exceeded that of the native tissue. Based on the cytotoxicity/cell viability assays, it was evident that cell viability increased after 7 days of culture. These electrospun layers were designed to be the inner layer of hierarchical vascular scaffold and promote growth of endothelial mono-layer and provide hemostasis. In addition, current research focuses on producing the outer layers of the tubular constructs by different fiber processing techniques so as to promote three-dimensional smooth muscle cell growth.

Jinmei Du, Stephen Michielsen, and Hoon Joo Lee
Graduate Program: Fiber and Polymer Science
Advisors: Stephen Michielsen and Hoon Joo Lee

Design and preparation of superoleophobic materials

A surface having a water contact angle greater than 150° and very low roll off angle (<5°) is called a superhydrophobic surface. Several superhydrophobic materials have been made by mimicking plant leaves. It would be beneficial if similar "superoleophobic" materials existed. However, it is very hard to obtain superoleophobic surfaces because of the low surface tension of oil. Interestingly, the Lady's Mantle leaf has hydrophobic cuticles and hydrophilic fibers rising from the surface. It may be possible to use this approach to make superoleophobic materials. In this case, the LaPlace pressure of a droplet on the hydrophobic substrate is higher than the LaPlace pressure of the droplet on the hydrophilic fibers. Thus, the liquid droplet is pushed from a flat surface onto fibers by the difference in the LaPlace

pressure. With proper chemical and physical modifications it may be possible to prepare superoleophobic materials mimicking the behavior of Lady's Mantle leaves. In this research, liquid transfer from flat surface to fiber is studied.

Leslie Spinney Hatch
Graduate Program: Textile Technology Management
Advisor: Traci Lamar

Assessing the Requirements for Hospital Apparel

This project's goal was to develop a comprehensive description of the requirements for a revolutionary healthcare garment for patients. The approach integrated survey and qualitative data from three key stakeholders: patients, health care providers, and supply chain constituents. The research is unique in integrating the requirements of these diverse stakeholders, based on current hospital experiences, and including a broad demographic.

One survey was distributed to 2,600 patients, who had recent hospital stays. The survey accommodated both English and Spanish speaking participants (20% response rate). A secondary patient survey, designed to provide depth on the emotional experience of wearing a gown and capture the perspective of a younger patient, was distributed as a follow-up. A third survey was distributed to 1,200 health care providers from a broad range of hospital departments (19% response rate) and additional data was collected through six distinct focus group sessions in North Carolina and Massachusetts. Information regarding the supply chain was obtained through a survey, interviews, and secondary industry research.

Data was combined with review of patents and literature to document the requirements of each group in relation to hospital attire. Identified requirements show some consistency across stakeholders, but unique requirements were also identified for each group. Some contradictions between stated priorities and behaviors related to purchasing hospital attire were discovered. An unexpected finding from the patient surveys was that healing may be influenced by the hospital gown. Additional findings show that health care providers' work was sometimes inhibited, but sometimes facilitated by the current patient gown. Finally, the gown purchase process is complex; decisions are made at individual hospitals, hospital associations, Group Purchasing Organizations (GPO), laundry services, or at any combination of those. In future work, these requirements will inform the work of researchers developing innovative, marketable patient garments.

Vamsi Krishna Jasti
Graduate Program: Fiber and Polymer Science
Advisor: Stephen Michielsen

Durable Electric Charge Storage and Dissipation in Nonwovens Via Surface Modification

Most of electret filters are melt blown nonwovens charged using an electrical corona. Charges stored in the fibers can be detrimental or essential to the performance of the filters. There are two types of electret materials; space charge electrets and dipolar electrets. However, it is not yet clear where charges lie within the electrets and how to control them. The main objective of this project is to determine the location of the stored charges and the mechanisms by which the charge is stored and dissipated. We modified the surface of nylon with poly(acrylic acid) and polypropylene-grafted-maleic anhydride. The modified surfaces are charged with corona and the field decay behavior was studied at various humidities. Combining the surface modification results with measured surface charge, charge dissipation results help to understand how the chemical moieties influence the charge storage and dissipation. Charge storage on the polymeric materials was found to be very sensitive to any material that contacted them as indicated by large changes in their static electrification. Attempts were made to find a relationship between the stored charge as measured by surface potential and the surface area (perimeter) and the linear density.

