
# Undergraduate Symposium

2013

# University of South Alabama
# Committee on Undergraduate Research

## *15th Annual Undergraduate Symposium*

Thursday October 17th, 2:00-5:00 PM

Welcome – Shelby Hall 2119
Dr. Lynne Chronister, Vice President for Research and Economic Development

Student Short Oral Presentations – Shelby Hall 2119
Courtney Day, Department of Music, College of Arts and Sciences
Katie Walden, Department of Visual Arts, College of Arts and Sciences

Invited Student Oral Presentations – Shelby Hall 2119
Daniel Corliss, Department of Civil Engineering, College of Engineering
Emily Allen, Departments of Music, College of Arts and Sciences;
Alexandra Kabeiseman, Department Earth Sciences, College of Arts and Sciences;
Janika Prajapati, Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions and Mitchell Cancer Institute;
Ellis Hicks, Department of Computer Science; School of Computing

## Best Paper/Portfolio Award

Joshua Taylor, Department of Psychology, College of Arts and Sciences

## Poster Session - Shelby Hall Lobby

## USA Day Mini Poster Sessions, Mitchell Center
## Saturday October 12th and Saturday November 16th

Sponsored by:
Alabama Space Grant Consortium, University of South Alabama Academic Affairs, University of South Alabama Graduate School, College of Arts and Sciences, School of Computing, College of Education, College of Engineering, Pat Capps Covey College of Allied Health Professions, College of Medicine

# Welcome

This marks the 15th year of the University of South Alabama's Summer Undergraduate Research Program. We are excited by the breadth and depth of presentations this year with twenty-four disciplines, seven colleges within the university, and an additional three institutions represented.


Since its inception, the USA Committee for Undergraduate Research (UCUR) has sponsored over 550 students in the Summer Undergraduate Research Program, which is open to students from all disciplines. Our goal is to promote scholarly and creative activity at the undergraduate level, enhancing critical thinking, problem solving skills, and written communication. Through this program students are provided with hands-on training in their discipline, expanding their experience beyond that of the normal classroom.

The program is generously sponsored by the Alabama Space Grant Consortium, USA's Academic Affairs, and individual colleges and departments. Additional funding for students comes from individual faculty grants and the National Science Foundation's REU program.

The committee thanks you for joining us in the culmination of the students' experience, our Undergraduate Symposium. We would like to take this opportunity to acknowledge not only the work of the students, but also the commitment of the faculty mentors to the training of these students.

Anne Boettcher
Director, USA Undergraduate Research Program

# Greetings

Welcome to the annual UCUR Symposium. Through the UCUR program undergraduate students have the opportunity to work with faculty and experience the process of accomplishing real research. The students learn to enjoy the creativity and accomplishment of problem solving, which can have a major impact on their lives.

Students realize many benefits including:

- Learn the relation of classroom knowledge to the real world
- Help identify career interests
- Develop skills to function more independently
- Build mentor relationships with faculty
- Learn to communicate better with a varied audience
- Learn to better think critically and logically
- Participate in the excitement of creative intellectual activity
- Increase self confidence
- Increase ability to overcome obstacles
- Increase likelihood of acceptance into graduate or professional school
- Learn research metrologies
- Learn about the ethics of research and scholarship
- Experience greater academic success in terms of GPA and retention

As the Graduate Dean, I think this program is especially worthwhile as students who participate in hands-on research are more likely to pursue advanced degrees. This perception is backed by a recent study of undergraduate research programs that found that a remarkable 83% of 1,135 research participants pursued postgraduate education.

Undergraduate research experiences can also result in some less obvious benefits, for example: helping to recruit outstanding freshmen, producing more successful alumni, and improving the university-learning environment. So please enjoy the important accomplishments of the students and their mentoring faculty today as presented in this symposium.

Keith Harrison
USA Dean of Graduate Studies

## University of South Alabama
### Committee on Undergraduate Research

June Ayling, Anne Boettcher, David Benko, Ellen Buckner,
Fulton Burns, Robert Coleman, Jason Coym, Michael Doran,
James Ellis, Roma Hanks, Zoya Khan, Andrea Kent, John Kovaleski,
Silas Leavesley, Mihaela Marin, Rebecca Mindock, David A. Nelson,
Elizabeth Rivenbark, James Swofford, Mary Townsley,
and Julio Turrens

# University of South Alabama
## Committee on Undergraduate Research

## 15th Annual Undergraduate Symposium
## Fall 2013

**Best Paper/Portfolio Award**

Joshua Taylor
Department of Psychology, College of Arts and Sciences

Title:
Caregiver Reaction to Placement Scale: A New Instrument to Assess Caregiver Emotional Functioning Following Nursing Home Placement

Mentor: Benjamin D. Hill, Department of Psychology, College of Arts and Sciences

Joshua will represent the University of South Alabama at the National Conference on Undergraduate Research at the University of Kentucky in April 2014

**USA Phi Kappa Phi**
**Undergraduate Research Award 2013**

Will be announced at the Symposium

# University of South Alabama
## University Committee on Undergraduate Research

## 15th Annual Undergraduate Symposium
## Fall 2013

### Invited Student Oral Presentations
### Thursday October 17th, 2:00-3:30 PM, Shelby Hall 2119

## Oral Presentations

**Daniel Corliss.** Feasibility of Roundabout Implementation at the Intersection of USA Drive N and Health Services Drive Using Analytical and Microscopic Traffic Simulation Approaches. Department of Civil Engineering, College of Engineering. Mentor: Min-Wook Kang, Department of Civil Engineering, College of Engineering. (see pg 14)

**Emily Allen.** Two Approaches to Self-Representation in Program Music: Hector Berlioz's Harold in Italy and Richard Strauss' Ein Heldenleben. Department of Music, College of Arts and Sciences. Mentors: Rebecca Mindock and Ward Miller, Department of Music, College of Arts and Sciences. (see pg A)

**Alexandra Kabeiseman.** Evaluation of Severe Weather Diagnostic Variables as Forecast Parameters. Department of Earths Sciences, College of Arts and Sciences. Mentor: Chad Shafer, Department of Earth Sciences, College of Arts and Sciences. (see pg 25)

**Janika Prajapati.** Role of miR-193a in Melanoma Pathogenesis. Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions. Mentor: Seema Singh, Department of Oncologic Sciences, Mitchell Cancer Institute. Co-authors: Udayan Bhattacharya, Nikhil Tyagi, Gurpreet Kauar and Ajay Singh, Department of Oncologic Sciences, Mitchell Cancer Institute. (see pg 49)

**Ellis Hicks.** Using Lego Bots for Enhanced Artificial Intelligence and Real Time Systems. Department of Computer Science, School of Computing. Mentor: Michael Doran, Department of Computer Science, School of Computing. (see pg 24)

# Abstracts

**Abstracts listed in alphabetical order by first author**
**Page number denotes poster number.**

**Note: Students giving oral presentations appear first in the abstract listings as pages A-C.**

# Research Abstracts

# Two Approaches to Self-Representation in Program Music: Hector Berlioz's *Harold in Italy* and Richard Strauss' *Ein Heldenleben*

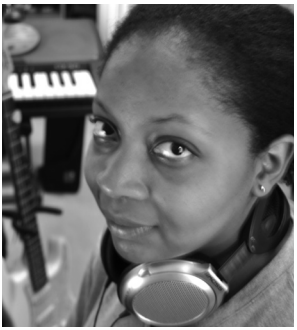
**Emily Allen**

Department of Music, College of Arts and Sciences

Mentors: Dr. Rebecca Mindock and Dr. Ward Miller, Department of Music, College of Arts and Sciences

Richard Strauss and Hector Berlioz both wrote programmatic works depicting the story of a hero's journey. This project illuminates how these composers conveyed the story through the presentation of one or more themes representing the hero, the heart of both pieces. The analysis of the representative themes of these works is categorized into different musical elements, including melody, harmony, rhythm, texture, timbre, and instrumentation. This systematic examination of the thematic material will demonstrate how these composers used two very different yet equally effective approaches to manipulating the hero lines to present a program for the works.

# Enhancing the USASL and Composing an Original Composition



**Courtney N. Day**

Department of Music, College of Arts and Sciences

Mentor: Dr. David Z. Durant, Department of Music, College of Arts and Sciences

Creating a significant quantity of high-quality samples for the University of South Alabama's Sample Library (USASL) will support the creative activity of modern art music composition in the acousmatic and other genres. I will demonstrate the use of samples in music with an original composition using the USASL. An acousmatic sound is defined as a sound without seeing an originating cause. Acousmatic music is composed using acousmatic sounds. This has in the past been called tape music or musique concrete. It is literally music for loud speakers. Computers and dedicated digital audio devices have been the primary means of composing acousmatic music this century. Acousmatic music is now simultaneously an established component and a cutting-edge component of modern art music. It is also a major part of commercial music, film and television music, sound effects utilized by Foley artists, art music, and electroacoustic music. All of these genres use a great deal of short representative audio recordings or "samples." I will demonstrate the use of samples in film with a short clip. Using the highest quality microphones, audio recorders, and editing software I enlarged and enhanced the USASL. I also used the accepted sound studio practice to collate and catalog the USASL. State-of-the-art recording techniques and quality control were employed at all stages of the project.

# Stereotypes and Judgment: Enough is Enough

**Katie Walden**

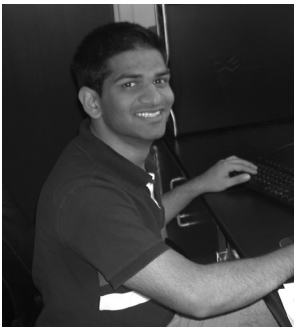
Department of Visual Arts, College of Arts and Sciences

Mentor: Margarita Skiadas, Department of Visual Arts, College of Arts and Sciences

We are bombarded by many different societal influences all of the time. This is especially true of my generation of people ages 20 to 30, for we are the generation born into this world of constant connection to outside sources such as the internet, and this connection takes a toll on each individual. With that in mind, my goal was to really draw attention to this negative way of thinking about ourselves. I feel that it is time to focus on the person and who they are instead of focusing on the individual's body type or the individual's achievements and roles in society. I wanted to portray this by using four different images for the same person. I used 6 models total. The first of each model is an image of them, totally nude. This shows the model as a blank slate. The second image of each model is of them, "touched" by society. The model is shown nude but covering a portion of themselves up with something that is known to be a big societal influence. Then next image is of the model, dressed in clothing that is stereotypical for their gender. The last image of the model is of the model holding something they enjoy, fully clothed, with their face scratched out (the reason being that, to the media, people are classifiable. The mentality is if a person doesn't fit into a particular stereotype, then they shouldn't be acknowledged). The models are all shown on a black background which represents emptiness.

# Design and Optimization of a High Powered Hyperspectral Illumination Source

Light guides offer a variety of applications ranging from uses in mineralogy to biomedical research and non-invasive medical imaging. Exploration of solid, hyperspectral LED light guides is a novel approach in light transmission optics offering a much needed cost, space, time and effective alternative to current illumination sources in hyperspectral imaging. In this study, a hyperspectral illumination source, consisting of a solid Plexiglas light guide and narrow band LEDs was modeled, and its design and geometric configurations analyzed for optimization. 3D light guide geometries designed in Autodesk Inventor were imported for testing in TracePro, an optical raytrace software. After surface labeling, 527nm LED source properties (C503B-GAN-CB0F0791, Digikey) were assigned to the modeled LED surface and subsequent Monte Carlo raytracing ($10^6$ rays/LED) realistically modeled light transmission through the light guide. Total entering and exiting light fluxes collected using irradiance/illuminessence maps were used to calculate percent light transmission though the tested geometry, and used a basis for geometric light transmission efficiency. Light guide length in straight models and curves in the geometries with an arc radius of 50mm or greater were found to have no effect on transmission efficiency. At lower radii, percent transmission decreases. In light guides with two consecutive tangential curves in the opposite directions, percent light transmission was more dependent on the primary curve radius. Light transmission efficiency was also found to be independent of arc angle. Finally, in bent models, bend angle was linearly related to transmission efficiency, with percent transmission peaking at 95.7% at 180°, and decreasing as the bend angle became smaller.



**Arslan Arshad**

Department of Chemical and Biomolecular Engineering, College of Engineering

Mentors: Thomas C. Rich, Department of Pharmacology, College of Medicine, and Silas J. Leavesley, Chemical and Biomolecular Engineering, College of Engineering

# Next Generation *de novo* Sequencing of the *Lentinula raphanica* Genome

**Alyson Askew**

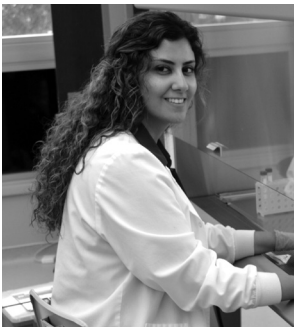
Department of Biology, College of Arts and Sciences

Mentor: Glen Borchert, Department of Biology, College of Arts and Sciences

Co-authors: Justin Roberts and Juan Mata, Department of Biology, College of Arts and Sciences

The genome of the commercial Shiitake mushroom, *Lentinula edodes*, was sequenced in 2009. The closely related genome of the Gulf Coast's American Shiitake mushroom, or *Lentinula raphanica*, however, has until now remained undefined. As such, we recently undertook this task and have successfully sequenced the American shiitake mushroom and are in the process of identifying similarities and differences between its genome and that of *Lentinula edodes*. In all, we were able to obtain ~4.8 billion base pairs of genomic sequence and as the *Lentinula edodes* genome is ~40.8 million base pairs in length, this suggests we have now sequenced the *Lentinula raphanica* genome ~120 times. While our genomic analysis remains ongoing, our initial analyses have found the genome to be ~45% GC rich and to have a 99.97% rate of base call accuracy with only a 0.1% rate of unidentified bases. In the near future we plan to define genomic chromosomal boundaries and undertake preliminary gene annotation using other known fungal genes and *Lentinula edodes* as a reference genome. We also plan to define the differences between the *Lentinula raphanica* genome and the genomes of other closely related species to identify novel genomic characteristics specific to *Lentinula raphanica*.

