

# **WELCOME TO THE 2013 RESEARCH and CREATIVE ACTIVITIES SYMPOSIUM**

**Friday, April 19, 2013  
Denver Campus**

**9:00am – 10:00am: Exhibit set-up and light refreshments**

**10:00am - 11:30am: Judging for Chancellor's Awards**

**11:30am - 12:30pm: STUDENT EXHIBITS OPEN SESSION**

Students will present their research and creative projects in an informal setting - *Lunch will be served*

**12:45pm - 2:00pm: GENERAL SESSION / STUDENT PRESENTATIONS (NC 1130)  
Outstanding Research & Creative Activity Award Winners  
Introduction: (Dr. Richard Traystman, VC Research)**

12:45pm - 1:00pm	<b>OPENING REMARKS:</b> (Dr. Rod Nairn, Provost)
1:00pm - 1:15pm	Ryan Anderson, Mechanical Engineering, CEAS "Bone Loss Affects Load Sharing in an Ankle Fusion Model Using a Compression-Generating Intramedullary Nail"
1:15pm - 1:30pm	Thomas Hraha, Bioengineering, CEAS & Nili Krausz, Mechanical Engineering, CEAS "Using Technology to Promote Interdisciplinary Learning in Colorado Middle Schools"
1:30pm - 1:45pm	Amy DePierre, Environmental Science, CLAS "Small-Scale Agriculture as an Alternative to Mechanized fields of Monoculture"
1:45pm - 2:00pm	Ian Danielson, Public Administration, SPA "Extra-Disciplinary Wanderings: The Benefits of Coloring Outside Epistemological Lines"

**2:00pm - 2:30pm: AWARDS CEREMONY**

- Lilly Marks, Executive Vice Chancellor, presenting the RaCAS Chancellor's Awards
- Mary Coussons-Read, Provost UCCS, presenting the Award for Outstanding Student Mentor and the Outstanding Undergraduate Research and Creative Activity Awards
- Mary Coussons-Read, Provost UCCS, presenting the Outstanding Graduate Research Awards
- John Lanning, AVC for Undergraduate Experiences, UROP Chair, presenting the UROP Awards

**2:30pm - 2:45pm: CLOSING REMARKS: Dr. Richard Traystman**

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# WELCOME

## RESEARCH and CREATIVE ACTIVITIES SYMPOSIUM April 19, 2013

I welcome you to the 16<sup>th</sup> Annual Research and Creative Activities Symposium (RaCAS). This is the fifth joint RaCAS between the Denver and Anschutz Medical Campuses, and we are here to celebrate our student's accomplishments. Over 190 students are displaying over 130 exhibits at this Symposium.

Discovery and creativity in learning is critical for the future of our students at the University of Colorado Denver (CU Denver). The discovery based and creative works on display today are representative examples of the kind of activity we want all CU Denver students to experience.

Many other individuals have demonstrated strong support for this symposium and are with us today, such as Provost Dr. Rod Nairn, and our Executive Vice Chancellor, Lilly Marks. Their leadership and support recognizes the importance of learning by doing.

Enjoy yourself as you recognize the efforts of our undergraduate and graduate students. Stop them and engage them in conversations about their topics. I assure you that they will be thrilled to speak with you about their work.

Finally, I would like to thank all those whose efforts were critical to bring about this celebration of student discovery and creativity.

Best wishes and have a great time at our Symposium.

*Richard J. Traystman, Ph.D.*  
*Distinguished University Professor*  
*Vice Chancellor for Research*  
*University of Colorado Denver | Anschutz*



University of Colorado  
Denver | Anschutz Medical Campus

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## **MIDDLE SCHOOL AWARD WINNERS**

### **Hosted by the College of Liberal Arts and Sciences**

Fourteen of the best and brightest local middle school students who placed in the top tier of the junior division categories at the Denver Metropolitan Science and Engineering Fair are showcasing their posters at the Symposium today. Around four hundred middle and high school students from the Denver area competed at the fair in February. The College of Liberal Arts and Sciences sponsored some of the first, second and third place junior division category awards. Prior to today's proceedings, the students had lunch with Dean Daniel J. Howard and CLAS professors who talked with the students about their research interests.

#### **Alby Musaelian**

Stanley British Primary School

Project: *Up or Down: Investigating Decision Procedures*

#### **Avi Swartz**

Challenge Middle School

Project: *An Attempted Polynomial Solution to an NP Problem*

#### **Melody Shellman**

Challenge Middle School

Project: *Can Fracking Cause Earthquakes? Investigating the Possible Effects of Fracking Fluids on Earthquakes*

#### **Hari Sowrirajan**

Challenge Middle School

Project: *Can Cyanobacteria be Used to Reduce Co2 Emissions from Cars?*

#### **Jake Ramsey & Sarah Williams**

Silver Hills Middle School

Project: *Achieving Interstellar Travel*

#### **Rahul Ramesh**

Challenge Middle School

Project: *Constructing a Microbial Desalination Fuel Cell to Generate Electricity from Anaerobic Waste Water Sludge and Reduce Conductivity of Salt Water*

#### **Sean Smith**

Challenge Middle School

Project: *Seeing Sound: A Study of Cymatics in Two Dimensions*

#### **Maddie Korman & Emma Kemper**

Stanley British Primary School

Project: *The Power of Words: The Scientific Study of Intrinsic and Extrinsic Motivation*

#### **Julia Jackson**

Notre Dame Catholic School

Project: *Ashes, Ashes, Will We All Grow?*

#### **Roger Nakagawa**

Hill Campus Middle School

Project: *Laundering Money – The Effect of Different Methods for Sanitizing Microorganisms on Money*

#### **Julia Baroth**

Stanley British Primary School

Project: *Does "Joe" Help Plants Grow?*

#### **Wiley Kemp**

Stanley British Primary School

Project: *MR Fluid—Is It Magic? No, It's Magnets*

## Undergraduate Students

### ***Isolation Rearing and Restraint-Stress Alters c-Fos Expression in the Forebrain of Male and Female Rats***

Jessica Adams, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Sondra Bland, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Isolation rearing in rats, which involves housing animals in isolation throughout adolescence, serves as an effective animal model for adverse events occurring during adolescence in humans. Adverse events in adolescence are implicated in lasting changes in cognitive and emotional functions and can lead to disorders such as schizophrenia, depression and anxiety in humans. Previous work in our laboratory has demonstrated that isolation rearing causes changes in prefrontal cortex function. This study looks at the effects of isolation rearing on the function of other forebrain regions in male and female rats. Neuronal function was assessed by measuring the expression of the immediate early gene c-Fos in response to restraint stress in four regions of the forebrain; the cingulate cortex, lateral septum, piriform cortex, and the agranular insular cortex. Immunohistochemistry was used to identify c-Fos and then density counts were performed in the regions of interest to measure activation. Results showed that restraint stress was greater in group reared males and isolate females, but this may in part be due to elevated basal levels in female group reared and male isolation reared rats.

### ***Control of Src Tyrosine Kinase in Detergent-Resistant Membranes***

Rachel Ancar, Biology, DC - College of Liberal Arts and Sciences

Courtney Warren, Biology, DC - College of Liberal Arts and Sciences

Yen-Ha Hoang, French, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Brad Stith, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

In fertilization of *Xenopus laevis*, the binding of sperm to the egg activates a signaling pathway at the plasma membrane of the egg involving calcium release to induce fertilization. Cell membranes are organized into specialized microdomains, or “rafts”, that are stabilized by caveolin-1, sphingolipids, and cholesterol. Disruption of membrane rafts prevents fertilization and the completion of developmental processes. Previous research in our lab has suggested that sperm binds at egg rafts, increasing a lipid, phosphatidic acid (PA) that activates Src tyrosine kinase, which then activates phospholipase C (PLC $\gamma$ ) to produce IP<sub>3</sub> and subsequent intracellular calcium release. In addition to their distinct composition, these membrane rafts are characterized by detergent insolubility compared to the rest of the membrane. Using *Xenopus laevis* egg cell lysates, detergent-resistant membranes were isolated using sucrose gradient ultracentrifugation. Raft fractions were identified through Western blotting using caveolin-1 and  $\beta$ -actin. Addition of PA to *Xenopus* eggs doubled the amount of PLC $\gamma$  in rafts, whereas Src did not increase. These results indicate that PA may not cause the translocation of Src into the lipid microdomains but potentially causes the translocation of PLC $\gamma$  to the membrane rafts.

***Examining How Dance/Movement Therapy Impacts Mood States of Patients in a Pediatric Psychiatric Hospital Setting***

Ashley Anderson, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Ms. Heather Kennedy, AMC - School of Medicine

*Activity Type:* Undergraduate Research

According to the National Institute of Mental Health, one in five children will be diagnosed with a mental health disorder. The prevalence of mental disorders among children prompts patients and providers to utilize complementary and alternative medicines, including Music, Yoga, Dance/Movement, and Art therapies. The Ponzio Creative Arts Therapy program at Children's Hospital Colorado (CHC) provides the aforementioned therapies to assist patients in achieving psychiatric or medical treatment goals. The objective of this retrospective research is to examine the relationship between reported mood changes and patient characteristics-age, gender, ethnicity, primary diagnosis insurance status, psychiatric medications, length of stay, and treatment unit-for adolescents who participate in Dance/Movement Therapy (DMT) at CHC between August 2010 and December 2011. The Fast Assessment of Child Emotions (FACE) assessed the following six mood states from pre to post therapy: fatigue, confusion, energy, anxiety, sadness and anger. FACE measures were then linked to patient characteristics for data analysis in R version 2.15.1. Analysis shows that there does appear to be a change in the total mood score and in individual mood scores after one DMT session, with the initial mood score being the most telling variable in regards to the expected change in total mood score. There does not appear to be a correlation between patient characteristics and changes in individual or total mood scores. The results from this formative study will aid future researchers in developing prospective studies that focus on therapeutic effects of subsequent DMT sessions for a wide range of patients.

***Bone Loss Affects Load Sharing in an Ankle Fusion Model Using a Compression-Generating Intramedullary Nail***

Ryan Anderson, Mechanical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Dana Carpenter, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

This research looks at an innovative solution to ankle fusion by applying biomechanical modeling techniques. Ankle fusion is a treatment for patients with severe injuries or degenerative disease to the ankle region resulting in extreme pain when walking or other daily activities. Intramedullary (IM) nails, which are inserted through the three bones that together make up the ankle, secure the joint and promote fusion of the bone. Once the joint is fused, rotation of the joint is lost but mobility of the patient is gained within weeks of the surgery. A new IM nail has been introduced that uses a compression generating material to apply compression to the joint. By applying compression, the new nail aims to increase fusion success rates. Starting with medical images, a 3D model of the ankle was developed and the IM nail was integrated into the model. The compression was simulated using mechanical engineering analysis software and stress levels were analyzed. The forward goal of this study is to determine the effects of a loss of bone density on the mechanical environment in and around an IM nail that uses a compression generating material.

## Undergraduate Students

### ***Genetic Differences in Initial Sensitivity to Alcohol as a Predictor of Alcohol Self-Administration Behavior in Rats***

Alexandra Anley, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Richard Allen, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Each year Americans spend about \$167 billion on social problems related to alcohol abuse and there is now very strong evidence that alcoholism is a heritable disease (i.e., there are strong genetic components). In addition to genetics, a person's level of response to alcohol can indicate whether or not they will have an increased risk of developing an alcohol use disorder. Specifically, individuals with an initial low level of response to alcohol have been found to be at an increased risk for developing alcoholism. We used genetic animal models of these human phenotypes (i.e., individual differences in initial alcohol sensitivity) to identify specific genes that result in increased drinking behavior. Briefly, rats were trained to self-administer alcohol using a fade procedure where the concentration of the sucrose solution was decreased as the concentration of the alcohol was increased, until rats were drinking only 10% ethanol. The response requirement was then increased from a fixed ratio (FR) 1 schedule to a FR4 schedule of reinforcement. Drinking behavior was then assessed over a range of increasing ethanol concentrations (10-30% ethanol). Finally, "motivation" to respond for 10% ethanol was assessed using a progressive ratio schedule of reinforcement. Data shows that rats bred to express a lower sensitivity to alcohol did in fact consume more alcohol than rats that were bred to express a higher sensitivity to alcohol. These findings suggest we may have identified specific genes responsible for an increased risk of developing alcoholism.