Hosun Lim
Graduate Program: Textile Technology Management
Advisor: Cynthia L. Istook

Comparing the virtual avatars with or without three-dimensional body scan data

Today, consumers using on-line shopping have increased dramatically. However, high product return rates persist due to consumers can't try on garments before purchasing. Currently, online apparel shopping allows customers to choose virtual avatar with their size and try virtual garments on their avatar. The reality of a virtual avatar is critical issue to reduce the product return rates. However, little research has been done that evaluates the reality of a virtual avatar. Therefore, this study compared with two virtual avatars: Avatar 1 was made directly from body scan data and Avatar 2 was made indirectly from body measurement data.

Subjects of women were located primarily from the Triangle area of North Carolina and were 18 years old or older. From all subjects measured using TC^2 body scanner, the body data of the top five body types including "Rectangle", "Hourglass", "Bottom Hourglass", "Oval", and "Spoon" were selected for the study. The subject's body scan data was directly imported to OptiTex software for Avatar 1 and the subject's body measurement was manually input into OptiTex software for Avatar 2. Then, we evaluated the reality of these virtual avatars comparing the images with images of garments on the real body. The result showed that Avatar 1, which had imported directly from the TC^2 body scanner, is more similar to the real body than Avatar 2 which had been created indirectly from body measurements, due to subject's specific body shape, pose, and other issues which couldn't be exactly reflected to the second virtual avatar.

This result supports that consumers need to be measured using a 3D body scanner and their body data need to be input into virtual try-on software to create their exactly sized avatar.

Anushree Mohan
Graduate Program: Fiber and Polymer Science
Advisor: Alan E. Tonelli

The Constrained/Directed Crystallization of Nylon-6

For nearly two decades inclusion compounds (ICs) have been formed by threading polymer chains into the cyclic starches, cyclodextrins. Non-covalently bonded crystalline ICs have been formed by threading CDs, onto guest nylon-6 (N6) chains. When excess N6 is employed, non-stoichiometric (n-s)-N-6-CD-ICs with partially uncovered and dangling N6 chains result. We have been studying the constrained crystallization of the N6 chains dangling from (n-s)-N6-CD-ICs in comparison with bulk N6 samples, as a function of N6 molecular weights, lengths of uncovered N6 chains, and the CD host used. While the crystalline CD lattice is stable to ~ 300° C, the uncovered and dangling, yet constrained, N6 chains may crystallize below, or be molten above ~225° C. In the IC channels formed with host α- and γ-CDs containing 6 and 8 glucose units, respectively, single and pairs of side-by-side N6 chains can be threaded and included. In the α-CD-ICs the ~ 0.5nm channels are separated by ~ 1.4nm, while in γ-CD-ICs the ~ 1nm channels are ~ 1.7 nm apart, with each γ-CD channel including 2 N6 chains. The constrained dangling chains in the dense (n-s)-N6-CD-IC brushes crystallize faster and to a greater extent than those in bulk N6 melts, and this behavior is enhanced as the molecular weights/chain lengths of N6 are increased. Furthermore, when added at low concentrations, (n-s)-N6-CD-ICs serve as effective nucleating agents for the bulk crystallization of N6 from the melt. Because of the biodegradable/bioabsorbable nature of CDS, (n-s)-polymer-CD-ICs can provide environmentally favorable, non-toxic nucleants for enhancing the melt crystallization of polymers and improving their properties.

Jung Hyun Park
Graduate Program: Textiles - Textile Management and Technology
Advisor: Hoon Joo Lee

Design of Rehabilitative Clothing for Wounded Soldiers

The goal of designing new products using smart textiles is (1) to apply fundamental and advanced technology to existing textile products and (2) to combine various technologies and materials in order to create new textile products

that improve people's life. In our research, we focus on designing and developing a smart textile product, rehabilitative clothing, which helps wounded soldiers in terms of self-training for rehabilitation.