# Growing Endothelial Cells in the Sylgard Tubes



**Marzieh K. Atigh**

Department of Mechanical Engineering, College of Engineering

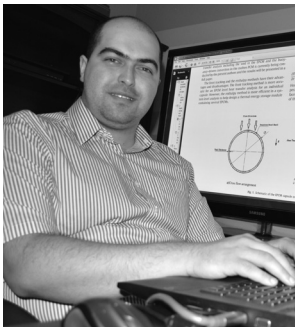
Mentor: Saami K. Yazdani, Department of Mechanical Engineering, College of Engineering

Co-author: Kristen Smith, Spanish Fort High School

More than 81 million Americans suffer from some form of cardiovascular disease, making it the leading cause of death in the country. Atherosclerosis, the major cause of cardiovascular disease, is a condition in which an artery wall thickens (hardening and narrowing of the arteries) as a result of the accumulation of fatty materials. Clinical studies shown that plaque growth occur in specific regions of the artery, correlating with areas of flow disturbances. Endothelial cells align the inner surface of the blood vessel, and are susceptible to these changes in forces. It is hypothesized that these flow disturbances reduce the endothelial cells ability to function optimally, eventually leading to disease initiation such as lesion development and later clinical complications. Therefore, the purpose of this project was to make *in vitro* endothelial cell culture system which mimics the geometry and hemodynamics conditions of an artery.

Endothelial cells from rat were first grown on 100ml dishes then clear Sylgard tube was created to stimulate the elastic modulus of an artery. A bioreactor system was utilized to seed endothelial cells on the inner surface of the Sylgard tubes. The bioreactor was placed inside an incubator, which provides body temperature (37$^{o}$C or 98.6$^{o}$F) for cell growth, for a period of 48 hours. The result demonstrated endothelial cells successfully attached to the inner surface of the Sylgard tube. This system has the potential to examine endothelial cell response to varying flow conditions mimicking arterial hemodynamics.

# Review on Different Solar Energy Systems and Proposal for a new Portable Solar Engine



**Fariborz Bayat**

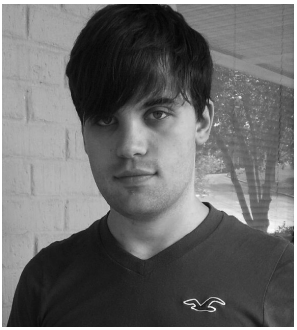
Department of Mechanical Engineering, College of Engineering

Mentor: Kuang-Ting Hsiao, Department of Mechanical Engineering, College of Engineering

It is widely known that the power of the sun is one of the cleanest, most long-term, and least expensive sources of energy. However, the best way to harness and ultimately use this energy has yet to be found. Problems, such as the varying presence of the sun and equipment portability, have made developing superior collection methods and apparatuses a challenge. In this poster, the advantages, disadvantages, and capabilities of some important solar power generating systems, including photovoltaic solar technologies, concentrated solar power systems, and portable solar technologies are discussed. With the analysis of various advantages and disadvantages of different systems, this study further concentrated on developing a parabolic solar energy engine that could be easily built and used. One part of this research was to introduce the basics of the steam turbine, the type of turbine being used in this system. The main focus of this UCUR project was to introduce and develop the solar reflector for the system, as well as to design and predict the best possible shape of the collector that was tasked with receiving sunrays. While it is believed that designs for the best possible solar reflector and collector were created, further research and examination must be done before the building and implementation stages can be completed.

# Carbohydrate Cravings Uniquely Predict Cognitive Impairment in Fibromyalgia

This project explored the links between self-reported mood, diet, and cognitive functioning in persons with Fibromyalgia (FMS). Recent research has shown a dysfunction in glycolysis in persons with FMS, resulting in less energy for cells. Intake of carbohydrates leads to less efficient cellular metabolism and concomitant reduced cortical energy for cognition. The resulting deficit in memory and attention has been termed Fibro-fog. Since research suggests a link between carbohydrate cravings and a higher intake of carbohydrates, cravings were used as an exploratory measure of carbohydrate intake. Female participants over the age of 19 were collected using community and online advertisement (N=102). Participants completed a 15-minute form surveying Fibro-fog, mood, symptom severity, and food cravings. A correlation assay was conducted along with a multiple regression analysis. A multiple regression model including measures of mood, severity of Fibromyalgia, and carbohydrate cravings was able to account for 59.6% of the variation in Fibro-fog severity. Most importantly, over and above the variance accounted for by Fibromyalgia symptom severity, Fibro-fog severity can be predicted by carbohydrate cravings which account for an additional 14% of Fibro-fog severity.



**Tyler Reed Bell**

Department of Psychology, College of Arts and Sciences

Mentor: Jack Shelley-Tremblay, Department of Psychology, College of Arts and Sciences

# Age-Related Effects on the N400 Component in a Dichotic Listening Task

**Bree Blackwell & Shelby Wiggins**

Department of Speech Pathology and Audiology, Pat Capps Covey College of Allied Health Professions

Mentor: Tara M. Davis, Department of Speech Pathology and Audiology, Pat Capps Covey College of Allied Health Professions

Dichotic listening tasks are commonly used to evaluate left-right ear differences (i.e. interaural asymmetry-IA) in the central auditory system. During dichotic listening, word stimuli are presented to the left and right ears simultaneously. Behaviorally, older individuals often show more difficulty than young adults in processing speech in the left versus the right ear. In this experiment, we compared IA using the auditory N400 brainwave component between five young and five middle-aged females during a divided-attention dichotic paradigm. Then we compared the N400 results to a previous study by Davis et al. (2012) to determine if the attentional mode (directed vs. divided attention) affected the degree of IA in the N400 amplitude. During the experimental task, each participant made a semantic judgment between a reference word and a pair of probe words that were simultaneously presented through the left and right loudspeakers. We compared the N400 amplitude when probe words were a semantic match in the left ear versus the right ear to determine the degree of IA. The middle-aged group showed greater N400 amplitude for words in the left ear than the right ear. IA was not seen in the N400 amplitude for young adults. This age-related difference in IA indicated that the older females processed the words more in the left ear than the right ear. The comparison of N400 amplitude between the two experiments confirmed that the N400 was affected by the mode of attention in dichotic listening.

# Direct Measurement of Dimethylsulfoniopropionate in Marine Water Samples

**Shelby Boyd**

Department of Biology, College of Arts and Sciences

Mentor: Alexandra Stenson, Department of Chemistry, College of Arts and Sciences

Dimethylsulfoniopropionate (DMSP) is an important part of the marine food web because marine bacteria use it as a precursor to biologically important sulfur products, notably dimethylsulfide (DMS). Unfortunately, little is known about how DMSP interacts with and affects the environment. The study of DMSP requires the development of an accurate way to measure the concentrations in marine samples. Because DMSP is a precursor to DMS, most techniques measure DMSP indirectly through cleavage and subsequent measurement of DMS concentrations. A direct approach allows for better accuracy by no longer involving other DMS precursors. To analyze DMSP directly, a method using a liquid chromatography - mass spectrometer (LC-MS) and a Sielc Obelisc N column was devised. Benefits of the LC-MS include the ability to easily analyze other important marine sulfur compounds alongside with the DMSP. After this method was verified by calibration curves, marine water samples were analyzed. Peaks for DMSP were observed and concentrations were measured by a traditional external calibration curve. A standard addition experiment will also be used to calculate the original concentrations of the samples to investigate potential matrix effects.

# Preliminary Analysis of Supercell to Bow Echo Transitions

**Michael Brown**

Department of Meteorology, College of Arts and Sciences

Mentor: Wesley Terwey, Department of Meteorology, College of Arts and Sciences

Although supercells are notorious for intense, localized damage, they have been observed to evolve into bow echoes – multicellular storms that cause wind damage over a much larger region. There are three primary types of supercells: low precipitation (LP), high precipitation (HP), and classic. Of these, HP supercells are most often observed to transition into bow echoes. Whereas supercells are identified by their rotating updrafts, bow echoes are defined by strong surface winds that force the line of thunderstorms to surge, or "bow out." Strong, straight-line winds of greater than 50 miles per hour are often observed with bow echoes.

In this study, we analyzed the transition of four HP supercells into bow echoes using radar data. In our analysis, wind surges were observed that may have influenced the transition. However, it did not appear that one specific process caused the transition from supercell to bow echo. Despite similar dynamic and thermodynamic environments, different supercell to bow echo morphologies were observed in the four cases.

# An Experimental Evaluation of the Effects of Eccentric Loading on the Compressive Strength of Concrete Test Specimens

**Raymond Buchanon, Jr.**

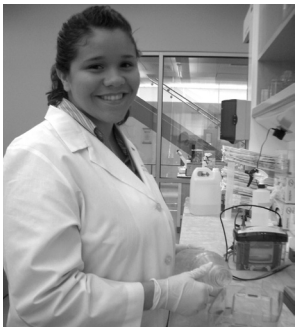
Department of Civil Engineering, College of Engineering

Mentor: Eric J Steward, Department of Civil Engineering, College of Engineering

The compressive strength of concrete is one of the main design requirements to ensure that a structure will be able to carry the intended load. The compressive strength test is performed by installing a cured concrete specimen into a loading frame and applying a steadily increasing load until failure occurs, adhering to the ASTM C-39 standard procedures to ensure the most accurate results. This procedure requires the top of the specimen to be in contact with a circular shaped hardened steel upper platen that must be made within a specified diameter of the cylindrical concrete specimen. There are times when the loading of the specimen is performed eccentrically by error of the technician, which can lead to inaccurate test results. This poster discusses the results of a research study investigating the accuracy of the test results when performing the compressive strength tests on 4 inch diameter concrete cylindrical samples using the common 6-1/2 inch upper platen and a smaller 5-1/2 inch upper platen. The study also compared the results of the tests when cylinders are tested eccentrically by an offset of 0.25 and 0.5 inches, and tested centrally beneath the upper platen.

After 28 days of curing, 74 cylinders were tested centered and at eccentric locations beneath both sized upper platens. The results did not indicate a significant difference in the compressive strength using the 5-1/2 inch upper platen compared to using the 6-1/2 inch upper platen. Loading eccentrically also did not provide conclusive evidence to indicate compressive strength results are inaccurate when compared to centrally located samples. Overall, the use of the smaller upper platen does not appear to produce more accurate test results, even when loaded with an eccentricity. However, the smaller upper platen would allow for a better visual guide in centering the cylinder due to the reduced surface area.

# CXCR4 Signaling in UVB-induced Skin Cancer



**Mary Campbell**

Department of Biology, College of Arts and Sciences

Mentor: Seema Singh, Department of Oncologic Sciences, Mitchell Cancer Institute

Co-authors: Gurpreet Kaur, Udayan Bhattacharya, Nikhil Tyagi and Ajay Singh, Department of Oncologic Sciences, Mitchell Cancer Institute

UVB radiation from sunlight is among the most common risk factors associated with skin carcinogenesis. During the carcinogenic process, UVB radiation-induced inflammatory responses can play multiple roles in the promotion and progression of skin cancer. It has been recognized that chemokines play an important part, not only in inflammatory responses, but also in the multistep process of carcinogenesis. Chemokines are soluble, small molecular weight proteins that bind to their receptors to elicit cellular responses. CXCR4 has been reported to be up-regulated in metastatic invasive squamous cell carcinoma therefore suggesting its role in skin carcinogenesis. Since UVB is the main culprit for skin cancer we hypothesized that CXCR signaling is induced by UVB and contributes to skin carcinogenesis. To understand the role of CXCR4 in UVB-induced carcinogenesis, we examined the expression of CXCR4 in SCC cell lines by Western blot analyses. Subsequently, we examined the effect of UVB irradiation in HaCaT (normal immortalized) keratinocytes. The SCC cell lines exhibited increased expression of CXCR4 as compared to HaCaT cells. Acute UVB irradiation unregulated CXCR4 expression in dose and time dependent manner. Chronic UVB irradiation induces mesenchymal like morphology and results in transformation of HaCaT cells. Our in *vitro* studies have also shown increase in growth, clonogenicity, epithelial to mesenchymal transition (EMT) and malignant behavior promoting functions of transformed HaCaT keratinocytes as compared to control cells. Our findings demonstrated, for the first time, a role of CXCR4 signaling in UVB radiation-induced skin carcinogenesis.