### ***Studying the Neurochemical Consequences of an Escalation in Cocaine Consumption***

David Bergkamp, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Richard Allen, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Cocaine addiction in the U.S. is a significant public health concern. Recent data from the National Survey on Drug Use and Health show that around 500,000 current users undertook some form of treatment for cocaine dependence in the past year. Unfortunately, the mechanisms underlying a transition from recreational to dependent cocaine-taking are not entirely understood. Several experimental designs that model cocaine-taking in rats have been developed to determine these mechanisms. One such model has been employed by the Richard Allen laboratory to examine the behavioral and biochemical effects associated with increased cocaine-taking over time, a pattern known as escalation. Specifically, escalation in cocaine consumption was found to occur following a switch from moderate to high dose cocaine (0.6 to 1.2 mg/kg/infusion) self-administration. Escalation could also be produced under moderate cocaine dose conditions by treating rats systemically with a NMDA glutamate receptor antagonist (MK-801), suggesting a role for glutamate in the escalation mechanism. Here we present an initial assessment of the neurobiological consequences of these forms of escalation in cocaine consumption. Western blot analysis of tissue from the nucleus accumbens and dorsal striatum brain regions did not reveal differences in concentrations of either the NR1 subunit of the NMDA receptor or the dopamine D2 receptor between rats that escalated cocaine-taking and those that did not. In the future, we aim to continue these analyses to determine concentrations of the glutamate 1 transporter and the NR2B subunit of the NMDA receptor, further exploring the relationship between cocaine dependence and brain chemistry.

## ***Why Did We Become Striders? On the Evolution of Human Bipedalism***

Mark Campo, Anthropology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Charles Musiba, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

In addition to the fossil records of Eastern and Central Africa, which indicate that various hominid ancestors of *Homo sapiens* may have developed bipedalism in a forested rather than a savannah environment as previously thought, fossils of Miocene apes that have been uncovered over the past fifteen years both in Africa and Eurasia, dated to 20-12 mya, show evidence of postcranial features consistent with a move toward a more upright posture (Nakatsukasa, 2004; Moyá-Solá et al, 2004). This not only points to an earlier start in the evolution of bipedalism than previously thought, but is also consistent with the idea of multiple instances of that evolutionary milestone. Given the diversity of Miocene ape Fossils and hominid species during the late Miocene-Pliocene, these different events may have been a result of homoplasy, via multiple ancestors. My research will address those issues by reviewing samples from the fossil record of Miocene apes such as *Nacholapithecus kerioi* and *Equatorius Afropithecus*, and hominids such as *Ardipithecus ramidus*, *Australopithecus afarensis*, and *Australopithecus africanus* with a focus on adaptations to their anatomies related to morphological upright features, identifying the paleoenvironmental conditions they lived in to determine possible variability and selective pressures which may have acted as "trigger" mechanisms contributing to upright posture and bipedal gait. My research also will look at the possibility that the last common ancestor of humans and chimpanzees may have been an upright ape rather than a quadruped.

## ***Interactions between the Human C-Reactive Protein and Lipid-Coated Nanoparticles***

Nara Chon, Chemistry, DC - College of Liberal Arts and Sciences

Eun Kim, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Hai Lin, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

C-reactive protein (CRP) is an inflammatory marker that can be used to predict the risk for cardiovascular diseases. Experiments have revealed that CRP binds to lipid-coated nanoparticles of small radii ( $\sim 140\text{\AA}$ ) but not of larger radii, and that the binding process is associated with conformational changes of the protein induced by the curved membrane. Here, we report a computational study of the binding process. Atomistic molecular mechanics is performed to simulate the approaching and binding of the protein to the membrane. Preliminary results suggest that calcium ions bound to the protein may play an important role in modulating the protein-membrane interactions. Acknowledgement: This project is supported by a UROP grant to Eun Kim and Nara Chon as well as by LABCOATS (NIH IMSD 5R25GM083333) to Nara Chon.

## Undergraduate Students

### ***Binding Energy of Ammonia-Sulfuric Acid Clusters***

Nara Chon, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Hai Lin, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Atmospheric observations and laboratory studies have shown that ammonia and sulfuric acid can be important for atmospheric aerosol nucleation, but the mechanisms are not well understood at the molecular level. We report here a computational chemistry study of the formation of ammonia-sulfuric acid clusters in the gas phase. Geometry optimizations were carried out to identify stable structures for the  $(\text{NH}_3)_n(\text{H}_2\text{SO}_4)$  and  $(\text{NH}_3)(\text{H}_2\text{SO}_4)_n$  ( $n = 1, 2, \dots, 6$ ) complexes, followed by normal-mode vibrational analysis. Electronic energy and the thermodynamic properties were estimated at the level of B3LYP/6-31+G(d,p) for various temperatures ranging from 200 K to 300 K. The electronic energy was further refined at the MP2 level by extrapolation to the complete basis set limit. The binding Gibbs free-energy shows noticeable temperature-dependence owing to the entropic contributions.

Acknowledgement: This project is supported by an NSF grant (#1136122) to Nara Chon.

### ***Molecules of the Mind that Matter: Development of a New Interdisciplinary Course and Research Experience in Chemistry***

Alysia Davey, Chemistry, DC - College of Liberal Arts and Sciences

Chelsea Ladd, Biology, DC - College of Liberal Arts and Sciences

Inna Trochanskaya, Chemistry, DC - College of Liberal Arts and Sciences

Maile Devine, Chemistry; Elizabeth Moua, Biology; Brian Kavinsky, Chemistry; Jessica Quintana, Biology; Andrew Aninye, Biology

Faculty Sponsor: Dr. Karen Knaus, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

This presentation explores the development of a new interdisciplinary course and undergraduate research experience Molecules of the Mind that Matter. The project represents a student collaborative action-research approach to the development of an interdisciplinary chemistry course. The course is a unique offering that has the potential to broaden students' and teachers' appreciation for the science of learning. For science education researchers, understanding these molecules and their mechanisms assists in the advancement of educational theory - an understanding that will lead to the creation of new educational methods. For students, the course promotes interest in both science education research and traditional chemistry research methods. A large component of the independent study research experience involves literature searches focused on specific learning objectives designed around cognitive science, educational psychology, biochemistry and molecular biology learning content. Course participation encourages interdisciplinary knowledge acquisition through reading comprehension, logical thinking, creative thinking and connective thinking.



***Deployment of GIS Web Services to Support Hospital Disaster Planning Professionals for Addressing Vulnerable Populations***

Eben Dennis, Geography, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Deborah Thomas, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Emergency planning for hospitals in Colorado is an essential part of integrated disaster preparedness planning. The identification of the most vulnerable populations is integral to ensuring that services can be provided for even the most marginalized people if an event occurs. This project presents an online interactive mapping tool for emergency planners that provides information on vulnerable populations based on socio-demographic characteristics from the 2010 U.S. Census. Populations are mapped at two different geographic units, the hospital service area and by census tract to assist in hospital emergency planning. Each of 15 different indicators is included so that a user can interactively choose how to view the data and create maps for inclusion into the planning process. Existing research on mortality mapping guided many of the cartographic choices used to represent the measure of vulnerability for each indicator. Once the initial tool was created, this project began to evaluate the usefulness and effectiveness of the interface and data for emergency planners through a user needs assessment. Students in disaster management courses at UCD were surveyed to analyze the usability, usefulness, and clarity of the mapping tool. These results are synthesized to guide the improvement of the tool and data and the next steps in the project. Analysis of one set of student surveys has resulted in satisfaction with the design choices, ease of use, and usefulness of the tool.

***Arterial Calcification in Pre-Menopausal Women***

Heather Dirkmaat, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Michael Greene, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Calcification occurs during advanced atherosclerosis. Atherosclerosis is the deposit of plaque along the aorta and mainly the arteries. This resistance for the blood causes the heart to work harder. Atherosclerosis can cause heart attack, stroke and angina. This disease kills 1 in 3 Americans every year. My data indicates that 1 in 2 women will die of heart disease and proven prevention methods are not helping. My data will help illustrate why women are no longer fitting the normal trend of atherosclerosis following menopause.

## Undergraduate Students

### ***Histological Assessment of Intersex Gonads in White Sucker (*Catostomus commersoni*) and Fathead Minnow (*Pimephales promelas*) Exposed to Wastewater Treatment Plant Effluent***

Zia Faizi, Biology, DC - College of Liberal Arts and Sciences

Kobi Nguyen, Biology; Ethan Cabral, Biology; Gary Broyles, Biology

Faculty Sponsor: Dr. Alan Vajda, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Histological evaluation of the effect of steroidal estrogen on the male reproductive system is an important technique in identifying the role of endocrine active hormones on the cell cycle. By utilizing microscopy and staining methods we can answer critical environmental and physiological questions such as; how clean our water systems are and what the impact of estrogen can have on testes and fertility. Integrating field studies with controlled laboratory studies allows us to capture the intrinsic variability in the concentrations and occurrence of environmental contaminants. We have previously observed intersex gonads in fish downstream of wastewater treatment plants, as well as fish experimentally exposed to wastewater chemicals individually, as controlled mixtures, and as complex mixtures. In this study, we conducted a morphometric analysis to compare oocyte follicle size and structure between intersex and females, of two different fish species. Comparison between oocytes in male and female fish will be made based on cell stage, cytoplasmic area, and development of a follicular envelope. A specific focus will be placed on the development of the follicular envelope. This histological analysis may answer crucial questions such as the viability of the oocytes found within the male testes as well as what variability may exist in the cell cycle of an oocyte found within two different chemical environments.

### ***MicroRNA Expression Profiles during Differentiation of Embryonic Stem Cells to Midbrain Dopamine Neurons***

Michael Ferreyros, Pre-med, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Curt Freed, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Parkinson's Disease (PD) is the second most common form of neurodegeneration in elderly populations with the principal impediment being the progressive degeneration of midbrain dopaminergic neurons (mDNs) as a result of oxidative stress, mutant  $\alpha$ -synuclein aggregation (Lewy Bodies), genetic predisposition and epigenetic elements. The main course of treatment has been a daily dose of costly medication, however; in recent years transplantation of differentiated embryonic stem cells (ESCs) into the putamen has emerged as a promising alternative to the daily regime of drugs, not only halting the progression of the disease but also reversing several of the clinical symptoms of PD. Current methods of differentiating ESCs to mDNs can take upwards of 20+ days with only 20% efficiency; therefore, a more efficient method of differentiation is needed. In recent years the discovery of highly conserved, small (18- to 25-nucleotide), non-protein coding sequences of RNA, known as microRNA (miRNAs), have been shown to regulate gene expression during development of the mammalian central nervous system. MicroRNAs regulate cell fate decisions by silencing and directing the degradation of mRNA, possibly providing a model for quicker and more efficient differentiation methods in vitro. Using two green fluorescent protein (GFP) cell lines and traditional methods of differentiation, cells in three different stages of differentiation (ESCs, neural stem cells, and mDNs) were isolated via fluorescent activated cell sorting (FACS). MicroRNAs were then extracted and sequenced to elucidate microRNA expression during differentiation of mDNs from ESCs.

## ***The Effect of Hepatic Blood Flow on the Volume of Microwave Ablations at 2.45 GHz and 915 MHz***

Richard Ferro, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Aimee Bernard, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

In 2005, the Journal for Clinical Oncology published an article on the growing presence of Hepatocellular Carcinoma (HCC) worldwide. It is reportedly the fifth most common solid tumor, and the fourth highest cause of cancer related death. What complicates the treatment of this disorder is the regenerative nature of hepatic tissue, which results in high rates of recurrence for malignant tumors (between 75-100% after tissue resection). Therefore, conventional methods such as chemotherapy and surgical resection need to be replaced with a more radical form of treatment. Studies show that cancerous cells are susceptible to high levels of damage and death in the presence of heat. This has led to the development of Microwave (MW) ablation. However, while ablations are effective against tumors, they are susceptible to heat loss through blood flow. In order to improve upon the effectiveness of MW ablation, studies need to be done on how different rates of blood flow affect the volume of an ablation site. Our lab is studying the effect that blood flow rates between 60 mL per minute and 100 mL per minute have on two different forms of ablation. One targets the water of cells at a frequency of 2.45 GHz, while the other uses 915 MHz. Using a bovine liver model, ablations were performed and measured to determine their total volume. What this lab considers as a more effective ablation technique is one that maintains a relatively stable volume in the face of different rates of blood flow.