In order to assist wounded soldiers' self-training, we will prepare rehabilitative clothing having elastic strain gauge and a multimeter which quantitatively measures the amount of exercise and monitors rehabilitation status. The users of this rehabilitative clothing can check their rehab status constantly and quantitatively and improve their physical health more strategically. The elastic strain gauge which is a one dimensional flexible sensor will be embedded in the fabric consisting of cotton/spandex blended yarns. This sensor is made of composite filament fibers having polyurethane and carbon black. The change of electronic resistance is measured and transformed to a user-friendly data, which makes sense to the patients, such as the angle between two bones at a joint. We will also develop rehab clothing patterns using a three dimensional body scanner and computer aided pattern design to make the clothes well fit to the patients. To enhance the comfortability of the clothing, we use cotton/spandex blended knit fabric with considering body temperature change, moisture management, and durability during the patients' exercise.

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Graduate Programs: Textile Engineering, Chemistry and Science[1]; Physics[2]
Advisors: Russell E. Gorga and Laura I. Clarke

Study of morphology, mechanical and electrical properties of electrospun poly(lactic acid) nanofibers incorporated with multiwalled carbon nanotubes as a function of thermal bonding

The process of electrospinning can be used to produce a random mat of nanofibers which can serve as a scaffold for tissue engineering. It has been shown that a nanocomposite system formed by the addition of multiwalled carbon nanotubes (MWNT) enhances the functionality of the scaffold by improving its mechanical and conductive properties. Further increase in mechanical and conductive properties can be obtained by improving inter-fiber connections in the scaffold through controlled spinning techniques or after treatments. Thermal bonding is discussed as a potential method to improve these connections in the scaffold.

The two different types of scaffolds which are compared for different properties are a nanofibrous scaffold of poly(lactic acid) (PLA) and a nanocomposite system of MWNT incorporated in PLA nanofibers. The glass transition temperature (Tg) and melting point (Tm) of both the scaffolds were obtained using differential scanning calorimetry (DSC). The scaffolds were treated for a predefined time for varying temperatures in open preheated petridishes in a convection oven.

The morphology of the scaffolds, before and after thermal treatment, has been studied through scanning electron microscopy (SEM) and various temperature points have been obtained for mechanical tests. Mechanical properties will be studied using tensile testing and dynamic mechanical analysis (DMA) at various temperatures starting at room temperature where there is no bonding, at a temperature above and below Tg where there is some relaxation seen in the fibers, at a temperature half way through glass transition and melting where there is moderate bonding, at a temperature below the Tm where the fibers fuse but maintain their structure and at a temperature above the Tm where the scaffold melts and forms a film. Furthermore, it is expected that the mat conductivity will increase as a function of thermal bonding (and therefore improved fiber-fiber contacts) allowing for better connectivity and, hence, electron transfer.

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Static Generation and Dissipation in Textiles

Static charge has been a major source of problems in the textile industry as well as for consumers. During textile manufacturing process, there is a potential of static charge generation when fibers are extruded, and yarns are spun, woven, knitted, and finished. This gives spinners and weavers much trouble in terms of productivity, and can lead to malfunction of electronic equipment.

This research was undertaken to gain a better understanding of static generation and dissipation on a continuous yarn surface and the effects of environmental conditions (temperature and relative humidity) and processing parameters

(yarn tension and speed). The levels of independent parameters were broad, in order to include the conditions practiced by the textile industry.

Static generation/dissipation was assessed by a newly developed device equipped with winder, two potential probes, charge pin, tension and speed controllers, and data acquisition system. The device was housed in an environmental room where relative humidity and temperature can be precisely controlled. Potentials were measured at two different positions on a running yarn in real time. Based on previously established exponential relationship, initial potential (at the generation point) and charge decay at any given time could be determined from two potential measurements.

Experimental data showed that temperature, humidity, yarn tension and yarn speed have significant effects on static generation; while temperature, humidity, and yarn speed yielded statistically significant changes on static dissipation. Anomalous behavior of static charge, which was observed at a temperature of 35°C, provided a meaningful clue to the importance of controlling the environmental conditions in textile industry.