# Effects of Biomechanical Forces on Stents Deployed In the Superficial Femoral Artery

**Nicholas Carroll**

Department of Mechanical Engineering, College of Engineering

Mentor: Saami K. Yazdani, Department of Mechanical Engineering, College of Engineering

Metallic stents are currently the number one choice to re-open clogged arteries due to atherosclerosis, the leading cause of heart attacks and strokes in the U.S. that accounts up to 800,000 deaths per year. However, stent fracturing is a major detractor from widespread stent usage. This is especially true in the superficial femoral artery and is reported to be more widespread of a problem in this area of the body than anywhere else. This high rate of fracturing is believed to be caused by the unique combination of biomechanical forces that the artery experiences in day to day activities. Although failure tests are performed quite regularly on the stents alone the problem still continues. A different approach is needed to identify the specific cause of failure in these stents and its impact on the biological performance.

It is the purpose of this project to design and build a medical testing device that will subject the stent to the same biomechanical forces, axial, torsional, and bending, that the stent experiences while deployed in an artery. The novelty of this project is that the stent will be implanted in an artery cultured with live cells and the tests will be conducted inside of an incubator. With atherosclerosis such a prevalent malady in the world it is imperative to find and implement a technology that is reliable and safe.

# Parent-Child Interactions in Children with Autism Spectrum Disorders vs. Those of Typically Developing Children with Behavioral Problems

**Amber Cole**

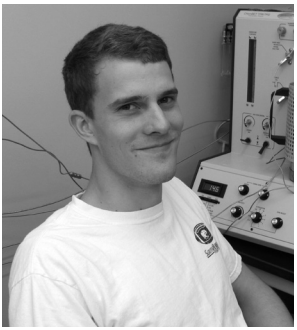
Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions

Mentor: Kimberly Zlomke, Department of Psychology, College of Arts and Sciences

Co-Author: Sarah Bauman, Department of Psychology, College of Arts and Sciences

The Dyadic Parent Child Interaction Coding System (DPICS) is an observational measure used as a proxy for attachment and positive parenting in typically developing children, but has not yet been validated for use in children with Autism Spectrum Disorders (ASDs), a collection of developmental brain disorders characterized by social and communicative deficits. The current research aims to examine differences in parent-child interactions between parent-child dyads of children with ASDs and typically developing children with disruptive behavior in an effort to discern how deficits of ASDs affect parent-child interactions. Sixty-six parent-child dyads have participated in the study, completing the DPICS observation as well as measures of autism symptomology and disruptive behavior. The sample is predominately male (53.0%), Caucasian (56.1%), and a mean age of 4.56. Analysis of random, sex-matched dyads (10 ASD and 10 typically developing) has shown that parents of typical children (M=1.00,SD=1.05), (M=7.2,SD=5.05) use more Labeled Praise and Commands than parents of children with an ASD(M=0.13,SD=0.35),(M=4.8,SD=1.04) respectively, while parents of children with ASDs (M=2.29,SD=2.14) used more Unlabeled Praises than parents of typical children (M=1.3,SD=1.06). There was also a trend toward significance that parents of typical children (M=1.3, SD=1.57) tended to employ more Negative Talk than their counterpart (M=0.57, SD=0.98). This data suggests that parent-child interactions in children with an ASD significantly differ from those of typical children, likely because of core deficits characteristic of these disorders. Further research is necessary to investigate these differences.

# Dispersion of Platinum on Alumina Supported Ceria Surfaces via Supercritical Deposition



**Blake Corey**

Department Chemical and Biomolecular Engineering, College of Engineering

Mentor: Christy Wheeler West, Department of Chemical and Biomolecular Engineering, College of Engineering

Co-author: Jacob W. Deal, Department Chemical and Biomolecular Engineering, College of Engineering

Catalytic materials containing precious metals and ceria are of importance in modern energy applications, such as hydrogen generation and fuel cell implementation. High dispersion of these expensive metals is crucial to the economic viability of the catalysts. Research has shown that dispersion of the catalyst is greatly affected by the deposition method. In this study we employ an alumina support to provide a high surface-to-volume ratio, ideal for catalyst delivery into fluid streams and packed beds. Pre-deposition of a layer of ceria provides a site for platinum (Pt) to adhere, which will increase dispersion. The methods used to prepare the support and to deposit the metal catalyst were tailored specifically to attain high levels of Pt dispersion. Supercritical fluid deposition was used because of the excellent mass transport properties of supercritical fluids, and $CO_2$ was chosen as the fluid due to its low reactivity with the two components. The ceria-coated support was placed in a stirred vessel where supercritical $CO_2$ was used to dissolve the Pt precursor and carry it to the ceria sites. Preliminary results show that dispersion is clearly affected by the addition of ceria onto the support. However, analysis of the Pt and ceria system has proven to be very complex. Several iterations of the analytical method used to determine the dispersion of catalyst are being tested to determine accurate values.

# Feasibility of Roundabout Implementation at the Intersection of USA Drive N and Health Services Drive Using Analytical and Microscopic Traffic Simulation Approaches

**Daniel Corliss**

Department of Civil Engineering, College of Engineering

Mentor: Min-Wook Kang, Department of Civil Engineering, College of Engineering

This report introduces a roundabout feasibility study for improving a stop-controlled university campus intersection located at the University of South Alabama. The roundabout feasibility is evaluated based on two primary goals: 1) traffic performance, and 2) safety. A microscopic traffic simulation was conducted to assess the traffic performance of the roundabout. The result shows that the intersection improvement with a roundabout significantly upgrades the intersection Level of Service (LOS) and can accommodate forecasted future traffic conditions. In addition, the roundabout can significantly reduce intersection crashes. It is also expected through a cost-benefit analysis that the roundabout would pay for itself in the very near future with continuation of the cost savings for the traffic delay and crash reduction after its implementation.

# Resonance Raman Analysis of Carotenoids in *P. Antarctica*

**Taylor H. Goodie**

Department of Chemistry, College of Arts and Sciences

Mentor: Robert E. Barletta, Department of Chemistry, College of Arts and Sciences

Co-authors: Hijrah A. El-Sabae, and Anjali Gandhakwala Department of Chemistry, College of Arts and Sciences

Intracellular sulfur compounds, such as dimethyl sulfide (DMS) and dimethyl sulfoniopropionate (DMSP) are important components of the global sulfur cycle and impact the global climate. DMS is diffused into the atmosphere from the oceans in which it is mainly produced by plankton and aquatic plants in its precursor form DMSP. In the Antarctic, one important producer of biogenic sulfur is *Phaeocystis antarctica*. We are currently developing the methodology for measuring intracellular biogenic sulfur in *P. antarctica* directly using Raman spectroscopy. Since Raman spectroscopy is a direct measurement of molecular properties, it has an advantage of being able to provide both qualitative and quantitative information about a variety of chemical species. We have measured a series of species algae using Raman with 488 nm excitation. While information about biogenic sulfur could not be obtained at this wavelength, pigmentation characteristic of the algae have been directly measured and, for *P. antarctica* in particular a bound on carotenoid concentration has been made. The results of these preliminary investigations will be presented.

# Shells to Sugars: Ionic Liquid Catalyst for the Degradation of Chitin into Feedstock Chemicals

**Taylor Goodie & Andrew Pischek**

Department of Chemistry, College of Arts and Sciences

Mentor: Dr. W. Matthew Reichert, Department of Chemistry, College of Arts and Sciences

With the availability of fossil fuels declining, a sustainable source of fuel and feedstock chemicals is needed. Potential sources of renewable fuels and feedstocks are biopolymers, such as cellulose and chitin. Chitin, a byproduct of the shellfish industry, is a biopolymer formed from linking *N*-acetyl-D-glucosamine units together. It has some similarity to cellulose, a biopolymer of glucose, but the additional functionality makes dissolution and processing more difficult. Ionic liquids have demonstrated the ability to dissolve both cellulose and chitin, which allows for unique processing opportunities. Not only can chitin and cellulose be dissolved and cast into any form but the biopolymers can be an excellent source of glucose and glucosamine, both of which are feedstock chemicals. This project focuses on the degradation of chitin into *N*-acetyl-D-glucosamine and other degradation products using ionic liquid based technology. Synthesis of ionic liquid based catalysts will be presented along with the effects ionic liquid catalyst structure has on the degradation products. This study focuses on the sulfonic acid functionality attached to a cation head group to form the ionic liquid catalyst. The catalysts synthesized were 1-(4-sulfobutyl)pyridinium triflate, 1-methyl-1-(4-sulfobutyl)piperidinium triflate, and 1-methyl-1-(4-sulfobutyl)pyrrolidinium triflate. The degradation of the chitin will be compared to a traditional mineral acid as well as imidazolium based catalysts, such as 1-methyl-3-(4-sulfobutyl) imidazolium triflate, 1-methyl-3-(6-sulfohexyl) imidazolium bis(trifluoromethylsulfonyl) imide, 1-methyl-3-(7-sulfoheptyl)imidazolium bis(trifluoromethylsulfonyl)imide.

# Effects of Strain on Endothelial Cells

Atherosclerosis, a progressive disease of the large arteries, is the primary cause of heart disease, and stroke. It is the underlying cause of about half of all deaths in westernized societies. Endothelial dysfunction precedes the development of atherosclerosis. Endothelial dysfunction is a condition where endothelial cells (ECs), cells that form a membrane that lines the inside of blood vessels, do not function properly. ECs are mainly affected by three mechanical factors; pressure from pulse, shear stress from blood flow, and strain due to the elasticity of the blood vessel. ECs require these mechanical factors to function at optimal levels. Deviation from these levels can result in damage to the cells and lead to disease. An additional factor for EC dysfunction may be the nonlinear elastic vessel response to local arterial stiffness due to vessel stretching. Therefore, the purpose of this investigation was to develop a non-invasive method to characterize local strain stiffness responsible for changes in EC function. To this end, a commercially available digital image correlation (DIC) system (VIC-3D Measurement System) was used to characterize local strain measurements under physiological conditions. Sylgard 184 was used to created synthetics models that mimic arterial geometry and mechanical properties. Local strain measurements could be estimated on a sylgard piece using the DIC system to an approximate accuracy of 2.1% in a control setup. These preliminary results demonstrate the potential of such a system to characterize local strain undergoing arterial hemodynamics.

**Emily Gould**

Department of Mechanical Engineering, College of Engineering

Mentors: Saami Yazdani and Gail Jefferson, Department of Mechanical Engineering, College of Engineering

# Identifying the Ecotone in the Dog River Watershed

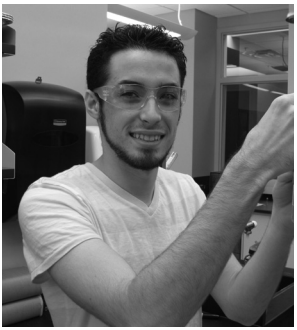
**Hunter D. Griffin**

Department of Earth Science, College of Arts and Sciences

Mentor: Mimi Fearn: Department of Earth Science, College of Arts and Sciences

The main objective for this research was to identify and locate the ecotone between salt and fresh water environments within Dog River, which is situated in the coastal community of Mobile, Alabama. Because Dog River is a tidal river, the ecotone displays a change in vegetation from plants that tolerate salt water to those that do not. The main reason for conducting this research is because the ecotone of Dog River has never been mapped before. Therefore, the findings/data obtained from this research create a foundation for future studies related to changes in the ecotone associated with the spread of impermeable surfaces and their effect on Dog River's hydrology. The method I used to identify the ecotone was observation of the study area to identify vegetation indicators of the salt to fresh water transition. The primary indicators are the distribution and condition of the plant species black needle rush and bald cypress. Black needle rush is found in areas were salt/brackish waters are present, while cypress trees thrive best in areas dominated by freshwater. From this research, I was able to use the results to create a map showing the location of the salt/fresh water ecotone within the Dog River Watershed.

# Extraction of Platinum Employing Novel Thiaalklyammonium Salts



**Nathan Griffin**

Department of Chemical and Biomolecular Engineering, College of Engineering

Mentor: Christy Wheeler West, Department of Chemical and Biomolecular Engineering, College of Engineering

Co-author: Richard O'Brien, Department of Chemistry, College of Arts and Sciences

Precious metals including platinum, palladium, and rhodium, among others, have recently been in high demand for their many uses such in catalysts, medicine, jewelry, and the electronic industry. The high cost and limited availability of these precious metals creates a need to recover them after the product containing them has been spent. A mechanism of separating and purifying these metals has been designed using a two phase system. Employing quaternary ammonium salts, the extraction of platinum and other metals from an aqueous phase into an organic phase is possible. The effectiveness of these quaternary ammonium salts in capturing and separating hexachloroplatinate ions will be analyzed for potential use in industrial applications. In addition to this research, novel quaternary thiaalkyl ammonium salts (thia-quats) will also be tested. These thia-quats have been found to bind tighter to anions in solution due to the sulfur atoms found at the fourth link within the hydrocarbon chains present on the ammonium salts. These novel thia-quat salts will be compared to the quaternary salts for platinum extraction in order examine the practical industrial application of these chemicals in processes for recycling of precious metals.