## ***Investigating the Role of Leukotrienes in Traumatic Brain Injury***

Antoinette Foster, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Kim Heidenreich, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Traumatic brain injury (TBI) results in biphasic injury. Primary injury is caused by the initial insult, while secondary injury occurs later by complex signaling cascades. Increasing evidence indicates that leukotrienes, pro-inflammatory lipid mediators, contribute to secondary injury. Our lab has shown that administration of MK-886, an inhibitor of leukotriene synthesis, attenuates edema and cell death after experimental TBI in rats. To verify the pharmacological results, a different experimental model of TBI using wild type (WT; C57BL/6) mice and 5-lipoxygenase (5-LO) knockout mice would be utilized. The goal of this project was to establish a mouse model of TBI and to investigate biomarkers to assess injury using WT mice in order to compare to 5-LO knockout mice. WT mice were subjected to a closed head injury (CHI). Experimental groups included naïve, sham, and CHI-injured mice. The severity of injury was assessed using a neurological severity score (NSS), and degeneration was assessed by histology (H&E and FluoroJade) and Western Blot. CHI-injured WT mice had higher NSS scores than sham-injured mice. CHI-injured WT mice demonstrated high levels of pyknotic, degenerating cells in the cortex and hippocampus in the hemisphere ipsilateral to the injury when compared to the non-injured hemisphere. Injured WT mice had increased hippocampal apoptotic cell death (active-caspase 3), but had similar levels of diffuse axonal injury ( $\beta$ -APP) in the hippocampus and cortex compared to sham mice. Overall, these results demonstrate that the CHI model produces measurable differences between injured and non-injured mice, making the method suitable for comparison of 5-LO knockout mice.

## Undergraduate Students

### ***Climate Data Acquisition via Autonomous Unmanned Aerial Vehicles***

Michael Frato, Electrical Engineering, DC - College of Engineering and Applied Science

Joseph Niswonger, Electrical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Dan Connors, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

At the moment one of the hottest topics in the scientific community is that of climate change. However, many important data points are unrecorded due to inaccessibility and the high cost in recording them. An example of this is in mountainous terrain, where it is extremely difficult to consistently and accurately collect data such as snow depth in back country regions. Current approaches to snowfall analysis range from fixed sensor locations to manual measurements. While new techniques have been proposed to leverage lasers to quantify snowfall, such techniques are expensive and cover only a limited area (about 100 yards). Our approach is to use of a set of GPS-guided fully autonomous unmanned aerial vehicles (UAV) to visit a large area to collect more measurements with more frequent collection intervals. With the recent advance and accessibility of GPS systems, what was once feasible with only a military budget is now easily within the range of the private sector. In addition, the resolution of GPS systems now allows for precise maneuvering of a UAV. The project will build on a wide variety of disciplines, fully integrating several areas of student in electrical engineering (remote sensing, embedded systems technologies, wireless communications, and electromagnetic fields and waves.) There are many additional applications involving unmanned aerial data acquisition in the Rocky Mountain region, such as fire monitoring, avalanche danger analysis, and water table recording.

### ***A Comparative Analysis of Oral Health on the Santo Domingo Pueblo Reservation***

Joaquin Gallegos, Public Health (BS), DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Terry Batliner, DDS, MBA, AMC - Colorado School of Public Health

*Activity Type:* Undergraduate Research

The American Indian Alaska Native (AI AN) population has the poorest oral health status compared to the general U.S. population. The objective of this study was to investigate the prevalence of oral disease among children and adults on the Santo Domingo Pueblo in New Mexico. Utilizing a community-based randomized sampling method, 195 adults and 204 children participated in an oral examination by the study dentist and 3 calibrated registered dental hygienists. Data collected included location, type and surface texture of oral lesions, numbers of decayed, missing and filled teeth, periodontal screening and recording (PSR) by sextant for individuals > 18 years of age. The prevalence of untreated decay was high with 63% of males and 56% of females having one or more untreated carious lesions. The highest prevalence of untreated lesions was 72% for males ages 20-64 years. The lowest percentage of untreated lesions was 52% for females ages 5-19 years. Adults also have high rates of periodontal disease and more than one half of the elders are edentulous (have complete tooth loss). People living on the Santo Domingo Indian Reservation have substantial unmet oral health needs. The Indian Health Service has been underfunded and in response to overwhelming demand for dental care, many locations have prioritized care to children. The Santo Domingo Pueblo can now work with oral health professionals in an informed way to improve the situation for their people.

## ***Role of VEGF Signaling in Schistosoma-Induced Pulmonary Inflammation***

Liya Gebreab, public health , DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Brain Graham, AMC - School of Medicine

*Activity Type:* Undergraduate Research

We have developed a mouse model of schistosomiasis-induced pulmonary vascular disease, characterized by significant Th2 inflammation coupled with vascular remodeling and elevated right ventricular pressures. In contrast to other experimental models of Th2-induced pulmonary vascular disease, this model is highly relevant to the human disease of schistosomiasis-associated pulmonary arterial hypertension (PAH) caused by chronic infection with the trematode *Schistosoma mansoni*, the third most prevalent parasitic infection worldwide, which affects over 200 million people and is one of the most common causes of WHO Group 1 PAH worldwide. There is significant evidence that Th2-mediated inflammation supports the pathogenesis of both human disease and experimental animal models of pulmonary hypertension (PH). A key immune regulator is vascular endothelial growth factor (VEGF), which is produced by Th2 inflammation and can itself contribute to Th2 pulmonary responses. In the present study we interrogated the role of VEGF signaling in a mouse model of schistosomiasis-induced PH. We exposed mice to *S. mansoni* ova, with or without concurrent pharmacologic VEGF receptor blockade, and assessed the degree of pulmonary vascular remodeling and inflammation. We found that VEGF receptor blockade resulted in decreased pulmonary vascular remodeling and Th2 inflammation resulting from *S. mansoni* ova exposure. These findings suggest that VEGF contributes to schistosomiasis-induced vascular inflammation and remodeling.

## ***TheraGO - Motor-Assisted Therapeutic Tricycle***

Chad Glidden, Mechanical Engineering, DC - College of Engineering and Applied Science

Ryan Reece, Mech. Eng.; Chris Jackson, Mech. Eng.; Darcy Lane, Mech. Eng.; Brant Baca, Mech. Eng.; Lane Childers, Mech. Eng.; Clayton Lehrian, Mech. Eng.; Chris Zarate, Mech. Eng.

Faculty Sponsor: Dr. Christopher Yakacki, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

In 2004, Jared Glidden was born with a brain malformation resulting in cognitive delays, physical difficulties, and autism. As a result, learning simple physical activities, such as riding a bicycle, can be a difficult and arduous task. The purpose of this project is to design and manufacture a motor-assisted therapeutic tricycle for special-needs children, like Jared, to create a progressive learning environment that allows children with disabilities to enjoy a family bike ride with a new level of independence. TheraGO was designed using principles across all areas of mechanical engineering. Pressure readings from sensors on the pedals will be relayed to the control system, which will provide assistance from a cordless drill motor. When these readings are within a specified range, the motor will engage, supplying a torque to the input of the continuously variable transmission (CVT). If rider input falls below a certain level, the motor will shut off, prompting the rider to apply more force. The lower threshold can be adjusted as the rider gains strength and muscle memory. TheraGO is also designed with comfort and safety in mind. An independent rear suspension ensures stability, while the CVT alleviates shift shock and the need to manually shift to create a more comfortable ride. The frame and suspension maintain a factor of safety of 5, while an ergonomic system of safety restraints secures the rider. The tricycle is also designed to fit on standard sidewalks and utilizes quick-disconnects to increase portability in vehicles.

## **Undergraduate Students**

### ***Border Policy, an Embodied Perspective***

Shay Gonzales, history, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Mr. Ian Dawe, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Creative Activity

Over spring break I will participate in a humanitarian aid project in the Arizona desert. Through the organization More Deaths, myself and other volunteers will spend the week providing water and medical support to migrants crossing through a deadly corridor created by US immigration policy. In a 10 minute multimedia presentation I will situate this experience in my embodied experience of the luminal and deadly desert as a queer, documented and multiracial person while also integrating academic critique of the neoliberal and nationalist ideologies which have brought us here. As an artist, academic and activist, I believe that personal narrative and an insertion of a human subject into the Sonoran landscape may disrupt the spectacular image of unauthorized migration in the US-Mexico borderlands. In our contemporary political moment, immigration reform is one of the highest priorities of the Obama administration. But all proposals continue to push for increased border enforcement. This macroscopic view of immigration encourages a continued a racial indifference to the hundred who die in the desert each year and whose narratives elude public discourse.

### ***Why Mattering Matters: An Analysis of the Relationship Between Family, Mattering, and Emotional Distress in Adolescents***

Joshua Goode, Sociology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Paula Fomby, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Previous research has shown that family structure and family instability are significantly correlated with emotional distress in adolescents. The purpose of this project is to further understand this relationship by investigating the role of mattering, which is a social psychological concept that considers the degree to which we perceive ourselves as a significant part of the world around us. Specifically, I seek to determine the degree to which family impacts mattering in adolescents, as well as the degree to which mattering mediates the relationship between family and emotional distress. To accomplish this task, I utilize the National Longitudinal Study of Adolescent Health. I distinguish between mattering to parents and mattering to other family members. I find that there is no correlation between family structure and mattering to parents. However, there is a strong correlation between family structure and mattering to other family members. In addition, I find that mattering does mediate the relationship family and emotional distress to a degree.

***A Comparative Study on the Role of External Assistance in Disaster Preparation and Mitigation in Vulnerable Populations***

Amy Hale, Public Health, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Karen Lutfey, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Many recent catastrophes such as earthquakes, hurricanes and floods seem inevitable, as though they are an act of God that leaves populations devastated in their random occurrence. However, upon analysis of these events we can begin to see obvious patterns that demonstrate that disasters do not necessarily occur in a random fashion but instead in a predictable nature. This research draws upon the vulnerability framework of natural disasters proposed by Terry Cannon to demonstrate the role of external assistance in changing the outcome of disasters in areas with populations of vulnerable people. External assistance is often provided after major catastrophes and disasters through organizations that include central government-oriented aid (CGA), national non-governmental organizational aid (NNA) and international humanitarian aid (IHA) as well as national counterpart aid (NCA). This paper looks at the impact of organized and sustainable assistance during the preparation and mitigation stage of the pathway of hazards to disasters and how this effort can be effective in preventing mortality and morbidity. The purpose of this research is to draw upon primary research conducted in the Trifino region of Guatemala during a rapid ethnographical study, documentary research on the CGA, NNA, and IHA models as well as a comparative analysis of disaster management systems that use external assistance in both preparation and post-disaster recovery and reconstruction to propose a linear model that ranks influence of these certain factors before others, in order of influence, to better understand the non-random distribution of disasters globally and the impact of external assistance.

***Wastewater Contaminant Effects on the Expression of Primary and Secondary Sexual Characteristics in Fish***

Alexandra Harrison, Biology & Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Alan Vajda, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Wastewater treatment plant effluents contain a complex mixture of endocrine-active contaminants, including steroidal and non-steroidal estrogens, and neuro-active pharmaceuticals. These contaminants are capable of interfering with the regulation of vertebrate reproduction at multiple loci, and can disrupt the development and expression of primary and secondary sexual characteristics. We have previously demonstrated that controlled exposure to wastewater contaminants individually, in controlled mixtures, and in complex mixtures can suppress secondary sexual characteristics and spermatogenesis in male fathead minnows (*Pimephales promelas*). Initial observations suggest that in control males, expression of primary and secondary sexual characteristics is highly correlated. However, these initial observations suggest that exposure to wastewater contaminants uncouples these traits. This study evaluates results from a series of integrated field and laboratory exposure studies to investigate the effects of contaminant exposure on the correlation between primary and secondary sexual characteristics. Disruption of primary and secondary sexual characteristics impacts individual fitness, but may have implications for sexual selection.