Syamal S. Tallury
Graduate Program: Textile Engineering
Advisor: Melissa A. Pasquinelli

Molecular Dynamics Simulations of Single-Walled Carbon Nanotubes Wrapped By Various Polymers

Superior electrical and mechanical properties of carbon nanotubes (CNTs) can be utilized to develop materials such as polymer nanocomposites with desired characteristics. Several experimental studies have recently suggested that polymers adsorb on the CNT surface by wrapping around the CNT. In the case of conjugated polymer chains, this phenomenon is of critical importance as it gives rise to better orientation of chains and hence can improve conducting properties of the polymeric material. An understanding of this wrapping behavior as a function of the polymer composition can be used to optimize the desired properties of these polymeric materials. Molecular dynamics simulations were used to study the interaction between a zig-zag single-walled carbon nanotube (SWCNT) and polymer chains with varying degrees of saturation, aromaticity, and aliphaticity. The simulations indicate that polymers with both flexible and rigid backbones tend to wrap around the SWCNT, although in different conformations. Flexible backbones like nylons and polyesters wrap in a random conformation, whereas semi-rigid backbones like polyethylene terephthalate (PET) partially wrap in an S-conformation. Poly-p-phenylenevinylene (PPV) and other polymers with rigid backbones wrap in a distorted helical orientation. Polymers with bulky and aromatic side groups such as polymethylmethacrylate (PMMA) and polystyrene (PS) prefer to coil rather than wrap the SWCNT, although PS showed some pi-pi interactions with the SWCNT. Other trends and the correlation of these features to experimental measurements will be discussed.

Nagarajan TM
Graduate Program: Textile Engineering
Advisors: Russell E. Gorga and Laura I. Clarke

Development and optimization of an alternative electrospinning process for high throughput

Nanofibrous materials, such as those fabricated through electrospinning, have diverse applications including filtration, tissue scaffolding, autonomous sensors within textiles (smart textiles), and fuel cells. In the standard electrospinning process, in which fiber growth originates at a droplet suspended from a charged needle, the fabrication rate is very slow. This low throughput limits commercial applications, despite the high potential for fibers of this size (~100 nm). Our research makes a paradigm shift. We grow fibers from a large concentration of droplets on a charged plate to significantly improve the throughput. In addition, by controlling the size of droplet formation on the plate, we may be able to also achieve smaller fibers than traditional electrospinning. Our approach combines two technologies: electrospinning and utilizing self-assembled monolayers to manipulate the surface properties to achieve a hybrid, improved approach. I'll discuss our first steps on this project: including achieving fine patterns of self-assembled monolayers on the plate, exploring the optimal electric field distribution, reducing inter-jet interactions (as a result of multiple jets), and reducing electrospraying, to optimize the parameters to obtain high throughput of nanofibers using our new approach. Our experiments on Polyethylene oxide (PEO) show fibers of 100 – 200 nanometers in diameter, which have the same or better quality as fibers from the traditional technique.

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Graduate Programs: Textile Technology Management[1]; Textile Engineering Chemistry and Science[2]
Advisors: Nancy B. Powell and Pamela Banks Lee

Hemp-PLA Needle-Punched Nonwoven Composite as a 'Green' Sound Absorber

The non-biodegradable synthetic materials which are produced and/or used by the nonwovens industry have a number of adverse effects on the eco-system. The more these adverse effects are considered, the more interest is generated in natural or renewable materials, such as natural fibers and biodegradable engineered polymers. Two promising ones are hemp and PLA. Hemp is a natural bast fiber, with high strength and stiffness, and is resistant to pest attack. PLA is a compostable engineered thermoplastic polymer, which has high strength and is based on renewable raw materials like corn. This research investigates the noise reduction performance of hemp-PLA nonwoven composites. The influence of production parameters such as needle-punching, heat and compression treatment and material parameters such as fiber type and size, layering sequence of fiber webs on sound absorption behaviour of the nonwovens are studied. The possibility of using Hemp-PLA as a viable sound absorber and opportunities of increasing its noise reduction performance are searched.