# Detecting Black Drink in Native American Pottery using LC-MS and DART-MS

**Alexander P. Harris & Genevieve E. Mullen**

Department of Chemistry, College of Arts and Sciences

Mentors: Alexandra Stenson, Department of Chemistry, College of Arts and Sciences and Gregory Waselkov, Department of Sociology, Anthropology and Social Work, College of Arts of Sciences

Co-authors: Erin Capley, Suranjana Dey and Shey Music, Department of Chemistry, College of Arts and Sciences

Archaeologists and historians have little direct knowledge of the functions of Native American pottery in Alabama; however, one suspected use is the preparation and storage of yaupon tea. Commonly called "Black Drink," this tea was a ceremonial drink brewed from the leaves of the yaupon holly, a plant that is indigenous to the Southeastern United States. This experiment makes use of organic residues left by Black Drink, namely caffeine and theobromine, which remain intact in ceramics for long periods of time and can be detected in minute quantities by analytical instruments. A method was designed to detect organic compounds extracted from pottery using liquid chromatography-mass spectrometry (LC-MS). Non-destructive direct analysis in real time mass spectrometry (DART-MS) was also investigated as a possible preliminary step. Multiple sherds were analyzed for the known markers caffeine and theobromine, as well as the additional compounds theophylline and nicotine. To date, none of these chemicals have been detected using LC-MS, therefore the next action is to define the current method's limit of detection by testing controls of spiked pottery sherds. Ursolic acid, an additional marker of the yaupon holly, will also be added to the current list of organic compounds for detection.

# Chlorination of Fulvic Acids

**Bradley Harris**

Department of Chemical Engineering, College of Engineering

Mentors: Alexandra Stenson, Department of Chemistry, College of Arts and Sciences, and Andrew Whelton, Department of Civil Engineering, College of Engineering

Chlorine based disinfecting agents react with naturally occurring organic materials (NOM) to produce disinfection byproducts, particularly trihalomethanes and haloacetic acids. Studies suggest long-term exposure to disinfecion byproducts (DBP) causes cancer or reproductive and developmental complications. With over two-hundred and sixty million individuals consuming DBPs regularly, precautions must be taken. Currently, the United States' Environmental Protection Agency enforces the Stage 2 Disinfectants and Disinfection Byproducts Rule to minimize DBP consumption by limiting the maximum contaminant level of DPB allowed per liter of water. Although this minimizes exposure, it does little to prevent the actual reaction between NOMs and disinfecting agents. To gain further understanding of the interaction between NOM and disinfecting agents, Suwannee River fulvic acid (SRFA), a form of NOM, was chlorinated. This study uses both unfractionated SRFA and fractionated SRFA (separated with a Water Corporation X-Bridge phenyl column) solution as a standard. By observing each sample through Fourier transform mass spectrometry, the molecular weight of each chlorinated compound created may be found, yielding the molecular formula. Through comparison of total chlorinated organic compounds produced by the chlorination of each SRFA fraction, identity of the precursor for byproduct production can be identified In addition, determination of reactivity levels of fractions can be obtained and conclusions can be made whether fractionation increases the DBPs produced. Information of the total chlorinated organic compounds created between disinfecting agents and SRFA samples may then lead to greater DBP formation prevention and elimination.

# Multi-Dimensional High-Performance Liquid Chromatography Fractionation of Suwannee River Fulvic Acid

**Codey Henderson**

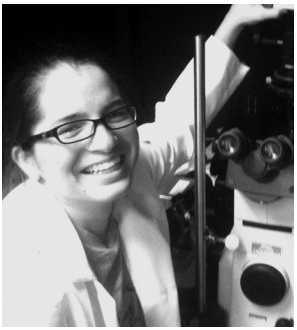
Department of Chemistry, College of Arts and Sciences

Mentor: Alexandra Stenson, Department of Chemistry, College of Arts and Sciences

Fulvic acids are mixtures of decomposed organic matter found in soil and streams. They are used agriculturally to enhance crop production and pharmaceutically as a dietary supplement. Despite their various uses, very little is known about the structure of the mixture's components. Fulvic acid mixtures are extremely complex and difficult to separate for analysis and characterization. They are too non-volatile for gas chromatography. Meanwhile, infrared spectroscopy and nuclear magnetic resonance only offer composite averages. A promising approach to the characterization of fulvic acid is to pre-fractionate the mixture by high-performance liquid chromatography (HPLC) then study it by mass spectrometry. Previously, we separated Suwannee River fulvic acid (SRFA) through a phenyl reversed-phase chromatography column into 100 fractions which were then analyzed through mass spectrometry (including tandem mass spectrometry and H/D exchange). The data revealed early eluting material is highly oxidized; late eluting material retains more characteristics of precursor molecules. Here, further fractionation of early and late eluting fractions was performed using a Sielc Obelisc N column. Fractions were analyzed through Fourier transform ion cyclotron resonance mass spectrometry to further elucidate compositional differences. Preliminary data suggest compositional differences between fractions eluting from the Sielc Obelisc N column was accomplished. The data also suggest multi-dimensional fractionation is an important tool for separating extremely complex mixtures, allowing structural characterization of humic substances.

# Identifying Colon Cancer Using Hyperspectral Imaging

Colorectal cancer is the third most common cancer in the US. Current screening methods for colorectal cancer include endoscopy, CT, and MRI. Of these, endoscopy is well suited for outpatient screening due to its low cost and relatively fast procedure time. Unfortunately, current endoscopic screening techniques are limited by poor sensitivity and specificity. Therefore, improved endoscopic imaging techniques are needed. Hyperspectral imaging could potentially provide a higher sensitivity and specificity colon cancer screening. Hyperspectral imaging experiments utilize specialized filtering systems to detect fluorescent molecules in cells and tissues. The goal of this study was to develop an approach for identifying colon cancer using hyperspectral imaging. In this approach, two hyperspectral imaging scans were taken; one sampling the fluorescence excitation spectrum and one sampling the reflectance spectrum. All images were calibrated to NIST-traceable standards. Preliminary data indicate that there are clear differences in the fluorescence excitation spectra of cancerous and noncancerous colon tissues and that hyperspectral imaging can identify those differences. In this work, we have optimized the initial approach for identifying colon cancer using hyperspectral imaging. Future work includes acquisition of a comprehensive set of cancerous and normal tissue specimens to divide them into training and validation sets. Analysis algorithms will then be applied to determine in the ability of excitation-scanning hyperspectral imaging to discriminate cancerous from normal colon tissues.



**Clarissa Hernandez**

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Mentors: Silas J. Leavesley, Department of Chemical and Biomolecular Engineering, College of Engineering and Thomas C. Rich, Department of Pharmacology, College of Medicine

Co-authors: Zack Moore, College of Medicine and Tiffany Heaster, Department of Biomedical Engineering, Mississippi State University

# Using Lego Bots for Enhanced Artificial Intelligence and Real Time Systems

**Ellis Hicks**

Department of Computer Science, School of Computing

Mentor: Michael Doran, School of Computing and Director of USA Honors Program

The field of Computer Science includes many research focus areas. Two areas of interest that often impact broader systems are those of Artificial Intelligence (AI) and Real-Time systems (RTS). AI is often described as the creation of an algorithmic or computation process that allows a computer to perceive, reason, and act. A RTS is a system that must provide an effective and correct response while meeting a timed deadline. The research described in this paper considers how concepts of AI and RTS can be used in increasing levels of complexity to solve process control systems. A more in depth look at the RTS can be found in the book *Real-Time Systems and Software* which provides a complete overview to the inner workings of Real-Time Systems. The simple platform employed to demonstrate these principles is a scale model slot car race track. In this environment, a variety of sensors are deployed around the track to monitor the location of the cars. A robotic gripper is built and used to control the speed and performance of the car through physical interventions. The control algorithm will use the data collected to intelligently and efficiently control the cars behavior. The use of multiple grippers and different control algorithm strategies will be considered to evaluate the various approaches to efficient and effective construction of intelligent control systems.

# Evaluation of Severe Weather Diagnostic Variables as Forecast Parameters

**Alexandra Kabeiseman**

Department of Earth Sciences, College of Arts & Sciences

Mentor: Chad Shafer, Department of Earth Sciences, College of Arts & Sciences

Previous studies have evaluated severe weather diagnostic variables (SWDVs) to evaluate their usefulness in distinguishing types of severe weather. For given magnitudes of SWDVs, which are combinations of other synoptic and severe weather variables, this study attempts to determine the probability of severe weather of any type or a specific type occurring within 40km of that location for lags of 0-1 to 5-6 h. Variables quantifying thermodynamic instability and vertical wind shear within the North American Regional Reanalysis are used for each 3-h time window from 1 January 2001 to 31 December 2010. These variables are used to calculate the SWDVs, including the energy-helicity index, supercell composite parameter, and significant tornado parameter. Preliminary findings include the following. (1) Very little change in probability of severe weather is observed for a given magnitude of the SWDV from 0-6 hours after analysis, with only a marginal decrease in skill. (2) Increased skill for a given SWDV magnitude is more strongly tied to knowledge of where convection occurs rather than which 1-h periods feature the severe report type of interest. (3) On the other hand, increased skill for a given practically perfect probability (PPP) is more sensitive to knowledge of which 1-h periods feature the severe report type of interest. (4) Interestingly, knowledge of where convection occurs and which 1-h periods feature severe weather can reduce the skill for the lowest PPPs and SWDV magnitudes, respectively.

# An Investigation into the Relationship Between Quality of Life Ratings and Speech Perception Ratings

**Karima Kemp**

Department Speech Pathology and Audiology, Pat Capps Covey College of Allied Health Professions

Mentor: Paul Dagenais, Department of Speech Pathology and Audiology, Pat Capps Covey College of Allied Health Professions

The purpose of this study was to determine any relationships between the three perceptual speech measures, intelligibility, comprehensibility, acceptability and the perceived quality of life of a speaker with dysarthria. Intelligibility, an objective measure, was measured as the number of words in an utterance that could be understood by a listener. Comprehensibility, another objective measure, was defined as how well a listener could understand the meaning of an utterance. Acceptability, a subjective measure, was defined as how well a listener accepted the speaker in terms of speaking ability. The speakers for this study included 5 speakers with dysarthria and one control participant with normal speaking ability. Speakers were recorded reading 5 different sentences each. Listeners for this project consisted of 24 young adults ranging in age from 19-24. Listeners completed four listening tasks, each task pertaining to a different perceptual measure. For the intelligibility task listeners were presented with 30 sentences. After each sentence listeners would type each word in the sentence they could understand. For the comprehensibility task listeners were again presented with 30 sentences. After each sentence the listener were given two questions to answer pertaining to the sentence. For the acceptability task listeners were presented with 30 sentences and asked to rate the acceptability on a scale from 1-9 with 1 being "not at all acceptable" and 9 being completely acceptable. To measure the listener's perception of the speaker's quality of life, each listener was presented with 5 sentences from one speaker and then asked to complete a quality of life survey. Each listener completed a survey for each individual speaker.

# Development of an in vitro Flow System to Characterize Flow in a Coronary Bifurcation Model

**Sung Hean Kim**

Department of Mechanical Engineering, College of Engineering

Mentor: Saami K. Yazdani, Department of Mechanical Engineering, College of Engineering

Cardiovascular disease is the leading cause of deaths worldwide. Heart and blood vessel disease (cardiovascular disease) includes numerous problems, many of which are related to a process called atherosclerosis. Atherosclerosis is a condition that develops when a substance called plaque builds up in the walls of the arteries. Atherosclerosis has been shown to correlate to local hemodynamic conditions, in particular flow disturbances near bifurcations. Understanding and characterizing the flow patterns may provide answers to why and where plaque grows.

It was therefore the goal of this project was to develop an in vitro model to mimic arterial hemodynamic conditions of to study the flow mechanics in a blood vessel. A flow model of the circulatory system was constructed using a gear pump, which could be controlled with computer software Labview. An ultrasonic flow meter and pressure catheter provided continuous monitoring of the hemodynamic parameters. The flow was subsequently captured using a high speed camera, with a temporal resolution of 1000 frames per second (fps) and resolution with grid spacing in the order of microns. Flow disturbances could be observed in a bifurcation model similar to that where native plaque grows in human. These results demonstrate the potential of the in vitro system in mimicking an arterial artery hemodynamic.

# Measurement and Modeling of $CO_2$ and $N_2O$ Solubility in Lipidic Ionic Liquids

**Jacob V. Langham**

Department of Chemical & Biomolecular Engineering, College of Engineering

Mentor: Kevin N. West, Department of Chemical & Biomolecular Engineering, College of Engineering

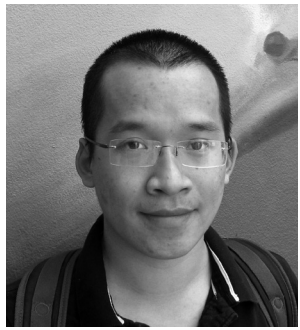
Ionic liquids (ILs) are organic salts, which are liquids at temperatures below 100°C. ILs are virtually non-volatile and have highly tunable properties. Conventional ionic liquids have the same solvent properties as polar or moderately polar solvents, which reduces industrial applications that involve non-polar solutes. Non-polar solvent properties can be attained with long alkyl chains, but the addition of these chains enhances intermolecular interactions creating room temperature solids. Lipidic Ionic liquids were created by imitating biological systems to create extended alkyl chains capable of interacting with non-polar molecules while remaining liquids at room temperature.

In this work, we examine the effect of alkyl chain structure and composition on the relative solubility of $CO_2$ and $N_2O$ in lipidic ionic liquid solutions, concentrating on binary systems pertaining to molecular separations for energy and environmental separations as well as separation of gases in biological systems (anesthetic gases).