## Undergraduate Students

### ***Active Galactic Nuclei and Relativistic Phenomena***

Benjamin Hase, Physics, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Alberto Sadun, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Active Galactic Nuclei ("AGN") are extremely bright and compact regions in the centers of galaxies that are believed to have formed due to accretion of mass by a supermassive black hole. They are extraordinary sources of electromagnetic radiation. In fact, they are the most persistent known sources of electromagnetic radiation in the universe. Studying AGN in all wavelengths (including the optical) allows astronomers to discover and investigate distant galaxies and the furthest reaches of the cosmos. Of particular interest are relativistic jets, or cosmic rays, which are of great scientific interest (as evidenced by recent publications in Scientific American and other publications). To add to the mysterious and fascinating nature of AGN, the mechanisms by which jets operate and are generated remain unknown. Our project represents a small but important part of a long-term and highly collaborative global effort to understand AGN through astronomical observation. The focus of the study is on blazars, a type of AGN host galaxy, whose relativistic jet is directed at the Earth. Using cutting edge technologies, remote telescopes, and specially designed software, our research allows us to study AGN in-depth and present the newest data on faraway galaxies that are between hundreds of millions to billions of light years distant. The data gathered by us will be added to a collection of astronomical data that will eventually be used in creating detailed cosmological models. In addition, recent advances regarding AGN and the implications of our ongoing research will be presented.

### ***Can the Fundamental Cause Theory Explain Racial/Ethnic and Socioeconomic Disparities in Injection Drug Use?***

Mason Hohstadt, Public Health/Sociology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Patrick Krueger, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Intravenous drug use is a key vector in the transmission of blood-borne pathogens. Yet previous interventions have done little to dissuade or alter the risky needle practices of intravenous drug users (IDU). The fundamental cause theory suggests that there are racial, ethnic, and socioeconomic disparities in health and health related behaviors. This study aims to test this theory for risky injection behaviors. I analyzed fifteen years of data from the National Survey of Drug Use and Health (NSDUH), a publicly available data set that is collected annually about the drug behaviors (N=754,736 total respondents, of whom 153,350 have ever used illicit substances, and 8,574 had ever used needles to inject drugs). I used multivariate logistic regression to predict five injection drug use items (ever having used needles, using a needle cleaned with bleach, reusing needles, sharing a needle prior to and after injecting) with race/ethnicity, education, and family income, while adjusting for other demographic characteristics. Blacks and Hispanics were less likely than whites to have used needles, but the sample showed few race/ethnic differences for the other risky needle use practices. There were no differences in behaviors based on educational attainment or family income. I also found no evidence of statistical interactions between year of survey and education or year of survey and family income when predicting the five injection drug use behaviors. Based on these findings the fundamental cause theory is poorly suited to explain disparities in needle practice behaviors within this sample.



***Detection of Varicella Zoster Virus in Thoracic Sympathetic Ganglia has Implications for Visceral Neurological Disease in Humans***

Jonathon Huntington, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Aimee Bernerd, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Varicella zoster virus (VZV) is a neurotropic viral pathogen that infects nearly all humans. After primary infection (chickenpox) VZV can become latent in nervous tissue followed, sometimes decades later, by reactivation causing serious human disease of varying type. Of these diseases, Zoster (shingles) is the most widely reported, however many serious conditions exist without presence of rash (zoster sine herpete). VZV reactivation from cranial nerve, trigeminal, dorsal root, celiac, and nodose ganglia have been found to result in a variety of human neurological and vascular diseases as the virus travels through nervous tissue to affect adjacent tissue and organs. The presence of latent VZV DNA in thoracic sympathetic ganglia suggests the potential for reactivation and subsequent cause of disorders of the autonomic system. In order to ascertain the distribution of latent VZV in human sympathetic ganglia 63 thoracic sympathetic chain ganglia from the fresh tissue specimens of 8 recently deceased subjects were examined using hydrolysis probe real-time PCR analysis as well as immunohistochemistry staining in order to confirm and quantify the amount of viral DNA present. Of the 8 subjects examined all showed significant levels of VZV DNA in at least one thoracic ganglion. Our results suggest the potential for autonomic disorders resulting from VZV viral origin.

***Pro-Inflammatory Stimuli Cause Injury and Dysfunction of Fetal Pulmonary Vascular Endothelial Cells***

Azita Jahangirloo, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Jen-Ruey Tang, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Pro-inflammatory Stimuli Cause Injury and Dysfunction of Fetal Pulmonary Vascular Endothelial Cells Background Antenatal inflammation contributes to the pathogenesis of bronchopulmonary dysplasia, but the underlying mechanisms are poorly understood. In a rat model of chorioamnionitis, exposure to intra-amniotic endotoxin (ETX) during late gestation reduces vascular endothelial growth factor receptor-2 (VEGFR2) in the lung at birth, which is followed by impaired pulmonary vascular growth during infancy. Whether intrauterine pro-inflammatory stimuli disrupt or enhance angiogenesis in the developing lung is controversial. Objectives To determine the consequence of exposure to intra-amniotic ETX on pulmonary vascular endothelium in the newborn, and the effects of ETX on fetal pulmonary artery endothelial cells (PAECs) in vitro. Methods Pregnant rats received intra-amniotic injections with E. coli ETX (10 mg/amniotic sac) or saline (control) at 20 days gestation; pups were delivered at due date 2 days later. Immunofluorescence staining with von Willebrand Factor and active caspase-3 was performed on newborn rat lung sections to identify and localize cellular apoptosis. Results Fetal exposure to intra-amniotic ETX increased active caspase-3 in pulmonary micro-vascular endothelial cells of newborn rats. Conclusion Exposure of fetal rats to intra-amniotic ETX during late gestation increases apoptosis in pulmonary vascular endothelium at birth. Future study will determine the role of down-regulated VEGFR2 in mediating ETX-induced apoptosis and disrupted angiogenesis of fetal PAECs.

## Undergraduate Students

### ***Microvariability of AGN 1ES1959+650***

Jeremy Judge, Physics, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Alberto C. Sadun, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Several Active Galactic Nuclei (AGN) have been observed in collaboration with the international group of scientists, VERITAS. These AGN are modeled as super massive black holes in the centers of young galaxies, and have a history of flares in the very high energy gamma-ray range. The presentation will concentrate on the micro variability of the brightness of a single object, 1ES1959+650, over the course of a few select nights. These observations were made in the optical spectrum, using yellow, red and blue filters. These micro variability observations are crucial because they give us important clues as to the mass, size, and radiation mechanism (including high energy particle jets).

### ***Novel Wnt Target Genes***

Sravya Kattula, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Christopher Phiel, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Glycogen synthase kinase-3 (GSK-3) isoforms, GSK-3 $\alpha$  and GSK-3 $\beta$ , are known to be key regulators of the Wnt signaling pathway. Wnt signaling inhibits GSK-3 activity, leading to an accumulation of  $\beta$ -catenin, which then translocates to the nucleus and binds to LEF/TCF factors to directly activate target gene expression. Several Wnt target genes have been identified in a variety of species. In an effort to identify novel Wnt target genes, we performed microarray gene expression studies using mouse embryonic stem cells (mESCs) in which both GSK-3 $\alpha$  and GSK-3 $\beta$  are genetically deleted (GSK-3 double knockout; DKO), and compared that expression profile with mESCs expressing a mutant form of  $\beta$ -catenin, S33A, that constitutively activates Wnt signaling. Our results identified dozens of genes whose expression is increased in both cell types. Real-time quantitative PCR (qPCR) was performed on 4 genes to validate the microarray data. The results from the qPCR experiments confirmed that the genes *Bhmt1*, *Bhmt2*, *Cdx2*, and *Ido2* were significantly up-regulated in both the DKO cells and S33A cells, which supports the hypothesis that these genes represent novel Wnt target genes.

***The Gap between Student Views of their Preparation and the Preparation Required to Earn their Desired Grade: An Analysis of General Chemistry II Student Exam Preparation***

Judas Kelley, Biology, DC - College of Liberal Arts and Sciences

Yalda Nazeri, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Margaret Bruehl, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Numerous students take General Chemistry II with the hopes of earning a grade that will allow them to pursue their future endeavors in chemistry, biology, or a health care profession. General Chemistry II can be a class that encourages students to continue their path in the physical sciences or consider an alternate path. The exams in General Chemistry II are generally considered to be more challenging than the exams taken in General Chemistry I, and many students are surprised by the difficulty they have in achieving their desired grade. In this study, student survey responses were collected and analyzed to see if students used the online chemistry problem solving supplement they had purchased and if it was valuable to their preparation for the exam. Students were also asked if they felt prepared for the exam and if they earned the grade they wanted. The results of the survey showed that the majority of students felt prepared for the exam, but did not earn the grade they wanted. A difference between how prepared students felt and how prepared they actually were has been identified.

***Around the World in Six Weeks: Promoting Child Growth through Education and Nutrition***

Susan Krueger, Individually Structured with emphasis on Elementary Education, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Ms. Diane Hageman, DC - School of Education and Human Development

*Activity Type:* Undergraduate Creative Activity

The summer curriculum will take place over a six-week time period. The premise of the program employs the "whole child approach" proposing that each child is safe, engaged, supported and challenged. The components of the program place emphasis on aspects of Geography, Science, Literacy, Writing, Mathematics and the Arts. Each unit is designed to meet the State of Colorado core standards and is tailored for elementary learning as found on [www.cde.state.co.us](http://www.cde.state.co.us). The purpose of this program will be to provide a learning component in partnership with two affordable housing communities serviced by the non-profit organization Rocky Mountain Communities, (Garden Court Community - Denver & Villas at Wadsworth - Lakewood) whose children attend Title I schools to obtain hot lunches for 60-70 children. Many children are unable to access nutrition during the summer months. The food will be donated by the Rocky Mountain Food bank. Each week will incorporate both guided study and hands-on activities with reference to six continents beyond the one on which we live. Germany will be discovered through examination of water bonds and the crystallization of snowflakes. India's markets will comprise a unit on personal finance. Geometry and spatial reasoning is studied through Spanish architecture. Folklore and literature will be used to illustrate Chinese history. At the end of this program, students will be inspired by a greater understanding of the world around them. Students will learn concepts that to advance their understanding of subject matter that will place them at the helm of their classrooms next semester.

## Undergraduate Students

### ***Meet the Molecules of the Mind that Matter!***

Chelsea Ladd, Biology, DC - College of Liberal Arts and Sciences

Inna Trochanskaya, Chemistry, DC – College of Liberal Arts and Sciences

Alysia Davey, Chemistry, DC – College of Liberal Arts and Sciences

Brian Kavinsky, Chemistry; Elizabeth Moua, Biology; Maile Devine, Chemistry; Jessica Quintana, Biology; Andrew Aninye, Biology

Faculty Sponsor: Dr. Karen Knaus, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

This interactive presentation involves meeting some molecules of the mind. What is a molecule of the mind? How can we learn about chemistry and the science of learning from these interesting molecules?

### ***I Art Hmong***

Champa Lo, Digital Design, DC - College of Arts and Media

Faculty Sponsor: Ms. Michelle Carpenter, DC - College of Arts and Media

*Activity Type:* Undergraduate Creative Activity

As a designer I am constantly trying to find new ways to better the community through graphic design. And, as a first generation Hmong American, I have come to realize that no community needs more acknowledgement than the Hmong community. For me, learning how to join a new culture while still trying to keep my roots has been the biggest challenge. But, the general lack of knowledge about the Hmong culture has always been a major issue. Addressing these two concerns, my work provides the public and younger generation Hmong Americans with stories and illustrations that reveal the beauty, heart, and history of the Hmong culture. In this project, I explore the power that illustrations and narrative design have in creating a bond among the Hmong American diaspora and the wider public. By illustrating a children's book about one young girl's emerging appreciation of her Hmong heritage, I hope that the Hmong audience will understand the importance of keeping their culture alive and that the general audience will gain a greater knowledge of the culture that has defined my artistic voice.

***In Defense of Unusual, Uncanny, & Grisly Texts***

Jennifer Mayo, English Creative Writing, DC - College of Liberal Arts and Sciences

Arthur Boo, Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Manuel Espinoza, DC - School of Education and Human Development

*Activity Type:* Undergraduate Research

Literacies - i.e., situated ways of reading, writing, perceiving, speaking, thinking, evaluating, and interacting - can play a role in re-humanizing individuals and society after violent experiences. We examine how unusual, uncanny, and grisly texts can be used to help adolescents mediate social relationships and develop discernment necessary for modern life. We have four goals: 1) justify the educational potential of unusual, uncanny, and grisly (UUG) texts; 2) provide a working definition of UUG texts; 3) theorize the potential social function of UUG texts; 4) provide actionable pedagogical knowledge regarding the teaching of UUG texts to adolescents.