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Invasion and Replication of *Bartonella* Species Within A Tick Cell Line

Bartonella species, are fastidious, gram negative bacteria, some of which are transmitted by different arthropod vectors, including fleas, sandflies, and lice. There is very little information currently available regarding the interaction and/or transmission capabilities of *Bartonella* species by ticks. In the present study, we demonstrate successful invasion of the *Amblyomma americanum* cell line, AAE12, by 7 different *Bartonella* isolates and 3 Candidatus *Bartonella* species by either electron or light microscopy. With the exception of *B. bovis* infected cells, infection with all other examined *Bartonella* species induced cytopathic effects characterized by heavy cellular vacuolization and eventually leading to cell lysis. Furthermore, using quantitative real time PCR (qPCR), there was significant growth of two *B. henselae* genotype I isolates in the *A. americanum* cell line over a 5 day period. Ultimately, tick-cell derived *Bartonella* antigens may prove useful for the development of more sensitive diagnostic reagents and may assist in the development of an effective vaccine to prevent the further spread of disease caused by these organisms.

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Development of a cell culture system to assess the effect of *Cryptosporidium parvum* infection on bystander cells

Research has shown that uninfected bystander cells in a *Cryptosporidium parvum* (CP) infected monolayer are at times preferentially apoptotic compared to infected cells. Our goal was to characterize this bystander effect in a nontumorogenic intestinal epithelial cell line. The effect of dose and duration of infection on number of organisms, life stage of CP, total epithelial cells, infected cells, organisms per infected cell, total apoptotic cells, and infected, apoptotic cells was assessed over a 48 hour period in the porcine intestinal epithelial cell line, IPEC-J2. In order to isolate the effect of CP on uninfected bystander cells, uninfected monolayers were co-cultured with infected monolayers for 134 hours, and transepithelial electrical resistance (TER) was recorded over time. At the end of the 134 hours, monolayers were assessed using transmission and scanning EM and light microscopy. The percentage of infected cells was independent of dose, ranging from 37-41% and peaking at 48 hours. Higher doses led to multiple organisms per infected cell. CP decreased the total number of cells independent of dose. Over the first 24 hours, bystander cells were preferentially lost and were more often apoptotic (2.2%$\pm$0.5) than were infected cells [1.9%$\pm$0.7 ($p<0.05$)]. The infected monolayers had a significantly lower TER than uninfected cultures ($p<0.05$) beginning 24 hours after infection. Uninfected, bystander cultures had a significantly lower TER ($p<0.05$) when compared with uninfected monolayers, and furthermore, the TER of bystanders was similar to infected monolayers. Morphologic changes consistent with cell loss

in the bystander monolayer were similar to the infected monolayer. Early in CP infections, loss of bystander cells appears to play a significant role in the decrease in barrier function and may be critical to the pathophysiology of CP diarrhea.

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Sp2: a Regulator of Stem Cell Differentiation and Tumorigenesis

Transcription factors regulate gene expression and de-regulation of their activities can transform normal cells into tumor cells. The Sp-family of transcription factors consists of nine distinct proteins (Sp1-9) that are evolutionarily-conserved and share a common DNA-binding domain. Sp2 is one of several poorly-characterized members of this transcription factor family. Previous data from our lab and others has indicated that Sp2 is over-expressed in human prostate cancer and in murine skin squamous cell carcinoma. To determine if the de-regulated expression of Sp2 is oncogenic, transgenic mice over-expressing mouse Sp2 via the keratin 5 promoter were generated. This promoter drives expression of linked genes in basal cells of stratified epithelia, such as skin. Two different transgenic lines (Family A and C) were derived and characterized. Homozygous animals develop normally and are indistinguishable from wild-type and hemizygous littermates until post-natal day 2. Family C animals invariably perish at this time whereas homozygous Family A animals develop skin lesions on post-natal day 4, are runted and developmentally retarded and perish prior to post-natal day 13. The expression level of keratin 6, a marker of epidermal wounding, inflammation, and/or tumorigenesis is increased in Family A animals beginning at post-natal day 4 as is the expression and distribution of CD34, a hair follicle stem cell marker. Hemizygous Family A animals progress to adulthood unremarkably, however 70% exhibit varying degrees of alopecia (hair loss) beginning at 1 month of age. Family C animals do not develop alopecia, however these animals are susceptible to the development of wound-induced hyperplastic growths (papillomas). These and other results have led us to speculate that Sp2 functions to limit stem cell differentiation and thus its over-expression contributes to the outgrowth of poorly-differentiated, tumorigenic cells.