We use the Redlich–Kwong equation of state to model the binary mixtures at pressures from 0.25 to 20 bar and temperatures from 298 to 323 K. To use this equation of state, we must first estimate the critical properties of the IL from temperature dependent density data. Additionally, we examine the applicability of other cubic equations of state to model this system and compare the experimental data with that of similar short chain ionic liquids.

# Molecular and morphorlogical studies on two mushrooms in the genus *Gymnopus*

A hundred years ago fungi were considered to be flowerless plants (cryptogams) but evidence such as lack of chlorophyll, presence of chitin, and DNA research has put them into the opisthokonts – a group that includes animals. Mushrooms are a group of fungi that emerge under certain conditions. While morphology is still the main way to identify mushrooms, molecular techniques such as DNA extraction, PCR, restriction digest of PCR and gel electrophoresis are now essential for identification of fungal species. Mushrooms in the genus *Gymnopus* live on leaf litter in forested areas around the world. Such fungi are important because they help minimize erosion and increase nutrient recycling. The purpose of the study was to better characterize two *Gymnopus* mushroom collections from the neotropics by means of molecular and morphological techniques.



**Phi Luu**

Department of Biology, College of Arts & Sciences

Mentor Juan Luis Mata, Department of Biology, College of Arts & Sciences

# Development of Hyperspectral Light Source Hardware and Software

**Sam Mayes**

Department of Chemical and Biomolecular Engineering, College of Engineering

Mentors: Silas J. Leavesley, Department of Chemical and Biomolecular Engineering, College of Engineering and Thomas C. Rich, Department of Pharmacology, College of Medicine

Hyperspectral imaging is a potential technology that allows more and better methods of tissue imaging, visualization, and analysis. Current tissue imaging practices rely on white light imaging. With white light imaging, reflectance data is collected and analyzed by visual inspection. However, under white light tissues can appear quite similar in reflectance, especially if only three wavelength-bands are viewed (traditionally red, green, and blue). This method is effective but has the potential to miss some tissue abnormalities due to limited data. The ability to illuminate at specific wavelengths, or combinations thereof, will produce much more data than standard white light. With the ability to collect data over a broad spectrum of illumination, the potential for tissue identification and classification should increase. Additionally, specific fluorescence emissions and excitation characteristics can be measured if a hyperspectral light source is utilized. This large increase in data has the potential to allow for novel methods of visualization, detection, and diagnosis both *in vivo* and *ex vivo*. Previous hyperspectral illumination methods were limited by small wavelength ranges and long imaging time. During this project it is our intent to design and construct an illumination device capable of broad spectrum of illumination which can change wavelengths and collect image data quickly.

# Initiation of a Sediment Budget for Little Lagoon Pass, AL

**Clay McCoy**

Department of Civil Engineering, College of Engineering

Mentor: Bret M. Webb, Department of Civil Engineering, College of Engineering

In the vicinity of Little Lagoon Pass near Gulf Shores, Alabama, an understanding of the coastal processes that affect the area is essential for enhancing management and sustainability of coastal resources. A sediment budget for Little Lagoon Pass has been initiated to improve our understanding of the sediment system. The Alabama Department of Transportation has proposed the replacement of the Little Lagoon Pass bridge and seawall, and an extension of the existing jetties. Knowledge of the existing and historical conditions is needed to determine the impacts of the proposed modifications on adjacent beaches. The analysis of the sediment budget is based on annual beach-profile survey data from 2006 to 2012. The average annual change in sediment volume, derived from beach-profiles, was examined for approximately two and a half miles east and west of the pass. A substantial variability in the yearly volume change was found for the reach west of the pass while a relative constant yearly volume change was apparent on the east side of the pass. This suggests a potential imbalance in the system. The long term average change in volume from 2006 to 2012 indicates an overall increase in the sediment supply over the entire western and eastern reach of the study area. The cause of this increase is currently unknown and additional research is needed to account for shoreline position and the variability of volume change above and below the water.

# β-cyclodextrins as mobile phase additives in liquid chromatography

**Stephanie McDonald**

Department of Chemistry, College of Arts and Sciences

Mentor: Jason W. Coym, Department of Chemistry, College of Arts and Sciences

β-cyclodextrins are 7-membered ogliosaccharides, which have the ability to complex various other molecules. They are typically used to solubilize non-polar solutes in polar environments. In this work, two derivatized β-cyclodextrins, methyl-β-cyclodextrin (MBCD) and hydroxypropyl-β-cyclodextrin (HPBCD), are employed as mobile phase additives in reversed-phase liquid chromatography. Because these additives may complex various solutes, their presence in the mobile phase can change the selectivity of the chromatographic system. Various chromatographic selectivities were examined as a function of cyclodextrin type, concentration in the mobile phase, and temperature. Temperatures of 25, 35, 45, and 55°C were used, and concentrations of the cyclodextrins in the mobile phase were 2, 4, 6, 8, and 10 g/L. Shape selectivity was assessed with either SRM 869 or the Tanaka test (triphenylene and o-terphenyl). Benzene, toluene, ethylbenzene, propylbenzene, and butylbenzene were used to determine methylene selectivity. Temperature dependence of the various selectivities allowed for a van't Hoff analysis of their associated thermodynamics. It was shown that the methylene selectivities of the cyclodextrins did not show much of a difference, however, both cyclodextrins changed the order of elution for the terphenyl isomers.

The work was supported by the National Science Foundation under grant CHE-0910474.

# Secondary Traumatization in Rape Crisis Advocates: A Multiple Case Study of the Emotional Effects of Working with Sexual Assault Victims

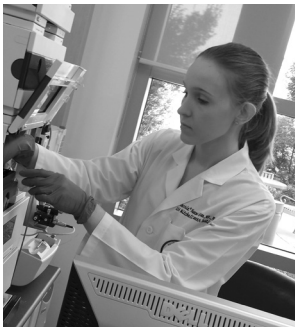
**Aldyn Miller**

Department of Criminal Justice, College of Arts & Sciences

Mentor: Sarah Koon-Magnin, Department of Political Science & Criminal Justice, College of Arts & Sciences

This research is designed to explore the psychological and emotional symptoms of secondary traumatization of a group of women who have rarely been studied before: rape crisis advocates. These advocates assist victims of rape and sexual assault in obtaining medical treatment, receiving mental health services, and guiding them through the criminal justice system after an assault has occurred. Recent research has theorized that both professional and volunteer service providers who work closely with sexual assault victims may begin to experience, over time, indirect physical and psychological traumatic effects that mirror those of the victims they assist. As a result of secondary traumatization, rape crisis advocates can experience compassion fatigue, burnout, and vicarious traumatization. A sample of advocates was selected from the Mobile County Rape Crisis Center. The rape crisis advocates were administered the ProQOL survey. Participants were then interviewed about their experiences working with sexual assault victims, and the questions asked during each interview were selected based upon participants' responses to the survey. Qualitative analysis was then used to outline the situational context of the participants' emotional reactions. Our research is expected to show respondents' experience fear and anger in response to environmental and individual cues. Additionally, we plan to explore whether or not experienced advocates use their emotional reactions as a tool for identifying with the sexual assault victims they serve. We also plan to examine how these emotional reactions can be conceptualized within the frame of secondary traumatization.

# Protein Stability in Human Pancreatic Secretions



**Genevieve E. Mullen**

Department of Chemistry, College of Arts and Sciences

Mentors: Dr. Lewis Pannell, Brittany Ferguson & Jana Rocker, Mitchell Cancer Institute

Late stage pancreatic cancer has a median survival of less than one year. No reliable diagnostic tools or screening methods for early tumor detection currently exist, highlighting the urgent need for more sensitive and specific detection strategies. Protein markers in the localized body fluid called pancreatic juice may allow the noninvasive detection of pancreatic cancer, however, the abundance of proteases in pancreatic secretions could cause excessive deterioration of samples before analysis. We used proteomic techniques to determine the effects of temperature and protease inhibitor on the stability of pancreatic secretions. Two human samples of pancreatic juice were collected either with or without protease inhibitor and incubated in 37°C or 20°C environments over a 24 hour time period. Data from high resolution tandem mass spectrometry (LC-MS/MS) was processed with protein identification software to evaluate differences in relative protein abundance with respect to temperature, enzyme inhibitors and time. We observed large variability in protein degradation among different patients and experimental conditions, but protease inhibitor had a stabilizing effect overall. Understanding the degradation behavior of pancreatic secretions is necessary to inform processing protocol and reveal analytical limitations in future biomarker research.

# Frontogenesis within Landfalling Tropical Cyclones

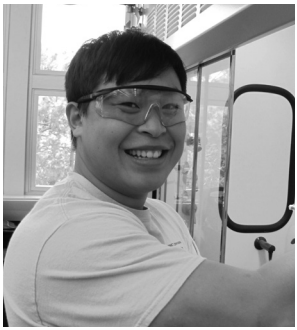
**Kelly Neugent**

Department of Meteorology, College of Arts and Sciences

Mentor: Sytske Kimball, Department of Meteorology, College of Arts and Sciences

Frontogenesis is the formation or strengthening of an atmospheric front; converging wind flow and distinct horizontal temperature and/or moisture gradients must be present for fronts to form. Due to their tropical nature and homogeneous horizontal temperature and moisture fields, fronts are not expected within tropical cyclones (TCs). However, recent research has led to the evidence of fronts in landfalling TCs. Being able to accurately detect and forecast fronts would help meteorologists prepare citizens for a TC's impacts such as enhanced rainfall and strong surface winds. Hurricane Ida (2009) displayed fronts during its landfall on the north central coast of the Gulf of Mexico. Although the impacts from Ida were minimal, heavy rain exceeding 140 mm over small areas occurred. Data from 15 stations from the USA Mesonet were analyzed. Sudden increases/decreases in temperature and dew point temperature (a measure of atmospheric humidity) and changes in wind direction were seen at several stations. Analysis revealed two fronts within Tropical Cyclone Ida- first a warm front, followed by a cold front. Decreased solar radiation and precipitation ahead of the warm front likely contributed to cooling of the air mass ahead of the front. Onshore flow behind the warm front brought in warm, moist air from the Gulf of Mexico. Future research will include detailed investigation of surface maps and Doppler radar data to diagnose the location and nature of the rainfall ahead of the warm front.

# Nanoscale Modification of Fibers via Reactive Dye Chemistry



**Nien Nguyen**

Department of Chemical and Biomolecular Engineering, College of Engineering

Mentor: Grant Glover, Department of Chemical and Biomolecular Engineering, College of Engineering

Co-authors: Kevin West and Christy Wheeler West, Department of Chemical and Biomolecular Engineering, College of Engineering

A large amount of research has been performed to attach dyes to fibers. One subject not covered is the attachment of reactive species and nanostructures to cellulose. Our research is focused on verifying the applicability of dye chemistry to reactive species and nanostructures and to secondly determine the impact of different reactive groups on the surface chemistry of cellulose. The research is focused on cellulose, however the reactive dye chemistry is applicable to synthetic polymer based fabrics as well as other natural fibers. Cyanuric chloride is used in this study as representative specimen to attach the reactive species and nanostructures. Applications of this research can potentially be used for military and industrial settings.

# Increasing the Strength of Pervious Concrete While Maintaining Permeability

This report outlines the findings from a study conducted to measure the effect of adding sand incrementally to a standard pervious concrete mixture. A standard mixture was obtained and used as the control, while six other mixes were produced, each with a different fine aggregate content. Every other component of the mixture was held constant. Specimens from each mix were tested for compressive, splitting tensile and flexural strength, and permeability. No apparent correlation was observed between added sand and increased compressive, splitting tensile, and flexural strengths. However, it was found that as the permeability of a sample decreased, the compressive strength increased. This was attributed to the fact that the pores in the pervious matrix are becoming more clogged with the incremental addition of sand. This reduced the permeability of the produced concrete and increased the compressive strength, as expected.

**Ahmad Omar**

Department of Civil Engineering, College of Engineering

Mentor: John C. Cleary, Department of Civil Engineering, College of Engineering

# Sulfoxonium-catalyzed Cyclopropanation of Alkenes

**Samantha Otzenberger**

Department of Chemistry, College of Arts and Sciences

Mentors: David Forbes and David Battiste, Department of Chemistry, College of Arts and Sciences

Co-authors: Cody Davis and Adirika Obiako, Department of Chemistry, College of Arts and Sciences

We have embarked upon the use of a bifunctional model system with a series of sulfonium salts with the intent of exploring chemoselective methylene transfer processes. The model system prepared has both aldehyde and activated alkene functionality. As such, the ratio of cyclopropane to oxirane formed will provide data on what key features of the S-ylide are needed in cyclopropanation versus epoxidation reactions. A series of sulfonium and sulfoxonium salts have been prepared and it is hypothesized that each will provide key metrics in methylene transfer preference. With a chemoselective in hand, we will be able to demonstrate streamlined synthetic processes involving bifunctional intermediates.