***Mobility Strategies at Liang Bua: Insights into the Behavior of Homo Floresiensis***

Daniel Michael, Anthropology, DC - College of Liberal Arts and Sciences

Dr. Julien Riel-Salvatore, coauthor

Faculty Sponsor: Dr. Julien Riel-Salvatore, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Opinions are still sharply divided over whether the hominid fossils from the site of Liang Bua (Flores, Indonesia) represent a distinct species or pathological modern humans. While much of the debate over the taxonomy of *Homo floresiensis* has focused on the morphology of the fossils themselves, the techno-typological characteristics of the site's stone tools assemblages have also been recruited by both sides to bolster their case. While these techno-typological observations have been used as ancillary data, they have only limited bearing on our understanding of the actual behavior of the hominids who made them and therefore on whether they indicate a modern human authorship. Using a new method to reconstruct the technological organization of the lithic assemblages allow the reconstruction of artifact discard patterns and mobility strategies in five layers at Liang Bua. Preliminary results from this analysis show that all of the Liang Bua assemblages attributed to *H. floresiensis* indicate mobility strategies that depart markedly from those documented in contemporary *Homo sapiens* and Neandertal in Western Eurasia. We conclude with a discussion of the implications of these results for the phylogenetic status of *H. floresiensis* and of the new lines of research they open.

## **Undergraduate Students**

### ***Investigation of Context Dependent Behavioral Interactions in Pavement Ants***

Michael Miller, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Michael Greene, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Social insects perform tasks as a colony via a coordinated effort by the many individuals that comprise a colony. Workers make individual behavioral decisions without any control from a central authority. This is performed through the individual's assessment of local cues, such as those detected by chemoreceptors on the antennae, during interactions with other workers. Information in cues can also be communicated through scent trails left by other workers. Nestmate recognition allows for a colony to maintain cohesiveness and prevent the exploitation of resources by non-nestmates. Members within a colony share closely related cuticular hydrocarbon (CHC) signatures, which serve as recognition cues to other ants. It is known that pavement ants will engage in predictable fighting behavior when encountering non-nestmates. Here I have investigated how the context in which that encounter occurs effects the behavior of the group. I studied how home field advantage changed the behavior of pavement ants encountering non-nestmates. Ants from the two groups were allowed to interact and fighting behavior was accessed. These results were compared to the same groups with neither having advantage. From an assay containing 15 pairs of test groups there is, on average, a higher incidence of fighting behavior in the groups with no home field advantage. When analyzing the data using a Wilcoxon paired t-test the difference resulted in a p value of 0.0642. It will be necessary to build more replicates of this assay in order to determine whether there is a significant difference between the two groups.

### ***Period and Cohort Effects in Non-Marital Childbearing in the United States, 1970-2009***

Stella Min, Sociology and Economics, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Paula Fomby, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

We test two hypotheses to explain the rise in non-marital childbearing in the United States since the 1970s. The cohort hypothesis posits that the historical rise in non-marital childbearing resulted from changing norms about premarital sex, cohabitation, and single parenthood that successive cohorts of young adults have introduced and reinforced over time. The period hypothesis asserts that social change works not just through cohorts of young adults, but also through historical circumstances that affect all birth cohorts simultaneously. In the case of non-marital childbearing, supporters of the period hypothesis point to structural changes during the last forty years that have reduced women's and men's incentives to marry regardless of their cohort membership. We use the age-period-cohort (APC) intrinsic estimator method to test our research hypotheses. Data come from six repeated cross-sections of the National Survey of Family Growth (NSFG), designed and administered by the National Center for Health Statistics.

## ***Analysis of Multiple CTCF Insulators in Adenovirus***

Jack Moen, Biology & Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Aimee Bernard, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

In the last 30 years adenovirus, particularly adenovirus serotype 5 (Ad5), has become one of the most promising vectors for gene therapy applications. Although Ad5 is usually associated with high infection rates across populations it is a relatively benign virus that only causes deaths in the most severely immune compromised patients. One of the largest problems currently encountered by Ad5 is a rapid and strong immune response from the body. Although the immune response has slowly become associated with a few key genes in the vector it is far from understood. Chromosomal insulators have risen to popularity as a way of controlling gene expression in chromosomes by blocking promoter enhancer interactions. Recent research has found that by targeting genes associated with the immune response the CTCF insulator, which binds the host-cell factor CTCF, does not function in a site-specific manner within the adenovirus chromosome, and that two CTCF sites in close proximity of each other actually led to a deletion in a manner consistent with recombination between the two CTCF-binding sites. Our lab is currently assessing the extent to which multiple CTCF binding sites will affect the adenovirus chromosome. Recent work has centered around building an adenovirus genome deleted for the E4 region and inserting the E4 open reading frame 6 for efficient viral DNA replication. The last stage of assembly has been to insert CTCF sites into pseudo wild-type virus for testing. Our research will shed light on the contrary nature of having multiple CTCF sites in viral genomes.

## ***Structure-Based Design and Synthesis of Mcl-1 Inhibitors for the Treatment of Multiple Myeloma***

Jack Moen, Biology & Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Lisa Julian, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Although mortality rates for common diseases have declined over the last twenty years the incidence of cancer is more prevalent than ever. More recently cancer research has evolved away from killing any rapidly dividing cell and more towards the use of small molecule inhibitors for the selective suppression of hematological cancer proteins. The Bcl-2 family of proteins has been of special note for their role in the apoptotic pathway. Mcl-1 is one such protein implicated in the anti-apoptotic pathway for many of these cancers. As of late there is only one known inhibitor of Mcl-1 in clinical trials, Obatoclax. An analysis of the structure activity relationships of Obatoclax as well as computer models of derivatives has lead our group to design new compounds for the selective inhibition of Mcl-1, using this structure-based approach. Our initial synthetic efforts focused on making Obatoclax and new analogues. The figure shows the proposed pharmacophore with variations at key linkers and heterocycles. Currently we are working on synthesizing the first generation pharmacophores for initial biological evaluation and further derivation. The second stage of research will focus on optimizing molecular binding affinities, the goal being to create a selective Mcl-1 inhibitor with nanomolar activity. Long-term goals of the project will be aimed at developing orally bioavailable pharmaceuticals for human trials in multiple myeloma patients.

## Undergraduate Students

### ***Students' Use of University Resources in Facilitating Learning of Organic Chemistry 2***

Jack Moen, Biology & Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Lisa Julian, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Two of the primary goals of a teacher are to help students learn course material and to retain the information learned. Over the years, research on teaching and student learning has been advocating for a paradigm shift in the way we teach.

Innovations such as Learning Assistants (LAs), teaching assistants (TAs), and tutors have been shown to be effective at helping students achieve a better understanding of the course content. Despite all this research, the best teaching method is still unknown. The University of Colorado Denver has recently started the Learning Assistant (LA) program; with the primary goal of helping students better understand science. In order to further investigate the impact of LAs on student learning, we tracked students' use of resources offered through the school, which included teaching assistants, learning assistants, tutors, and professor office hours. Students' use of these resources was compared with their first midterms and homework.

### ***Kinetics of Magnesium-Acid Reaction***

Iman Mohamed, Ethnic Studies, DC - College of Liberal Arts and Sciences

Tiffany Cung, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Margaret Bruehl, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Creative Activity

Our knowledge of kinetics will be used to determine the rate law of the Magnesium/ Hydrochloric acid and the Magnesium/ Acetic acid reactions. Solid Magnesium metal will be reacted with the above acids to determine the time it takes for 10.00 mL of Hydrogen gas production. The order of the acid and metal are calculated to support that the concepts of zero order in solids and first order in Acetic and Hydrochloric acids.



### ***CD39/CD73-Mediated Immune Responses in Pulmonary Arterial Hypertension***

Zakaria Moumen, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Laima Taraseviciene, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Severe pulmonary arterial hypertension (PAH) is a fatal vascular disease that is characterized by lung vascular remodeling, high pulmonary blood pressure and right ventricular hypertrophy, with no known effective therapies. PAH is known to be associated with T cell dysfunction. It has been recently shown that regulatory T cells can limit vascular cell injury and prevent PAH, yet no studies are known so far in respect to the impact of the enzymes CD39 and CD73. One of the factors contributing to lung vascular remodeling is hypoxia. In response to hypoxia, vascular and blood cells release ATP. The released extracellular ATP (eATP) plays an important role in regulating vascular and immune responses. Levels of eATP are regulated by two plasma membrane ecto-nucleotidases: CD39 (apyrase/NTPDase 1 that hydrolyzes ATP to ADP and AMP) and ecto-5' nucleotidase CD73 (that hydrolyzes AMP to adenosine (Ado). While eATP is known to exert pro-inflammatory effects, extracellular Adenosine (eAdo) has been implicated in anti-inflammatory responses. Here we investigated levels and functional activity of CD39 and CD73 in the circulation, spleen and lungs from Sprague Dawley rats (the rats were placed in hypobaric chambers for 3 weeks with one group injected with SUGEN (to simulate PAH) and the other as the control) in response to hypoxia and the contribution of CD39/73 expressing inflammatory cells to vascular remodeling. We concluded, that our findings underline the hypothesis that CD39 and CD73 might have a fundamental role in the development of PAH.

### ***Korea Meets Songdo***

Abra O'Leary, Public Health , DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Tony Robinson, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

This presentation is focused on the political science aspects of the new international city Songdo, in South Korea. This presentation covers all aspects of the new city, from environment, technology, and even the social determinants.

## Undergraduate Students

### ***The Roles of Beta Catenin in the Wnt Signaling Pathway***

Verena Oberlohr, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Christopher Phiel, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Cell signaling pathways are important for coordinating various cell actions, including reproduction, development, immunity, regeneration and disease processes. The wnt signal transduction pathway is known to determine the early events of development. Beta Catenin is protein of interest within the wnt pathway and its ability to assume different cellular functions is central to this study. Glycogen synthase kinase-3 (GSK-3) isoforms, GSK-3 $\alpha$  and GSK-3 $\beta$ , are known to be key regulators of the Wnt signaling pathway. Wnt signaling inhibits GSK-3 activity, leading to an accumulation of  $\beta$ -catenin, which then translocates to the nucleus and binds to LEF/TCF factors to directly activate target gene expression. Several Wnt target genes have been identified in a variety of species, but the number of genes is not comprehensive. We set out to identify all of the loci in the genome where  $\beta$ -catenin binds. We performed chromatin immunoprecipitation (ChIP), a technique that isolates the DNA bound by a given protein. ChIP was performed on mouse embryonic stem cells (mESCs) in which both GSK-3 $\alpha$  and GSK-3 $\beta$  are genetically deleted (GSK-3 double knockout; referred to as DKO), and in mESCs expressing a mutant form of  $\beta$ -catenin, S33A cells - both cell types have constitutively activated Wnt signaling. After ChIP, we performed next-generation DNA sequencing (ChIP-seq), which will precisely identify all of the  $\beta$ -catenin binding sites in the mouse genome.  $\beta$ -catenin binding sites that are found in both GSK-3 DKO and S33A cells will be considered true binding sites. It is our hope that this investigation of the wnt pathway and the variable roles of its components, will give rise to a better understanding of both development and the processes involved in tumorigenesis.

### ***Roles For DNMT3A and DNMT3B in Non-CpG DNA Methylation Revealed in Mouse Embryonic Stem Cells***

Yumi Okubo, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Christopher Phiel, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

DNA methylation is an epigenetic modification that occurs predominantly on cytosines within the context of a CpG dinucleotide. Although much less frequent, there are examples of cytosine methylation occurring at non-CpG sites (i.e., CpA, CpC, or CpT). DNA methylation is mediated by enzymes known as DNA methyltransferases, or DNMTs. One specific DNA methyltransferase, DNMT3A, has been implicated as the enzyme that performs non-CpG DNA methylation. We have tested this hypothesis by examining non-CpG DNA methylation in mouse embryonic stem cells (mESCs) in which DNMT3A or the related DNMT3B have been genetically deleted. We performed DNA sequencing on genomic DNA treated with sodium bisulfite, which reveals the presence of methylated DNA. Focusing on the splicing factor 1 (SF1) locus, which has been shown to have relatively high levels of non-CpG DNA methylation, we show that mESCs lacking DNMT3A or DNMT3B still have normal levels of non-CpG DNA methylation. Genetic deletion of both DNMT3A and DNMT3B, however, revealed an almost complete absence of non-CpG DNA methylation. Our results are consistent with functional redundancy between DNMT3A and DNMT3B with respect to non-CpG DNA methylation.