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The Involvement of Superoxide and Nitric Oxide in Inflammation-Enhanced Diesel Exhaust Particle Cytotoxicity

Thirty-four million Americans have asthma, a chronic inflammatory lung disease. Although the mechanisms are unclear, epidemiologic studies show that exposure of asthmatics to air pollutants, like diesel exhaust particles (DEP), is more likely to result in adverse health effects. We have previously shown that in an analogous *in vitro* system that models "healthy" (control) and "inflamed" (asthmatic) epithelial cells, exposure of "inflamed" cells to DEP results in greater cell injury. To understand this enhanced cell injury, we investigated further the role of oxidative stress in the setting of inflammation. We hypothesized that "inflamed" epithelial cells exposed to DEP would result in oxidative stress, in part, due to the combined effect of decrease cytoprotective mechanisms and nitric oxide (NO) production. "Inflamed" LA-4 epithelial cells, induced by treatment with pro-inflammatory cytokines (TNFα+IL-1b+IFNg), were exposed to DEP, and subsequently analyzed for reactive oxygen species (ROS) as measured by the fluorescent probe H_2DCFDA, and superoxide dismutase (SOD) activity. Results indicate that intracellular ROS were significantly increased in "inflamed" cells exposed to DEP as compared to "inflamed" or DEP alone treated cells. To determine, if increased ROS was the result of decreased cytoprotective mechanism, the activity of SOD, an enzyme involved in superoxide anion catabolism, was measured and shown to be significantly reduced in "healthy" cells exposed to DEP. Lastly, NO, a free radical gas often induced in asthma, can interact with ROS to produce additional potent and long lived radicals. Using a NO inhibitor, L-NAME, ROS production was significantly decreased in DEP exposed "inflamed" cells. Together, exposure of "inflamed" cells to DEP can result in cellular oxidative stress, due to the combined decrease in antioxidant defenses and elevated NO. Similar mechanism may account for the adverse health effects experienced by asthmatics exposed to DEP.

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The Role of CRFr1 and CRFr2 in Mediating Intestinal Barrier Dysfunction in a Porcine Model of Early Life Psychological Stress

Psychological stress is a major contributing factor to the onset of several gastrointestinal (GI) diseases but the pathophysiology of the stress response is poorly understood. Our previous studies showed that early weaning stress (EWS) in a porcine model triggers disturbances in intestinal mucosal permeability that is mediated through activation of CRF receptors expressed on mucosal mast cells (MCs). This study investigates the role of CRF receptor subtypes (CRFr1 and CRFr2) in intestinal dysfunction triggered by EWS. Yorkshire 17-day-old piglets were assigned to one of four experimental treatments (n=8 piglets/treatment): 1) unweaned control, 2) EWS + saline vehicle, 3) EWS + Astressin B (CRFr1 and CRFr2 antagonist, 30 µg/kg), and 4) EWS + Astressin 2B (CRFr2 antagonist, 30µg/kg). Antagonists were administered via intraperitoneal injection one hour prior to weaning. Colon was harvested from piglets 24-h post weaning and permeability assessed on Ussing chambers (as transepithelial electrical resistance (TER) and mucosal-to-serosal flux of ^{3}H-mannitol). Electrogenic ion transport was measured as short circuit current, (I_{sc}). EWS triggered increased colonic permeability and I_{sc} in vehicle-treated piglets, seen in reductions in TER, and elevations in ^{3}H-mannitol flux and I_{sc} compared with unweaned piglets. Astressin B prevented EWS-induced increases in intestinal permeability. CRFr2 blockade with Astressin 2B increased intestinal permeability and I_{sc} compared with vehicle-treated piglets ($P<0.001$). Astressin B treated colonic tissues exhibited reductions in neutrophil infiltration and MC degranulation, whereas Astressin 2B markedly increased this response. Overall, these data suggest that CRFr1 mediates deleterious mucosal barrier responses to stress while CRFr2 mediates beneficial, protective responses.