# The Role of the OmpR Response Regulator in the Generation of a Maximal Starvation-Stress Response (SSR) in *Salmonella enterica* Serovar Typhimurium

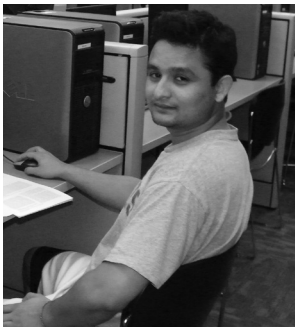
**Sana Ozair**

Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions

Mentor: Michael Spector, Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions

*Salmonella enterica* serovars (*e.g.*, *Salmonella enterica* serovar Typhimurium) cause more than 1.4 million cases of food-borne diseases with hundreds of deaths each year in the United States. In order for *Salmonella* to grow and survive in non-host (*e.g.*, soil, water, and slaughterhouses) and host (*e.g*, intestines, inside cells) environments it must recognize and respond appropriately to environmental stresses. One way *Salmonella* does this is via two-component systems composed of a membrane-bound sensor His kinase (HK) that phosphorylates a cytoplasmic response regulator (RR), which in turn regulates a set of genes. OmpR is one such RR, which is known to regulate gene expression in response to osmotic and acid pH stress, and to control genes needed for virulence. Microarray analyses showed that *ompR* is induced almost 3-fold during carbon-energy (C-) source starvation. In response to C-starvation *Salmonella* elicits a starvation-stress response (SSR), which provides resistance to long-term C-starvation and cross-resistance to other environmental stresses, *e.g*. acid pH, oxidative stress and antimicrobial peptides. Thus, we proposed that OmpR is required to generate a maximal SSR. To test this, we compared a wild-type and *ompR* knock-out mutant strain for the development of C-starvation-inducible (CSI) cross-resistance to a 60 minute challenge with 15 mM H2O2, pH 3.3 or 109 mg ml-1 of polymyxin B (an antimicrobial peptide). Results to date show that OmpR is not needed for CSI cross-resistance to H2O2. Studies to access its need for CSI cross-resistance to other stresses are ongoing.

# Virtual Material Testing of Functionally Graded Materials



**Bikal R. Parajuli**

Department of Mechanical Engineering, University of South Alabama

Mentor: Joseph D. Richardson, Department of Mechanical Engineering, College of Engineering

The present effort is an initial step toward characterization of functionally graded materials (FGMs) using strain gradient elasticity as determined through virtual material testing. FGMs are composite materials which gradually change their composition and structure over volume or in a particular direction. The state of the art for modeling FGMs is the assumption that the same form of Hooke's law used for standard materials may be used with the sole modification that the elastic constants are functions of space. However, due to constraints involving the strain-compatibility conditions, many stress distributions, some of which must certainly exist from physical arguments, are inadmissible. The proposed effort challenges the standard form of Hooke's law which has been used by assumption and suggests a couple-stress theory which may provide a more realistic description. Two consequences of the couple-stress theory are that the stress tensor is no longer symmetric and that stresses may produce strain gradients unlike the standard theory where stress produces only strain. The difficulty in this description is that the appropriate forms of Hooke's law are very complicated, introducing a number of constants which are difficult, if not nearly impossible, to measure physically. For this research, least squares regression analysis of finite element solutions is used to characterize higher order deformation.

# Modeling Coronary Arterial Bifurcations

**Alex Parks**

Department of Mechanical Engineering, College of Engineering

Mentor: Saami K. Yazdani, Department of Mechanical Engineering, College of Engineering

Cardiovascular (or heart) disease is the most common cause of death worldwide. Atherosclerosis and hypertension are the most common causes of cardiovascular disease. Atherosclerosis is the thickening of a vessel wall due to absorption of fatty materials such as cholesterol and triglyceride. This absorption is due to compromised endothelial cell function lining the interior wall of a vessel and allows plaque to accumulate. Other than prescription, treatments for atherosclerosis include different strategies such as the use of catheters with drug coated balloons and stents. Bifurcations throughout the vascular system are among the most common locations that atherosclerosis may form. Within the span of an arterial bifurcation, uniform flow is disrupted and more complex mechanical situations exist. Analysis of a flow path complicated by a change in direction is much more complex than studying flow patterns through a single channel. For this purpose, modeling an arterial bifurcation with sylgard may allow for extensive analysis of the system. Therefore, the purpose of this study is to develop a rapid and inexpensive method to develop consistent bifurcation models. Three types of materials, molding wax, polymers, and low-temp melting metals, were tested as the inner mold. Results demonstrated that the low-temp melting metal possesses the best properties for our application. These studies will potentially lead to more accurate testing of cardiovascular devices such as stents in a laboratory setting.

# Phosphorylation of STIM1 as a Possible Regulatory Mechanism of *Isoc*

**Neel Patel**

Department of Biomedical Sciences, Pat Capps Covey College of Allied Health

Mentor: Audrey A. Vasauskas, Department of Biochemistry and Molecular Biology, College of Medicine

The endothelium lines blood vessels, forming a semi-permeable barrier. Disruption of the endothelial cell barrier leads to increased permeability, allowing the passage of molecules and solutes. This can contribute to certain pathologies such as acute respiratory distress syndrome. In the pulmonary vasculature, calcium entry through store-operated calcium (SOC) channels, and specifically the *I*soc channel, leads to inter-endothelial cell permeability. It is known that the *I*soc channel is made up of at least the canonical transient potential proteins (TRPC) 1 and 4, with the protein Orai1 determining its calcium selectivity. However, the molecular makeup and channel gating properties of *I*soc are not completely understood. It is known that *I*soc inactivation is phosphorylation dependent. In this study, we sought to determine whether stromal interacting molecule 1 (STIM1) associates with the *I*soc channel, possibly via interaction with Orai1 or TRPC4 and whether STIM1 is phosphorylated upon SOC entry. We treated pulmonary artery endothelial cells (PAECs) with thapsigargin to activate SOC entry at various time points and made whole cell lysates. We used SDS-PAGE to separate the proteins in the lysates and performed western blot analysis using a phosphoserine-specific antibody. We found that a phosphoserine-specific band at ~85 kD, corresponding to the molecular weight of STIM1, increased over time upon SOC entry. These results suggest that STIM1 phosphorylation plays a role in SOC entry in PAECs.

# High Order Polynomial Approximations for Three-Dimensional Surfaces

The ability to mesh surfaces with elements of arbitrary order is not trivial; arguably the leading mesh generator **Gmsh** only allows meshes of fifth order polynomials. This paper presents a hierarchical meshing approach for higher order elements. The method estimates the location of the nodes of each element based on the nodes of an element of polynomial order reduced by one degree. The key feature of this method is to generate finer meshes of complex geometries using a gradient search optimization, in particular the steepest descent method. In general, higher order modeling can only be approximated as no closed-form mappings exist for most curved surfaces. The approach will allow the establishment of higher order surface models to represent complex surfaces as opposed to dense formats such as STL files, (Stereo Lithography) which use a large number of minute flat triangles to approximate curved surfaces. Numerical results show that it is possible to model general curved surfaces with a high level of fidelity using only a few nodal coordinates as data.

**Nilkumar Patel**

Department of Mechanical Engineering, College of Engineering

Mentor: Joseph Richardson, Department of Mechanical Engineering, College of Engineering

# A role for O-GlcNAc in the Regulation of Store-operated Calcium Entry of Pulmonary Artery Endothelial Cells

**Payal Patel**

Department of Biomedical Sciences, Pat Capps Covey College of Allied Health

Mentors: Audrey A. Vasauskas and Donna L. Cioffi, Department of Biochemistry and Molecular Biology, University of South Alabama College of Medicine

Endothelial cells line blood vessels and allow for the selective transport of molecules. Disruption of this barrier leads to increased permeability resulting in pathologies such as acute lung injury. Store-operated calcium entry (SOCE), specifically through the calcium-selective channel, *I*soc, leads to increased lung endothelial cell disruption and permeability. *I*soc activation/inactivation may be regulated through post-translational modification, and indeed it is known that inactivation of the channel is phosphorylation-dependent. In addition to phosphorylation, the channel may be regulated by O-linked β-N-acetylglucosamine (O-GlcNAc) which can have an inverse relationship with phosphorylation on the same serine or threonine residues. Proteins associated with *I*soc include the canonical transient receptor potential proteins 1 and 4 (TRPC1, 4) (which are subunits of *I*soc), Orai1, and STIM1. In this study, we sought to determine whether STIM1 has the O-GlcNAc modification and whether the degree of this modification changes upon SOCE activation. Since competition between O-Glc-NAcylation and phosphorylation has been observed in some models, we also sought to determine whether cross talk regulates SOCE activation. Western blot analyses show that STIM1 is O-GlcNAcylated. A decrease in band density suggests that STIM1 O-GlcNAcylation decreases as SOCE is activated. These results suggest that O-GlcNAcylation regulates SOCE.

# MicroRNA Sponge Production using PCR-based Concatemerization of Short DNA Oligonucleotides

**Tabitha Perry**

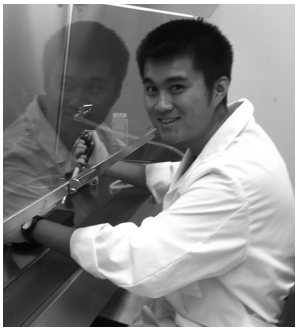
Department of Biology, College of Arts and Sciences

Mentor: Glen Borchert, Department of Biology, College of Arts and Sciences

Co-author: Alyson Askew, Department of Biology, College of Arts and Sciences

Only discovered in humans in 2001, microRNAs are a surprisingly abundant class of RNAs that function as negative gene regulators involved in diverse biological processes. A large body of evidence has now shown that miR mutations or mis-expressions correlate with a wide array of human cancers and commonly play a causative role in tumorigenesis. Several miRs have been clearly shown to repress the expression of important tumor suppressors and are quickly becoming invaluable in the diagnosis and treatment of various malignancies. In this study we are attempting to regulate the overexpression of miRs linked to disease. While miR misregulation is clearly indicated in numerous malignancies, therapeutic tools for their suppression have only recently begun to be developed. The most promising miR inhibitors to date have been deemed microRNA sponges. A single miR sponge is capable of specifically binding and inactivating numerous miRs per cell. While work with miR sponges is encouraging, their cost is often inhibitive as the only current means of sponge production is commercial synthesis or time consuming ligation-based cloning. In this study, we have developed a rapid, PCR-based methodology for microRNA sponge production that reduces production costs by as much as 90%. Our method involves allowing two inexpensive, ~40 nucleotide DNA primers with complementary ends to concatemerize one another in a slightly modified PCR amplification. Altogether, we find primer design, PCR, cloning, and final sequence confirmation are readily achievable in under two weeks at a fraction of the cost of commercial inhibitors.

# Addition of Extracellular Bicarbonate to Pulmonary Microvascular Endothelial Cells Alters Intracellular pH



**John Pham**

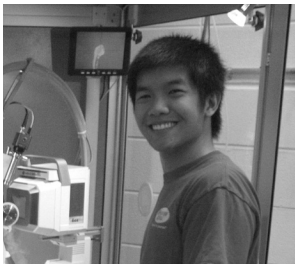
Department of Biology, College of Arts and Science

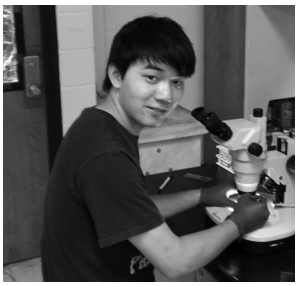
Mentor: Sarah L. Sayner, Center for Lung Biology, College of Medicine

The pulmonary endothelial barrier is critical to gas exchange in the lung. Cyclic AMP (cAMP) is a signaling molecule that regulates the integrity of the pulmonary endothelial barrier. Transmembrane adenylyl cyclase synthesizes cAMP in a sub-plasma membrane compartment to tighten the endothelial barrier, yet not all elevations in cAMP tighten the barrier. Adenylyl cyclase isoform 10 (AC10) is a mammalian soluble adenylyl cyclase that is stimulated by bicarbonate. AC10 protein is expressed in pulmonary endothelial cells. In addition, when extracellular bicarbonate is added to pulmonary microvascular endothelial cells (PMVECs) there is an increase in intracellular cAMP suggesting bicarbonate stimulation of AC10. This bicarbonate stimulation of AC10 is sufficient to disrupt the endothelial barrier. Currently, it is unclear how extracellular bicarbonate crosses the plasma membrane to gain access to the cytosol and activate AC10. Sodium bicarbonate transporters (NBCs) have been detected on pulmonary microvascular endothelial cells and could act as a mechanism to transport bicarbonate into the cell. Here we examine the intracellular pH (pHi) fluctuations in PMVECs in response to increasing extracellular bicarbonate.

# Variable-Temperature Structural Changes and Resultant Photoluminescent Effects in Isostructural Lanthanide Cyanometallates Containing $Au_2Pt_4$ and $Au_2Pd_4$ Cyanide Clusters

Four isostructural compounds with the formula $K_2[Ln(H_2O)_4(M(CN)_4)_2]$ $Au(CN)_2 \cdot 2H_2O$ (Ln = Eu, Gd; M = Pt, Pd), abbreviated KLnMAu, will be discussed. Studies of said compounds will be presented with four foci. First, $Au_2Pt_4$ or $Au_2Pd_4$ clusters within the compounds have the potential to transfer energy to either $Gd^3$+ or $Eu^3$+ in KLnMAu. Such potential was studied via temperature-dependent photoluminescence experiments. With $Gd^3$+ having no visible emission, it acts as a control for energy transfer from cyanide clusters to $Eu^3$+. Second, the difference in degree of covalency in metal-metal interactions in the $Au_2Pt_4$ vs $Au_2Pd_4$ clusters will be presented. Third, M-Au and Au-Au distances, cell volumes, and *a*-axis and *c*-axis unit cell lengths of all four compounds were recorded with X-ray diffraction. Changes in those properties with respect to change in temperature will be displayed. Finally, variable-temperature structural and photoluminescence changes will be correlated.