***The Use of Silanes on Silica Nanoparticle Surfaces to Mimic Lipid Membrane Compartmentalization***

Veronica Parra, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Scott Reed, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

New model systems are needed to explore cellular biological functions by allowing us to mimic compartmentalized membrane regions that will improve our understanding of mediated signaling and transport. Our research focuses on developing cell membrane models by linking hydrophobic octadecyltriethoxysilane (ODTS) and hydrophilic 3-[2-(2-aminoethylamino)ethylamino]propyl-trimethoxysilane (DETAS) silanes on the surface of silica nanoparticles. Thermogravimetric Analysis (TGA) was performed to observe the weight loss from ODTS and DETAS and the ratio of ODTS and DETAS on silica nanoparticles. TGA data showed that DETAS contributes to greater multilayering. NDB-PC Fluorescence Quenching was able to measure lipid multilayering at different ODTS:DETAS ratios, and showed that as the amount of ODTS increased, the of lipids present in the inner layer decreased. Functionalized silica was also entrapped in calcein loaded liposomes to test the amount of interstitial water present at different ODTS and DETAS ratios, by calculating the amount of calcein dye that was released after melittin was added. DETAS was found to support lipid bilayers with increased interstitial water, while the addition of ODTS decreased interstitial water. The goal of my project is to refine this support lipid bilayer model with DETAS and HTS (hexyltriethylsilane), a hydrophobic 6 carbon silane, instead of ODTS which has greater hydrophobic region because of its 18 carbon structure. We predict that HTS compared to ODTS will interact closer with the outer lipid bilayer, allowing close interaction with the surface of the silica nanoparticle. This close proximity will decrease the volume of interstitial water even greater than ODTS.

***A Detailed Method for Building Fast-Scan Cyclic Voltammetry Microelectrode Sensors for Sub-Second Dopamine Detection***

Brian Peters, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Richard Allen, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Dopamine (DA) is a neurotransmitter known to have significant influence on brain processes in reward-reinforcement learning and plays a role in the addictive nature of stimulants such as cocaine. Additionally, nerve cells use DA to help control muscle functions, therefore loss of DA producing cells in the brain can lead to motor symptoms as seen in Parkinson's disease. The electrochemical technique of fast-scan cyclic voltammetry (FSCV) allows DA detection on a sub-second temporal scale. Although microdialysis studies have shown effects of tonic DA in drug addiction on minute-to-minute scales, FSCV allows data capture of phasic DA on subsecond scales, allowing for the real-time correlation of DA signaling and drug-seeking behaviors. This study describes the construction of chronically implantable microelectrodes capable of DA detection over the course of months. In order to improve on published methods for constructing microelectrodes, a unique technique of fusing silica and carbon fiber was developed. Microelectrode sensors were constructed from isolated strands of carbon fiber encased in silica and manufactured under microscopic magnification. Carbon fiber was threaded through the capillary using 2-propanol lubricant. The carbon fiber was then coated with epoxy and internally fused to the silica capillary. Electro conductive silver epoxy was used to fix a connector pin in contact with the body, and then insulated in epoxy. Measures were taken to prevent signal loss and reduce the amount of electrode ultimately protruding from the cranium. Electrodes will be used to measure DA release during behavioral testing, including while animals actively self-administer drugs of abuse.

## Undergraduate Students

### ***Quantification of Tribological Phenomena Using Three-Dimensional Interferometry***

Shannon Peterson, Mechanical Engineering, DC - College of Engineering and Applied Science

Abrar Satar, Mechanical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. L. Rafael Sanchez Vega, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

Complex interaction between tools, lubricants and sliding bodies are studied using a set of dedicated experiments. The experiments were specifically designed to isolate friction and contact effects, which normally occur together during real life interactions. The focus of this study is on sheet metal bending, stretching and sliding along specific geometries under various levels of lubrication. However, sections of the technique under development may find applications in other areas, such as bone to bone contact effects, bone to metal inserts interactions, teeth contact phenomena, etc. The experiments are tailored to factor out and assess the effects due to under layer changes, rubbing (friction), contact, and the influence of the lubricating medium. Contact forces and strains are measured using various sensors, and in-depth surface studies are carried out using interferometry. A Wyko 2000 interferometer captures three-dimensional profile data from which surface texture, surface profile geometries, peak-flattening, volume containment, bearing area, and many other statistical parameters are assessed. The experimental quantification is in itself of significance, but also provides experimental support to the development of more general theoretical models, such as the determination of the actual contact pressure and friction and wear patterns of contacting surfaces.

### ***Entertain***

Laura Phelps Rogers, sculpture, DC - College of Arts and Media

Faculty Sponsor: Ms. Rian Kerrane, DC - College of Arts and Media

*Activity Type:* Undergraduate Research

The undergraduate research project Entertain employs a multidisciplinary approach to creating an interactive installation environment. The concept developed out of a small scale installation titled Entertain, in which I expressed subconscious thoughts through visual language. I have begun to connect similar artistic experiences to Narrative Identity. Upon completion of the original work, I was inspired to entertain the community as a whole. The driving force behind all my artistic endeavors is creating environments in which viewers have personal experiential moments. This work seeks to expand that dialogue, where viewers are presented and opportunity to express their own visual language. Viewer's efforts will create the actual work, through their inclusion in the process of this larger scale interpretation of the original installation. The viewer's become an integral part of the expanded installation by employing their subconscious responses to color and form, armed with the ability to express themselves with the objects themselves. The finished work will include 1100 pieces each 4" x 4" and will be complete when all 1100 pieces are incorporated into a grid on a wall approximately 20' x 10'. Each of the 1100 pieces has an alphabet letter and viewers become participants as they select pieces to spell words. The process of creating a community experience through art is an amazing opportunity this work is able to provide. Your support is greatly appreciated.

## ***Targeted Subsequencing of Human Genomes for Ancestry***

Daniel Polanco, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. David Pollock, AMC - Graduate School

*Activity Type:* Undergraduate Research

The mitochondria are the powerhouses of cells, and their genomes have already shown us how human migration history can be reflected in the histories of genes and the accumulation of mutations in those genes. The rest of our genomic material contains orders of magnitude more information. The details of our ancestral history that can be inferred from whole genomes should therefore be orders of magnitude more powerful. Here, we aim to efficiently access this information by developing an approach to obtain over 30 million nucleotides of information from hundreds of thousands of related regions in different humans. Our goal is to obtain the information for \$100-\$200 per person, making it highly affordable for most people. The same mutation processes that allow us to track our ancestry also give rise to genetic diseases. By studying genetic disease and ancestry together, we also hope to provide information that will help medical genetic professionals understand and diagnose the basis of genetic disease. Our recent results using simple mutation types show that the current approach to analyzing ancestry is promising. As we begin to explore more complex mutation types, we expect to see this trend continue.

## ***H2 Eco Challenger Hydrogen Fuel Cell Vehicle***

Ronnie Prado, Mechanical Engineering, DC - College of Engineering and Applied Science

Ryan Anderson, Mechanical Engineering, DC - College of Engineering and Applied Science

Surawud Martinez, Mech. Eng.; John Ngo, Mech. Eng.; Nick Wager, Mech. Eng.; David Edelman, Mech. Eng.; Dong Nguyen, Mech. Eng.; Aydh Alajmi, Mech. Eng.; Ibrahim Alzamanan

Faculty Sponsor: Dr. Ron Rorrer, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

For the 2013 Shell Eco-Marathon Americas (SEMA) competition, the H2 Eco Challenger team has chosen to enter the hydrogen fuel cell category. Knowledge obtained from the 2012 Mile Highhydrogen team members in regards to their prior competition experiences has motivated this team to focus on designing and building a new vehicle, rather than over hauling the 2012 vehicle. By doing so, the intent is to create a vehicle with reduced weight and improved fuel efficiency. The new vehicle will be 93 cm in height, 82.5 cm in width and 260 cm in length. In order to achieve the goal of at least 2000 miles per gallon (mpg) equivalent fuel efficiency, the overall weight for the vehicle will be 60 kg using a carbon fiber monocoque body. Under consideration for the monocoque is a honeycomb core material sandwiched between carbon fiber layers to increase structural strength and stiffness in key areas while reducing the vehicle body weight. The vehicle will be driven on three wheels (two in the front and one in the back) using an electric hub motor at the rear wheel, 20 in. low rolling resistance tires, and an Ackerman steering geometry that is capable of the required 6 m turning radius. Powering the electric motor will be a 1000 Watt hydrogen fuel cell stack from Horizon Fuel Cell Technologies.

## **Undergraduate Students**

### ***Fos-B Expression in the Medial Prefrontal Cortex in Isolation-Reared Rats Exposed to Social Stress***

Eric Prince, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Sondra T. Bland, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Recently, there has been an increased focus on the effects of social isolation on the psychosocial stability of individuals. Here we are investigating the effects of early life isolation on social behavior and medial prefrontal cortex (mPFC) function. Adolescent male and female rats were housed, either singly or in groups, for four weeks during adolescence. The experiment took place in an apparatus that was composed of a large social chamber, which contained a tethered novel stimulus rat, and a slightly smaller escape chamber (which the stimulus rat could not enter). They were divided into four subgroups: home cage controls, no-trials, one-trial, and a three-trials. Each rat was familiarized with the apparatus for three days. The no-trial group never encountered the stimulus rat in the apparatus; the one-trial group encountered the stimulus rat on the third day; and, the three-trial group encountered the stimulus rat on all three days. Behavior was recorded during the 10-minute trials. Rats were then sacrificed and the prefrontal cortex (PFC) tissue was sliced and subjected to immunohistochemistry (IHC) staining for the protein product of the immediate early gene Fos-B. Fos-B has been demonstrated to be an indicator for numerous functions in the brain including learning and stress-response. It is predicted that in rats raised in isolation and subsequently exposed to a novel stimulus rat, Fos-B levels will be significantly lower than in rats raised in group housing subject to the same conditions.

### ***Family Health History: A Comparative Study Between the United States and Sweden***

Lina Rafstedt, Public Health (B.A), DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Ronica Rooks, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Family health history (FHH) provides an important insight on patients' genetic and behavioral risks for chronic diseases, such as type 2 diabetes and cardiovascular diseases. People who have close family members with these diseases have a higher risk of developing them. Being aware of our own FHH and taking appropriate preventive steps, such as practicing healthy behaviors and seeking regular healthcare and screenings, is therefore important in order for us to stay healthy. However, how do general practitioners, dieticians and nurses in Sweden and the United States utilize FHH? How do they interact with patients about FHH? What tools are being used when they interact with their patients to change their behaviors? Methods used for this study will include 7 interviews and a systematic literature review using Medline, CINAHL, and Ebsco databases. Findings from interviews at hospitals in Sweden tell us that general practitioners do various things if a person is obese. First, patients are screened for diabetes, hypertension and hyperlipidemia, and given direct oral and written advice on lifestyle changes. Second, they "prescribe physical activity" which gives the patient discounts in various gyms and health clubs. Third, they refer the patient to a dietician or a nurse specializing in motivational therapy for obese patients. Findings from the United States tell us that Americans are not in the habit of collecting and documenting their FHH, and physicians often overlook this problem due to concerns about accuracy of the information and time required to collect it.

## ***Varicella Zoster Virus-Induced Vascular Remodeling***

April Rempel, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Maria Nagel, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Varicella zoster virus is a common alphaherpes virus that is the cause of chicken pox (variella) and, after reactivation of the virus, shingles (zoster). When reactivation of the virus occurs in the cerebral arteries, deleterious vascular remodeling occurs. This vascular remodeling causes an increased risk of hemorrhagic or ischemic stroke. The purpose of this research is to discover molecular factors involved with the remodeling of the artery wall during VZV infection.