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Determination Of Intermittent & Chronic Hypoxia In Canine Tumors

Introduction: Cancer is one of the most common causes of death in dogs. One reason for treatment failure in patients is tumor hypoxia. Tumor hypoxia results in resistance to radiation and chemotherapy in solid tumors and has been documented to exist and be linked to a worse outcome in canine patients. Tumor hypoxia is also associated with increased metastasis. Tumor cells experiencing hypoxia alter their gene expression and these changes likely result in the worsened outcome. It has been shown that hypoxia associated gene expression predicts more about outcome in people than other parameters routinely used to make treatment decisions. There are two dominant types of hypoxia, chronic and intermittent. Recent reports have shown that intermittently hypoxic cells may be more resistant to standard therapy than chronically hypoxic cells.

Materials and Methods: 3 canine soft tissue sarcoma cell lines were used; PSTS, CoFSA, and MBSa1. For chronic hypoxia, cells were exposed to 1, 8, and 24 hrs of 0.5% oxygen and 1 and 8 hours of reoxygenation. Intermittent hypoxia was studied by exposing cells to three cycles of 1 hour of hypoxia followed by 30 min. of normoxia. Normoxic control cells were included at every time point. RNA was extracted and biotin labeled using Affymetrix GeneChip® Reagents and hybridized to Affymetrix Canine 2.0 GeneChips.

Results: Preliminary results with chronic hypoxia revealed increased gene expression of HIF1α, adrenomedullin (ADR) and carbonic anhydrase IX (CA IX). Intermittent hypoxia only showed increased expression in CA IX.

Conclusions: Differences in gene expression between two types of hypoxia can be identified. The ability to identify different expression profiles between chronic and intermittent hypoxia will allow determination of the type and severity of hypoxia in individual patients. This will help clinicians decide the most appropriate course of therapy for patients.

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Canine lymphoma - the prognostic significance of cytogenetic changes

Lymphoma accounts for up to 24% of all canine neoplasia and is treatable with chemotherapy. The post-treatment survival times can be more than 24 months but are often less than 12 months. However, the response and overall survival time of an individual dog to treatment remain unpredictable. Few factors have correlated with prognosis for canine lymphoma, indicating a need to identify additional biomarkers that are of prognostic significance. There is increasing evidence that cytogenetic evaluation of human non-Hodgkin's lymphoma provides the physician with important diagnostic and prognostic information that is not available through traditional pathology and clinical staging systems. In our previous studies, several recurrent chromosomal aberrations were identified in canine lymphoma; however, an insufficient number of cases had been observed to determine the diagnostic or prognostic significance of these aberrations. This study was designed to analyze the significance of ten recurring chromosome aberrations in a panel of over 300 archival lymphoma specimens derived from dogs that were used as part of a multi-center clinical trial, all receiving the same treatment. Using genome integrated bacterial artificial chromosome clones as probes in fluorescence in situ hybridization analysis of cells isolated from formalin fixed paraffin-embedded biopsy specimens, cases have been evaluated for enumeration of the ten loci of interest to determine their prognostic value. Linear regression analysis of the data indicate that chromosome aberration in one of the ten loci evaluated is significantly associated with longer disease-free intervals (Bonferroni corrected $p<0.05$). Higher resolution studies and further regression modeling are underway to validate these findings and to define the potential roles of genes within this region as predictors of prognosis. This study supports previous findings that tumor cytogenetic changes are an important prognostic indicator in lymphoma. Such a scheme for cancer subtyping and personalization of therapy at the diagnosis could improve patient care.

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