**Lam Pham and Kang Rui Xiang**

Department of Chemistry, College of Arts and Sciences

Mentor: Richard Sykora, Department of Chemistry, College of Arts and Sciences

Co-authors: Anthony Thames and Frankie White, Department of Chemistry, College of Arts and Sciences and Zerihun Assefa Department of Chemistry, North Carolina A&T State University

# Colorectal Cancer Screening Methods are Prediction Factors for Determining the Practice in a Patient Center Medical Home

**Andrea Pittman**

Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions

Mentor: Allen Perkins, Department of Family Medicine, College of Medicine

As the current system of healthcare is changing rapidly, practices must develop and change to stay afloat in the new age of healthcare. The National Committee of Quality Assurance (NCQA) has stepped in to change health care as we know it. The care of patients concerning colorectal cancer screening correlates to the overall ability of the practice to serve patients' needs, making it a good study to see the path that practices will most likely take in the near future. The hypothesis in this study is that by colorectal cancer screening as a marker we can predict the resources necessary for practices to become Patient Centered Medical Homes (PCMH). Colorectal cancer screening is an example of a task that requires complex behaviors on the part of many people (including the patient) to accomplish. As care transforms from volume based to value based, practices that have well developed systems of care will become more efficient and effective. A survey was developed and administered to a variety of different practices over eight counties in Alabama. Questions that are relevant to all practices were applied to the survey about the practice overall, staff, electronic health records (EHR), screening methods, chronic care, and overall outreach. The physicians surveyed in our area are doing better as whole than the average physician in Alabama.

# Role of miR-193a in Melanoma Pathogenesis

MicroRNA's exhibit differential expression in several human diseases such as cancer and play important roles in the disease processes. The hypothesis tested in this study was that miR-193a downregulation facilitates melanoma progression and metastasis. The FEMX-1 cell line was transfected with the miR-193a overexpressing vector and the cells were incubated and used for several assays. A clonogenicity, growth, aggregation and motility assay were conducted along with cell cycle analysis and western blot for several proteins. The results indicate that when miR-193a is overexpressed it has tumor suppressing abilities. Increases in the band intensity of Bax as well as p21 in the miR-193a infected cells show that it promotes apoptosis. Whereas, a decrease in the band intensity of Cyclin A1 and E in the miR-193a overexpressed cell line highlight the microRNA's ability to reduce tumor growth. The reduced growth of the miR-193a cells, along with the 2.7 fold decrease in the amount of DNA in the S phase, further highlight suppression of tumor growth. It was also found that the miR-193a cells displayed a 2.7 fold decline in colony formation in addition to the 2.9 fold difference in motility of the cells. In summary, miR-193a downregulation contributes to melanoma pathogenesis; however, further investigation is required to understand the mechanism by which miR-193a suppresses tumor growth by exploring target genes of miR-193a.

**Janika Prajapati**

Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions

Mentor: Seema Singh, Department of Oncologic Sciences, Mitchell Cancer Institute

Co-authors: Udayan Bhattacharya, Nikhil Tyagi, Gurpreet Kaur and Ajay Singh, Department of Oncologic Sciences, Mitchell Cancer Institute

# Effect of Ground Calcium Carbonate on Concrete Strength

**Arnav Rajbhandari**

Department of Civil Engineering, College of Engineering

Mentor: John Cleary, Department of Civil Engineering, College of Engineering

The process of making cement is an energy intensive and expensive process. It would be economically, as well as, environmentally sound if some of the cement in a mix could be replaced with something cheaper and more environmentally friendly. The American Concrete Institute Committee 211 has stated a need for research on the effect of replacing some of the cement with ground calcium carbonate in a concrete mix. Replacing some of the cement with ground calcium carbonate will not only make the concrete mix cheaper, but will decrease its carbon footprint.

For this research, cement was replaced with 5%, 10% and 15% of ground calcium carbonate and was compared with a control sample by conducting compressive and splitting tensile strength tests at 7- and 28-days. Seven-day compressive tests showed a reduction of almost 14% for the mixes with some proportion of ground limestone. This shows a significant drop in early strength between mixes with and without ground limestone. Twenty-eight day compressive tests showed a reduction of almost 6% for the mixes with some proportion of ground limestone. This showed a small, but insignificant drop in ultimate compressive strength. The compressive strength of mixes did not change significantly among the mixes containing different proportions of ground limestone for both 7-day and 28-day tests. The splitting tensile strength at 28 days showed no significant change in tensile strength between the different mixes.

# Identification and Characterization of Naproxen Degrading Bacteria Isolated from Weeks Bay, Alabama

**Camille Reynolds**

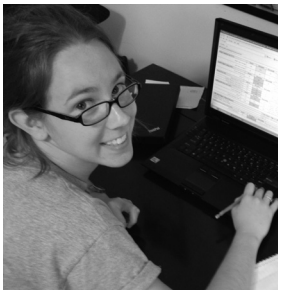
Department of Biology, College of Arts and Sciences

Mentor: Sinéad M. Ní Chadhain, Department of Biology, College of Arts and Sciences

Naproxen is a non-steroidal anti-inflammatory drug used to treat pain and/or inflammation. Personal care products and pharmaceuticals (PPCPs), including naproxen, have been found in varied concentrations in soil, wastewater, surface water, drinking water, and natural water due to humans and animals excreting both urine and fecal matter into wastewater. This is an emerging and important environmental issue as PPCPs may have ecotoxicological effects on humans, plants, and animals. Microorganisms, including bacteria, have the ability to degrade PPCPs.

Bacterial samples from Weeks Bay, Alabama were collected. These samples were cultured on agar plates containing 1 mM naproxen as the sole carbon source. Specimens that had high growth rates on the plates were classified into operational taxonomic units (OTUs) by performing Polymerase Chain Reaction (PCR) and Amplified Ribosomal DNA Restriction Analysis (ARDRA). A total of 6 OTUs representing 27 isolates were classified based upon gel appearances and molecular weights. Seven isolates representing 5 OTUs have been sequenced. Twenty isolates are *Pseudomonas balearica*, representing 74.1% of all isolates. In total, 25 out of 27 (92.%) isolates are Pseudomonads; one other is *Staphylococcus pseudintermedius* and the other was not identified. *Pseudomonas* species are known to degrade a wide variety of hydrocarbons (alkanes, mono-aromatic and poly-aromatic hydrocarbons). Initial triparental mating was completed, giving an antibiotic profile of bacterial strains and plasposons. For future research, this gives us direction to perform complete knockout mutagenesis and find specific naproxen-degrading genes.

# Impact of Cognitive Reserve on Intra-Individual Variability



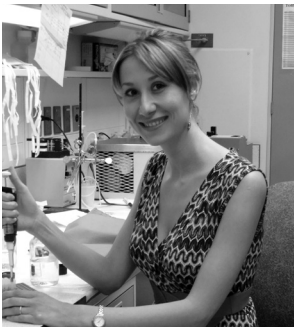
**Megan Roe**

Department of Psychology, College of Arts and Sciences

Mentor: Benjamin Hill, Department of Psychology, College of Arts and Sciences

Intra-individual variability (IIV) in cognitive performance is emerging in the literature as a marker of neuropathology. This study evaluated the relation between cognitive reserve and IIV. Specifically, we examined whether physical exercise could act as a stressor on cognitive reserve to reveal increased IIV post-exercise. Data were collected from a sample of 7 members of a local gym (5 males and 2 females). The mean age of the participants was 29.88 years (SD= 10.61). The computerized neurocognitive test battery CNS Vital Signs was completed before any exercise and 1-2 weeks immediately after intense exercise. The baseline was used to calculate an individual's overall test battery mean (OTBM) and served as the baseline measure for each participant. The standard deviation around their own OTBM (OTBM SD) was used as the individual's measure of IIV. Pearson correlation comparing baseline and post-exercise OTBM SD found a negative association ($r=-0.438$, $p=0.325$). Paired sample t-tests found significant baseline and post-exercise differences between the OTBM and OTBM SD as well as the CNS Vital Signs domains of psychomotor speed and reaction time. Baseline OTBM predicted 13% of the variance in IIV post-exercise. Our hypothesis that exercise as a physical stressor would increase IIV was not supported from the data. However, we believe this may be due to confounds at the baseline testing condition.

# Collagenase Assisted Tissue Engineered Blood Vessels



**Lilia Rusu**

Department of Chemical Engineering, College of Engineering

Mentors: Diego Alvarez, Department of Lung Biology, College of Medicine, and Saami K. Yazdani, Department of Mechanical Engineering, College of Engineering

Co-author: Jordan Simonson, Department of Biomedical Engineering, College of Engineering

Tissue engineered blood vessels (TEBV) have been proposed as a graft alternative for the hemodialysis treatment, having the potential to overcome the high failure rates of the current vascular access methods. Producing tissue engineered blood vessels involves the processing of natural porcine carotid arteries and their repopulation with new smooth muscle cells (SMC). To date, researchers have successfully repopulated the endothelium layer of the decellularized scaffolds. However, repopulation of the medial layer of an acellular scaffold with smooth muscle cells (SMC) has been the major challenge during the process of engineering a TEBV. The presence of SMCs helps to minimize the risk of infection and helps the blood vessels to heal from repeated needle punctures. The goal of this project was to increase the cellular migration within the tunica media of the blood vessels. The decellularized scaffolds were treated with collagenase to create pores or free volume spaces that would allow effective smooth muscle cell proliferation and migration. We performed static seeding to determine the level of repopulation of the blood vessels with smooth muscle cells. Hoechst and H&E staining were performed. The results indicated that the blood vessels were fully decellularized but partially repopulated with smooth muscle cells. Future investigations will include repeated seeding of collagenase treated blood vessels with the assistance of bioreactors.

# Analysis and Correlation of Skin Blood Flow and Temperature Data

**Lisa Schibelius**

Department of Mechanical Engineering, College of Engineering

Mentor: David A. Nelson, Department of Mechanical Engineering, College of Engineering

The objective of this project is to fit experimental skin surface temperature and blood flow data to a model which describes skin tissue heating during radio frequency (RF) exposure. Data has been obtained from laboratory animals (rats and rabbits) under approved protocols. This project will determine whether the experimental data is consistent with previously-developed models of skin heating from RF sources--specifically sources in the millimeter wave (MMW) band, 30-300 GHz. In the course of this work, we will attempt to answer the question, "Can a homogenous tissue model of millimeter-wave skin heating be used to describe skin blood flow in a laboratory animal?" This work will be important to further development of millimeter-wave based health technologies--specifically, millimeter wave skin blood flow measurement. The ability to correlate the rate of skin temperature increase with skin blood flow during millimeter-wave heating could enable accurate measurement of skin blood flow. If a correlation is able to be developed, then it may be possible to extend the method to humans. This would be an important clinical advancement in the treatment and management of diabetic ulcers, peripheral artery disease, and other serious health conditions. [Note: Data analysis and modeling will be conducted using previously gathered data. No animal experiments will be conducted as a part of this research.]

# Development of an Undergraduate Programmable Logic Controller Laboratory

The purpose of the project is to create a new Programmable Logic Controller (PLC) laboratory that will better prepare students for the engineering work place in the job world. A laboratory and a three credit hour lecture will be taught in the same semester, and assignments will be coordinated. Team-based learning will be employed. Each week, the teams will be given an assignment that builds on a set of design specifications from the previous week. The assignments are in a problem-solution style. The roles of the laboratory instructor and laboratory assistant will be more of a manager/ supervisor relationship to the teams. The roles of the students will be as project engineers. The laboratory experiments will simulate industrial design projects. Furthermore, safety will be emphasized and risk analysis will be done for each assignment. Students will be followed and will be periodically surveyed to see if the PLC laboratory experience is a benefit in job placement. Surveys are already conducted each year as part of the effort to maintain accreditation by the Accreditation Board for Engineering and Technology (ABET) for the program of the Department of Electrical and Computer Engineering (ECE).

**Johanna Schleinitz**

Department of Electrical and Computer Engineering, College of Engineering

Mentor: Thomas G. Thomas, Department of Electrical and Computer Engineering, College of Engineering

# Effects of Coastal Climates on Durability of Concrete

**Vince Sellers**, Department of Civil Engineering, College of Engineering

Mentor: John Cleary, Department of Civil Engineering, College of Engineering

Concrete is the most used building material in the world. Engineers use it around the world to build structures such as bridges, towers, roads, and buildings. Reinforced concrete is a structural member consisting of a concrete with steel reinforcing bars to improve overall strength, more specifically tensile strength. Reinforced concrete has excellent strength; however, some of the durability is compromised since the steel reinforcing bar is susceptible to corrosion and degradation mechanisms, especially in a coastal environment.