## ***Dissecting the Transmembrane Receptor Siglec-6 and Determining its Functional Role in Gestational Trophoblastic Disease & Preeclampsia***

Michael Renecke, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Aimee Bernard, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Our research investigates the functional role of sialic acid immunoglobulin-like lectin 6 (Siglec-6), a protein expressed in the placenta, in gestational trophoblastic disease (GTD) and preeclampsia (PE). GTD is a spectrum of disorders in which placental trophoblast cells abnormally develop, leading to molar pregnancies and metastatic cancers. PE is a hypertensive disorder during pregnancy affecting 4-8% of all pregnancies. It is a leading cause of maternal deaths in the US and accounts for 50-76,000 worldwide maternal deaths per year. The etiology of PE is currently not known, but the placenta is essential. The overall mechanism(s) by which these disorders arise is not well understood; however, previous microarray data show Siglec-6 as differentially expressed in both conditions. Siglec-6 is a transmembrane receptor and has an extracellular domain with a highly conserved critical arginine residue necessary for ligand binding. It also has an intracellular immunoreceptor tyrosine-based inhibitory motif (ITIM) and an ITIM-like motif. The aim of our work is to determine the structure-function relationship of these Siglec-6 domains involved in ligand binding and downstream signaling with alterations in placental development seen in the pathogenesis of GTD and PE.

## Undergraduate Students

### ***Probing the Structural Origins of Membrane Affinity Differences between C2A Domains from Synaptotagmins 1 & 7***

Beatriz Salazar, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Jefferson Knight, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Synaptotagmin (Syt) proteins serve as Ca<sup>2+</sup>-sensitive triggers in many exocytotic pathways, with the seventeen different human isoforms active in various cell types. Generally, Syt1 is implicated in fast events such as rapid neurotransmitter secretion, while Syt7 operates in slower pathways requiring smaller peak Ca<sup>2+</sup> concentrations. Syt proteins contain two C2 domains, C2A and C2B, which bind membranes in response to Ca<sup>2+</sup> to drive vesicle fusion. The C2A domain of Syt7 binds membranes with a Ca<sup>2+</sup> sensitivity >10-fold greater than its counterpart in Syt1 despite very similar structure; the two C2A domains share a common fold and 90% conserved amino acid polarity. Here we provide initial evidence that Syt7 C2A achieves greater membrane affinity through a combination of hydrophobic and electrostatic interactions with target membranes, in contrast to the known electrostatic membrane interaction of Syt1 C2A. Using kinetic and equilibrium fluorescence measurements of C2A domain docking to synthetic liposomes approximating the lipid composition of physiological membranes, we show that the differences between the two isoforms include kinetic and solute effects consistent with greater hydrophobic membrane contact for Syt7 C2A. In order to test this hypothesis and probe its structural origins, individual surface-exposed nonpolar residues on Syt7 C2A have been mutated to the corresponding polar amino acid present in Syt1 using site-directed mutagenesis. The effects of these mutations on the unique membrane binding properties of Syt7 C2A are interpreted to provide information on the structural origins of differences in function between these two isoforms.

### ***Mining Digital Herbaria to Document Range Expansion in Noxious Weeds, A Case Study of *Lythrum Salicaria* L. (Lythraceae)***

Brooke Sekora, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Leo P Bruederle, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

With the growing recognition of the value of museum collections including herbaria, there is a concomitant need for increased access and accelerated communication if these collections are to be useful for scientific research, education, and policy development. While many US herbaria have initiatives to digitize their collections, only about 30% of all US specimens are currently accessible online. My research addresses the usefulness of these electronic databases to provide accurate and reliable data from a scientific standpoint. One means by which to evaluate their utility is to document the introduction and spread of noxious weeds into and across North America using data mined from these databases. *Lythrum salicaria* L. (Lythraceae), more commonly known as purple loosestrife, is an invasive vascular plant species that has had a significant and detrimental ecological and economic impact since its introduction around the turn of the 19th century. I mined databases from individual herbaria, as well as consortia from which detailed locations and other collection information for purple loosestrife were obtained. These locations were mapped chronologically using an online spreadsheet to generate a set of placemarks in Google Earth. These maps were then compared to the migration of purple loosestrife as described by Stuckey in his 1980 publication. This investigation found that, while digitization is still in the early stages of development, data from digital herbaria may be used to accurately track range expansions, with implications for other lines of biogeographic research.



***Polycomb Group Protein Cbx2  
Regulates Chromosome Stability of  
Embryonic Stem (ES) Cells by  
Directly Binding to Mitotic  
Chromosomes***

Craig Stoflet, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Xiaojun Ren, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Embryonic stem (ES) cells are unique due to their pluripotency, chromatin structure, and cell cycle profile. Polycomb group (PcG) proteins control pluripotency and chromatin structure of ES cells by transcription-dependent mechanisms. We describe here a transcription-independent function for PcG protein Cbx2 in regulating the chromosome stability of ES cells by directly binding to mitotic chromosomes. ES cells lacking Cbx2 exhibit a greatly reduced cell proliferation with altering G2/M phase, but without changing G1 phase. Cbx2 is required for faithful chromosome segregation. Cbx2 knockout results in defective prometaphase organization, chromosome mis-alignment at metaphase, chromosome mis-segregation, and spindle defects. Cbx2 among Cbx family proteins is only protein to associate with mitotic chromosomes from prometaphase to anaphase. Functional complementary assay with full-length and truncated Cbx2 indicates that Cbx2 association with mitotic chromosomes is essential for control proliferation and chromosome segregation of ES cells. Thus, these data reveal a unique role for Cbx2 in regulating chromosome segregation and stability and might provide new insights for PcG function's in development and cancer.

***The Lucky Breaks***

Michelle Strand, Film and Television Production  
BFA, DC - College of Arts and Media

Rebecca Miller, Film and Television Production,  
DC - College of Arts and Media

Ucheoma Echeozo, DC – College of Arts and Media

Kiah Butcher, Film and Television Production, DC  
- College of Arts and Media

Faculty Sponsors: Mr. Craig Volk, DC - College of Arts and Media

Jessica McGaugh, DC – College of Arts and Media

Jim Phelan, DC – College of Arts and Media

*Activity Type:* Undergraduate Creative Activity

In this unique two-semester film project, over 30 students conceptualize and write ten episodes in a web series format. In the second semester, we start pre-production and principal photography. By May, we have all 10 episodes edited and complete for viewing on YouTube and Video.

## Undergraduate Students

### ***Time-Course for Macrophage Detection in Vivo by Ferumoxytol-Enhanced T2-MRI***

Marina Stukova, Biology, AMC - School of Medicine

Faculty Sponsor: Dr. Natalie Serkova, AMC - School of Medicine

*Activity Type:* Undergraduate Research

In previous studies, we have reported on significant decrease in T2-relaxation times (RT) using custom-designed 75-nm targeted super-paramagnetic iron oxide (SPIO) nanoparticles for non-invasive detection of C3-complement activation in inflamed lupus kidneys via magnetic resonance imaging (MRI). In addition to this targeted approach, there is a significant interest to develop a non-targeted SPIO T2-MRI protocol for macrophage imaging present at the site of inflammation. The use of commercially available Fe<sub>2</sub>O<sub>3</sub> nanoparticles, such as Ferumoxytol (small 30-nm ultra-SPIO), has its advantages since it can be directly translated into clinical trials. The aim of this study was to establish a time course (pharmacokinetics) for Ferumoxytol effects on T2-RT in control mice and mouse models of inflammation. Ferumoxytol (10 mg iron/kg) was injected into mice intravenously. A control group (n=5) and a renal I/R model (n=8) of male C56BL/6 mice were used. Female athymic mice (n=4) with human UMSSC2 head-and-neck squamous cell carcinoma xenografts underwent MRI scans before and after 2 Gy radiation treatments. T2-MRI maps were obtained at 4.7T MRI scanner using spin echo with 16 echo times (all MRI protocols are reported previously by our groups). In control kidney, Ferumoxytol is excreted in <24 hrs. In inflamed tissues (both kidney and tumor) Fe<sub>2</sub>O<sub>3</sub> retains up to 48 hrs. due to its uptake by macrophages. The results indicate that Ferumoxytol can be used clinically off-label as a novel negative contrast agent for inflammation and tumor MR imaging.

### ***Introducing Visual Logic Maps into a Chemistry for Engineers Course***

Elana Taylor, Engineering, DC - College of Engineering and Applied Science

Alysia Davey, Chemistry, DC - College of Liberal Arts and Sciences

Chelsea Ladd, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Karen Knaus, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

The Visual Logic Maps system involves teaching students how to construct concept maps through the use of a symbolic language and information categorization. Engineers need to think logically, connectively and creatively in order to solve the engineering problems of today and the future. This poster presentation focuses on how Visual Logic Maps were introduced into Chemistry for Engineers course at the University of Colorado Denver. The visual logic mapping process helps students construct knowledge in a logical, connective and creative way.

## ***EEG Analysis of Meditative States During Ambulation***

Jeffrey Thompson, Psychology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. David Albeck, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

A growing body of evidence exists suggesting that meditation, as a form of treatment, has been useful in mitigating the negative effects of anxiety and depression. While meditation is typically performed while sedentary, some forms of exercise such as yoga and tai-chi claim to induce meditative states, and other forms of meditation are now being taught to be performed while walking. Despite this, there is an overall paucity of research that has attempted to quantitatively correlate walking with meditation. Both experienced meditators and those who have not meditated will participate. EEG measurements will be recorded while the participant is either sedentary or walking. Participants will complete surveys that quantify their average amount of physical activity and level of mindfulness, a by-product of meditation. Correlation between mindfulness and physical activity will be calculated. EEG data in both the sedentary and walking conditions will be analyzed for patterns associated with meditation, such as high level Alpha and Theta expression. The hypothesis for the EEG portion of the research is that overall percentages of Alpha and Theta rhythm will be higher among practiced meditators during mediation compared to during non-meditation conditions. Further, percentages of Alpha and Theta will remain relatively equivalent across treatment conditions for the non-meditators. The hypothesis for the survey portion is that levels of mindfulness will rise as levels of exercise increase, with expected higher scores for mindfulness among mediators.

## ***Photobiological Hydrogen Production in Recombinant Synechocystis 6803 Strain***

Logan Thompson, Integrative Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Zhiyong Ren, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

Hydrogen (H<sub>2</sub>) is a renewable energy carrier whose combustion or splitting produces only water as a byproduct without any pollution. A Hydrogen economy has the potential to create zero-emission cars, buildings, and power plants. However, the photo-biohydrogen production catalyzed by the hydrogenase enzyme is inhibited by O<sub>2</sub>, which is an inherent byproduct of cyanobacterial photosynthesis. In addition, the current rate of hydrogen production is still too low to be cost effective. To overcome oxygen inhibition, a hydrogenase enzyme from *Alteromonas macleodii* "deep ecotype" was cloned into a plasmid and transformed into *Synechocystis* 6803. To increase total hydrogen production a mutant hydrogenase was also transformed containing two amino acid point mutations in the catalytic site which resulted in increased hydrogen production versus the wild type enzyme. Both transformed hydrogenase enzymes exhibited an increased level of oxygen tolerance compared to the native *Synechocystis* enzyme. This work moves research closer to an organism capable of producing hydrogen continuously at a high rate for a full day without oxygen interruption.

## Undergraduate Students

### **Structure-Based Design of Small Molecule Inhibitors of Mcl-1 Protein**

Lesley Tyk, BioPhysics, DC - College of Liberal Arts and Sciences

Cecelia Johnson-Sasso, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Hai Lin, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Mcl-1 is a member of the Bcl-2 family of anti-apoptotic proteins and is overexpressed in many different types of cancer. Overexpression of Mcl-1 inhibits apoptosis by binding to the BH3 protein that promotes apoptosis, leading to cancerous phenotype. It has been found that the BH3 protein can bind to a long binding groove at the Mcl-1 surface. Such binding can be prevented by the insertion of a small molecule into this groove of Mcl-1. The binding of a small molecule leads to release of the pro-apoptotic BH3 protein, which promotes the death of cancer cells via the intrinsic mitochondrial apoptosis pathway. Molecular modeling, based on a combination of quantum chemistry and force field calculations, has shown that one such small molecule, Obatoclax, binds to the Mcl-1 BH3 binding domain. Ultimately, our goal is to identify a more potent and selective small molecule inhibitor of Mcl-1, with better drug-like properties. Toward this goal, docking calculations using Tripos' Flexidock program have been carried out for a series of drug-like molecules, derived from Obatoclax, with the Mcl-1 protein. The docked structures were analyzed by a conformational-cluster-based approach and by scoring program CscoreTM; CscoreTM employs multiple types of scoring functions to achieve consensus docked structures. Herein, we report our preliminary results toward the identification of new small molecule Mcl-1 inhibitors using a structure-based design approach, which are currently being synthesized in the laboratory for subsequent biological evaluation.