Many research studies have been conducted to identify the mechanisms of corrosion and potential solutions for reducing it. This paper consists of a literature review of several research studies on the behavior of reinforced concrete in the coastal environment. The studies include topics that identify factors of durable concrete, the corrosion and degradation mechanisms relevant in the coastal environment, and potential solutions for reducing the possibility of corrosion and degradation.

As a result of this literature review it is recommended that, for reinforced concrete in this type of aggressive environment a water-to-cement ratio be selected that is relatively low, proper curing methods are used, adequate concrete cover is provided, good construction practices are followed, and supplementary cementitius materials are used. Some potential additional cementitius materials could include ground granulated blast furnace slag (GGBFS), silica fume (SF), or fly ash (FA). The use of stainless steel reinforcing is a potential solution for improved durability in prestressing strands and reinforcing bars.

# JagPlane: Autonomous Flight and Data Collection

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Mentor: Michael Doran, School of Computing & Director of USA Honors Program

Co-author: William Holder, School of Computing

The focus of this research is to gain a better understanding of the process of data collection in real time systems during autonomous flight. Autonomous technologies have been proven to be useful in many situations such as the use of drones for search and rescue and military operations. In order for a real time system to navigate through its surroundings, various sensory systems are needed to provide usable data that allow it to understand and react to a dynamic environment. With the growing use of drones, our goal is to understand what it takes to create a machine that is almost completely independent, relying on the data that it collects on its own.

Using information from our research we equipped a remote control aircraft with the ArduPilot board to begin collecting data from a real life aircraft. Using the data collected from our flights with the ArduPilot, we were able to create a plane that can react as any competent human being. For example, when making turns, climbs and descents, we had to use our own perception of the plane as it flew and control its direction. Once we collected data on how the turn was actually made such as time, angle, and location, it was possible for the device to know how long and far to turn to reach a destination.

# Methods for Allowing Equal Access to Music Theory for a Visually-Impaired Student

**Meghan Squier**

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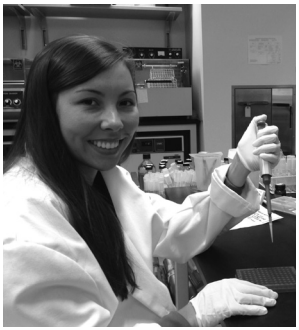
Mentor: David Durant, Department of Music, College of Arts and Sciences

Though music is an auditory experience for the audience, the process of performing and learning music in a formal collegiate environment requires the ability to visually analyze musical notation. Specifically, this ability is required for music students taking mandatory courses in music theory, which are fundamental in order to fully equip students to attain an optimal level of performance and understanding of music. Methods have been developed to give visually-impaired students a limited understanding of music theory but most either require an unreasonable amount of time and/or money from any particular university that does not specifically fund for a specialized program. Our research evaluated the accessibility of music theory for visually-impaired individuals at the collegiate level through the case study of our current visually-impaired student. We assessed the affordability and convenience of Braille and electronic textbooks as well as several relevant technologies. We concluded that making our own worksheets on the program, Finale, and formatting the files to be compatible with the Dancing Dots Braille Music Technology program, Lime Aloud, would be the most cost effective and efficient method of instruction for both student and teacher. Though the short-term goal of this research project was to assess the ways in which our Music Department can make the music theory program accessible to our current visually-impaired student, the ultimate goal of this research is to bring attention to some of the impediments to visually-impaired musicians in order to incite change.

# The Role of the Diguanylate Cyclase AdrA in the Development of a Maximal Starvation-Stress Response in *Salmonella enterica* Serovar Typhimurium



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Mentor: Michael Spector, Department of Biomedical Sciences, Pat Capps Covey College of Allied Health Professions

*Salmonella enterica* serovars (e.g., *S.* Typhimurium) are common causes of food-borne diseases worldwide; due in large part to their capability of surviving in numerous and diverse natural, commercial, and host environments. The ability of *Salmonella* serovars to sense, respond, and survive abrupt changes in their immediate environment is essential to their growth and survival during their life cycle. One of the most common stresses encountered by *Salmonella* is the deprivation of a carbon-energy source (C-starvation). The genetic and physiological changes that occur upon C-starvation are called the starvation-stress response (SSR). The SSR helps the bacteria survive periods of C-starvation and provides cross-resistance to other stresses, i.e., reactive oxygen species, acidic pH, and antimicrobial peptides. One of the ways bacteria respond to environmental conditions is by controlling the levels of second messenger molecules. e.g., AMP (cAMP) and cyclic diguanylate (c-di-GMP). Diguanylate cyclases synthesize c-di-GMP from 2 GTPs and c-di-GMP is degraded by c-di-GMP phosphodiesterases to 5'-pGpG. c-di-GMP levels regulate the transition between motility and biofilm formation as well as virulence. The diguanylate cyclase AdrA controls cellulose biosynthesis and biofilm formation. To test the hypothesis that AdrA controls c-di-GMP levels during and is needed for the development of the SSR, a mutant strain lacking *adrA* was compared with its wild-type parent strain for the ability to generate cross-resistance to exposure to acidic pH, hydrogen peroxide, and the antimicrobial peptide polymyxin B. Results to date are inconclusive and studies are still ongoing.

# Chagas Disease and its Vector, *Triatomid sanguisuga* in Mobile, Alabama

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American Trypanosoma or Chagas disease was named for Carlos Chagas. In 1909 he discovered the hemoflagellate parasite *Trypanosoma cruzi* responsible for this zoonotic disease. The kinetoplastid parasite that causes Chagas Disease was once thought only to be endemic to Latin America, however within the last century evidence has shown Chagas disease exists in the sylvatic habitat in the southern region of the United States. At least 6 autochthonous cases have occurred in the United States, with 2 cases reported from Louisiana and Tennessee. The southern United States has 11 species of *Triatomids* that are potential vectors for the parasite *T. cruzi*. In Alabama, only 1 species is known to exist, *Triatomid sanguisuga*. Studies show 18 counties within Alabama have tested positive for *T. cruzi* in wild reservoirs and in *Triatomid sanguisugas*. There are no written publications to show that *Triatomid sanguisugas* have been found in Mobile, County or that a search has been conducted. It was the objective of this project to sample sites within Mobile, AL to verify the presence of *Triatomid sanguisuga*.

# Sulfur-Containing Quaternary Ammonium Salts as Phase Transfer Catalysts

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Co-author: Richard O'Brien, Department of Chemistry, College of Arts and Sciences

Processes involving the synthesis of pharmaceutical drugs, agricultural chemicals, and polymers often required complex organic compounds to be reacted with species in an immiscible liquid phase. Performing such reactions using traditional homogeneous-phase methods normally results in low yield, waste, and low rates of reaction. However, in the 1960's, a new technique emerged known as phase transfer catalysis (PTC). PTC allows for reactions to take place directly between immiscible phases, increases reaction rates, allows for greater control of selectivity, and reduces the amount of waste and pollution associated with such reactions. Advantages in PTC are due to catalysts being tailored to specific reactions. The objective of this project is to evaluate the relative influences of tetraalkylammonium catalysts in comparison to their sulfur-containing analogues in the alkylation of an organic aryl substrate. The substrate being utilized is deoxybenzoin, which was chosen because it allows for the study of selectivity between two possible alkylation sites (carbon and oxygen). The results from the project show conclusively that the sulfur-containing tetraalkylammonium compounds decrease the reaction rate and increase the O-to-C selectivity. This is most likely due to the unique catalyst conformation created by the presence of the sulfur atoms. Future directions of interest for this project involve studying the susceptibility of the catalysts to degradation via Hoffman elimination and studying the effects of catalyst alkyl chain lengths upon the reactions. This will aid in the identification of the rate limiting step in the reactions.

# Caregiver Reaction to Placement Scale: A New Instrument to Assess Caregiver Emotional Functioning Following Nursing Home Placement

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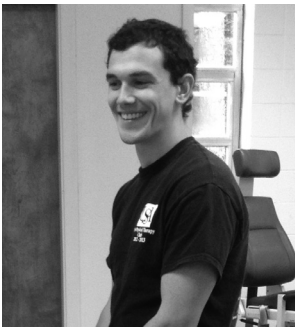
Mentor: Benjamin D. Hill, Department of Psychology, College of Arts and Sciences

Guilt is a core feature of dementia caregivers' experiences following nursing home placement. This study describes and validates a new assessment tool for monitoring caregiver adjustment after nursing home placement. Forty-six items addressing ambivalence and guilt about nursing home placement were tested with 53 dementia caregivers who were within six weeks of the individual with dementia's placement (M age = 60.26, SD = 11.42; 76% female; 66% adult child). Using principal axis factor analysis, 15 items were retained that showed acceptable internal consistency (Cronbach's alpha of 0.92). Construct validity was established with measures of depression (r = 0.45) and burden (r = 0.45). This scale may be used to identify caregivers at risk for adjustment problems following placement and to monitor adjustment over time. When examining potential differential associations among each of the factors and these outcome measures, decisional guilt (factor 1) appeared more related to depressive symptoms. In contrast, guilt related to violating a commitment or promise to the care recipient (factor 2) appeared more closely associated with the social consequences and psychological burden factors. This scale will allow nursing facilities and families to know what to expect, psychologically, ahead of time and is timely given our aging population.

# Biomechanical Measures of Ankle Bracing in Jump Performance and Injury Risk



**Matthew Wilt**

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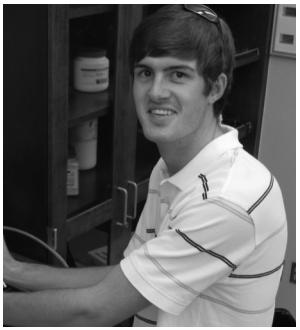
Mentor: John E. Kovaleski, Department of Health, Physical Education and Leisure Studies, College of Education

Ankle sprains are the most common injury in recreational and competitive sports and account for almost 50% of all sports injuries. No comprehensive analysis has been reported on the effects of ankle bracing on ankle complex motion, jump performance, and vertical ground reaction forces associated with injury risk. Participants (13 male, 7 female) performed three trials of the 10-repetition ankle-hop test, the 5-repetition double-leg countermovement jump test, and a countermovement jump onto a force plate. Maximal active plantarflexion and dorsiflexion range-of-motion (ROM) and inversion-eversion load-displacement curves were collected using a six degrees-of-freedom ankle arthrometer. The countermovement jump on the force platform was used to measure the first and second vertical ground reaction forces associated with the jump landing phase. Repeated measures ANOVA compared the performance data and ankle complex stability among no brace and braced ankles (soft-shell, lace-up, rigid). The rigid and soft-shell braces provided superior inversion-eversion rotation support ($P < .05$) with minimal interference in plantarflexion/dorsiflexion ROM. Restriction of sagittal plane motion by the lace-up brace decreased ankle hop jump height ($P = .02$), but not the counter movement jump height. It is likely that any limitation in ankle complex sagittal plane motion with brace application was not great enough to interfere with the mechanics of jumping. In addition, double-leg landing peak vertical ground reaction forces were not increased with brace application. The sagittal plane kinematic and kinetic data support the use of ankle bracing for injury prevention and treatment following ankle sprain injury.

# Liquid/Liquid Equilibria of Binary Systems of Lipidic Ionic Liquids with Molecular Species



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Ionic liquids are molten salts that have melting points below 100°C. They are of interest to chemists and engineers due to their nearly negligible vapor pressure, thermal and chemical stability, and the ability to create ionic liquids that are tailored for specific processes. However, as ionic liquids are polar to moderately polar in nature, they are not typically miscible with nonpolar compounds, which encompass many common organic solvents. One way to increase non-polar solute solubility in ionic liquids is to add a long, alkyl (lipidic) chain to one of the ions. Our group, along with colleagues in Chemistry, has been investigating a class of ionic liquids with non-polar-like solvent properties, which we have named lipidic ionic liquids. As part of the characterization of these solvents, we are measuring their binary liquid/liquid equilibria with molecular compounds to probe their solvent properties.

The experimental setup that is used to observe the liquid/liquid phase behavior is a custom built cloud point cell which contains a mixture of Ionic liquid and a molecular compound of interest. The temperature is controlled by a recirculating chiller and the cell is suspended over a magnetic stir plate to keep the mixture well mixed. A laser is directed through the mixture which completes a circuit which will trip when the circuit is broken by the cloud point of the mixture scattering the laser light. The data collected is being modeled using the NRTL activity coefficient model.

# Synthesis and Analysis of a 5-Substituted Norcantharidin Analog as a Protein Phosphatase 4 Inhibitor

Every year over twelve million people are diagnosed with cancer. As scientists continue to search for treatments, serine/threonine protein phosphatases are emerging as novel anti-tumor drug targets. Overexpression of protein phosphatase type four (PP4) has been observed in various forms of cancer. Recent findings regarding the role of PP4 in cell cycle regulation suggest that inhibition of PP4 could suppress tumor cell survival. Consequently, this study seeks to develop a potent and selective inhibitor of PP4 that will serve as a lead compound for anti-tumor drug development. Upon examination of the structure of serine/threonine protein phosphatases by means of computer modeling software, a norcantharidin analog tethered to a lactone substituent was predicted as a target molecule for the inhibition of PP4. Several conventional synthetic protocols were merged to form a unified synthetic scheme. Future work will include completion of the synthesis of the target compound and analysis of the compound's effect on PP4 via an established fluorometric protein assay.

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