### **Investigation of *Xenopus Laevis* Fertilization Events and Signal Transduction Pathway Using Calcium Imaging Technology and PLD Inhibition**

Ngoc Vu, Biology/Psychology, DC - College of Liberal Arts and Sciences

Tara Collister, Biology; Issa Abdi, Biology; Kendall Marine, Biology

Faculty Sponsor: Dr. Bradley Stith, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Fertilization involves membrane fusion and phospholipid production and hydrolysis. Successful fertilization results in intracellular calcium release that causes most, or all, subsequent fertilization events. Although the exact signaling pathway is not known, prior work in our lab suggests that Phospholipase D (PLD) production of Phosphatidic acid (PA) plays a role in fertilization. PA may activate Src, a tyrosine kinase, which then may activate Phospholipase C $\gamma$  (PLC $\gamma$ ), increasing Inositol trisphosphate (IP3) and intracellular calcium to induce fertilization. A variety of methods were used to identify fertilization and study the signal transduction. Calcium imaging technology has allowed for observation of intercellular calcium release. Microscopy coupled with video equipment was used to observe and capture gravitational rotation and cleavage events. Present focus has been on successful replication of the calcium imaging protocol previously developed in our lab and understanding the current fertilization signal transduction model. Demonstrating the proposed fertilization pathway, one of our experiments uses FIPI, 5-fluoro-2-indoyl des-chlorohalopemide, to inhibit PLD. By varying the concentration of FIPI added to *Xenopus laevis* eggs, we can observe the lag time in fertilization, thus demonstrating that PLD is a crucial part of fertilization. Currently, experiments are being run to determine the optimal amount of FIPI. The next step of the experiment will be establishing how PLC inhibition affects calcium release. Future plans also include the investigation and use of other PLD inhibitors, as well as established tyrosine kinase inhibitors such as herbamycin and tyrphostins.

## ***Proximity Wall***

Brian Ward, Sculpture and Digital Animation, DC - College of Arts and Media

Faculty Sponsor: Ms. Rian Kerrane, DC - College of Arts and Media

*Activity Type:* Undergraduate Research

This project is the next iteration of a series of interactive installations looking to integrate animation and sculpture. Using the motion tracking and infrared depth mapping capabilities of the Xbox Kinect, "Proximity Wall" creates an engaging and inviting environment in which the viewer can move and watch their digital reflection being displayed on an LED panel. The colors of the reflection are cooler, purples and blues, as the person views the piece from a distance, but as they approach, the cools become warmer, shifting through the spectrum till eventually they are entirely white. Similar to a thermal camera, the person's proximity to the wall directly affects the colors that make up their reflection. The premise for the piece came from watching people interact with its predecessor, "Light Wall", which functioned off of shadow play and LEDs. As people moved and interacted with the piece, they would become so engrossed that they would become blissfully unaware that they had become a part of the piece as they danced around, trying to push the installation to its limits. I wanted to take this premise to the next level by evolving the installation and incorporating a 3-dimensional, multi-colored aspect where the physical location and proximity of the viewer would affect the resulting image.

## ***Experimental Iron Smelting***

Walter Ware III, sculpture, DC - College of Arts and Media

Faculty Sponsor: Ms. Rian Kerrane, DC - College of Arts and Media

*Activity Type:* Undergraduate Research

Artists are often in search of new materials and techniques for creating art. The use of wrought iron as a contemporary artistic medium is very rare. I set out to explore the idea of creating wrought iron with the purpose of using it to make metal sculpture. Wrought Iron is a soft, malleable form of iron metal that can be very versatile in forming metal objects. The creation of wrought iron has several steps. The first step requires having pure metallic iron. Smelting iron is the first objective in my long term research goal to produce wrought iron on a small, intimate scale. Smelting was an ancient way to create iron metal from raw iron ore. Modern day technologies have allowed good quality steel to be created cheaply and abundantly. The large scale production of wrought iron could not commercially compete with steel. This led to the last domestic production of wrought iron in the late 1960's. With the guidance from sculpture professor Rian Kerrane and techniques based on ancient smelters, I have attempted to create iron from iron ore. I will show the results of my attempts in the creation of iron thus far.

## **Undergraduate Students**

### ***The Right to Learn Project***

Mandy Wong, Philosophy, DC - College of Liberal Arts and Sciences

Tamara Lhungay, Biology, DC - College of Liberal Arts and Sciences

Tania Valenzuela, Sociology

Faculty Sponsor: Dr. Manuel Espinoza, DC - School of Education and Human Development

*Activity Type:* Undergraduate Research

Our research examines the social origins of educational rights - i.e., the legal and individual power to shape the quality of one's own education. Through collaboration with our faculty mentor, we aim to craft a novel argument that may inform the way the law utilizes educational rights - what they are, who has access to them, what those rights make possible. We are co-authoring an article for publication in a major law review that will argue for classroom learning as a 'rights-generative' activity in hopes of shifting the professional vision of law. Through an apprenticeship in both the anthropology and philosophy of education, and an analysis of Supreme Court landmark cases such as the *Brown v. Board of Education of Topeka* (1954-55) rulings, the use of interdisciplinary thinking and writing, complex and abstract analysis, teamwork, and communication, we aim to link social science and the law to challenge and reorganize the beliefs surrounding modern research methods on education. Our project centers around student and faculty collaboration with the goal of transforming scholarly research into something of direct relation to the community in areas pertaining to the quality of education from the perspectives of divergent thinking, creative spaces, and social justice.

### ***Understanding Early Development Using Embryonic Stem Cell Modeling***

Chao Zhen, Chemistry, DC - College of Liberal Arts and Sciences

Huy Duc, Chemistry, DC - College of Liberal Arts and Sciences

Craig Stoflet, Biochemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Xiaojun Ren, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

All mammalian life starts with the formation of the blastocyst which is made up of embryonic stem cells (ES cells). With the characteristic of pluripotency, the ES cells can differentiate into many different cell types of cells through mitosis by an unknown mechanism. In our laboratory, by using advanced techniques, including immuno-fluorescence, gene knock out, and pro-metaphase spread, we are looking into the most current theory in which the differentiation of ES cells is regulated by the polycomb group (PcG) proteins, which are composed of PRC1 and PRC2 subunits. Further understanding of the role of PcG protein in mitosis of ES cell could potentially be applied to the field of regenerative medicine and cancer cells apoptosis.

## ***The Scorpion***

Molly Zimmerman, Mechanical Engineering, DC - College of Engineering and Applied Science

Jeff Cole, Mechanical Engineering, DC - College of Engineering and Applied Science

Steven Runnings, Mechanical Engineering, DC - College of Engineering and Applied Science

Brendan Caldwell, Mechanical Engineering, DC - College of Engineering and Applied Science

Aleksandra Sokovic, Mech. Eng.; Jay Nanninga, Mech. Eng.; Wes Bower, Mech. Eng.; Paul Stone, Mech. Eng.

Faculty Sponsor: Dr. Ron Rorrer, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

The Scorpion is a tubular chassis, algae-generated biofuel powered vehicle which has been designed to compete in the Pikes Peak International Hill Climb (PPIHC). A Volkswagen Mk. I diesel engine will be utilized to power the vehicle, with modifications made to increase performance capability and to allow the vehicle to utilize biofuel. These modifications include the addition of a turbocharger as well as a modified fuel system. A 1026 DOM steel frame has been fabricated to comply with the standards and rules of the PPIHC and will ensure the safety of the driver and integrity of the body of the vehicle. The weight of the Scorpion will be less than 1200 lbs. and the vehicle will have a maximum speed of 105 mph. Fabrication commenced on the frame in December 2012 per design specifications and analysis previously completed in order to optimize vehicle performance. The design features and specifications confirmed vehicle integrity allowing fabrication to begin so that the vehicle can be manufactured in a timely manner in order to ensure completion of the vehicle by May 2013. Currently, every indication alludes to full completion of the Scorpion by May 2013.

## ***Synthesis and Characterization of a Nanoparticle-Based, Endogenously Immunogenic Cancer Therapeutic Agent***

Leonid Zukin, Biology and Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Scott Reed, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

While a plethora of cancer therapies have been approved for clinical application, a key issue arises in seeking to optimize cancer cell targeting to minimize side effects. Two approaches that mitigate these issues are cancer immunotherapy and nanoparticle delivery. Immunotherapy seeks to improve cancer cell targeting, while nanoparticles provide a platform for the delivery of multiple chemotherapeutic agents simultaneously at high local concentrations. We combine these concepts to create novel nanoparticles containing both a tumor associated antigen and an immunogenic agent. Using a double emulsification method, we demonstrate the successful loading of protein and poly I:C (a viral RNA mimic) into nanoparticles composed of the biodegradable polymer, poly(lactic-co-glycolic) acid. These particles are also coated with polyvinyl alcohol to ensure nanoparticle stability and prevention of aggregation. Protein loading was confirmed with UV-visible spectroscopy and poly I:C loading was confirmed with gel electrophoresis using ethidium bromide staining. Through delivery of such particles, it is expected that immune cells will become responsive specifically to the loaded proteins and will proliferate as a result of the immunogenic viral RNA mimic that is simultaneously delivered. This marks the first combination of proteins and nucleic acid polymers into PLGA nanoparticles, and initial experiments provide promising data for these particles as potential cancer therapeutic agents.

### ***Characterization of Antenna Parameters using a Reverberation Chamber***

Levon Barsikyan, Electrical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Mark Golkowski, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Today antennas used for sending and receiving wireless signals are an integral part of everyday technology. Antennas are included as parts of our cell phones, credit cards, satellites, and cars. For these devices, it is important that communication of data be efficient and that operation of the antenna be well understood. A reverberation chamber is a metal enclosure that creates a perfectly reflective environment for electromagnetic waves. Reverberation chambers are useful in studying the operation of antennas. In this work we use a reverberation chamber at the National Institute of Standards and Technology (NIST) in Boulder Colorado to investigate the efficiency of antennas. The reverberation chamber is loaded with different amount of absorbing material and the antenna efficiency is solved for using a novel two-port network model. Results show that including insertion loss from the chamber in the antenna model can provide better estimation of its efficiency.

### ***A New Role for Decapping Factors in Premature Termination of Transcription***

Kristopher Brannan, Molecular Biology, AMC - Graduate School

Faculty Sponsor: Dr. David Bentley, AMC - Graduate School

*Activity Type:* Graduate Research

Transcription is the process by which a cellular protein called RNA polymerase II (pol II) copies genetic information from genes in DNA into "transcripts" made from a molecule called RNA, which can then be used to make protein. Transcription termination is a term that describes the completion of transcription by pol II at the end of genes. This study has discovered that, surprisingly, transcription termination quite often occurs at the beginning of human genes. This "premature" termination may be a device used by human cells to decide when and where genes are activated in response to the environment. For example, if the cell needs to turn a gene on, it can send a signal to that gene that allows pol II to escape premature termination and transcribe to the end of the gene, producing a full transcript that gives rise to the corresponding protein. Since improper transcription of genes can cause a number of human diseases, including cancer, it is important that we understand in great detail mechanisms, such as premature termination, that are used to regulate transcription.



## **Graduate Students**

### ***Forest Fragmentation in Protected Areas of Mexico***

Tanya Buxton Torres, Environmental Sciences,  
DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Rafael Moreno, DC -  
College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Forest fragmentation is one of the most studied subjects by conservation biologists and generally can be described as the breaking up of a forest unit. Having the ability to quantify forest fragmentation provides scientists and policy maker's valuable information which can then be applied to a variety of issues including forest productivity, species biodiversity and anthropogenic influences, which are of particular concern in protected areas. Using remotely sensed land cover data in a Geographic Information System (GIS) has become a common tool to quantify forest fragmentation. There are currently a variety of GIS tools available to calculate forest fragmentation and connectivity. This study will first use a selected pilot area in Mexico to compare two methods while maintaining similar parameters in each method. The first method described by Riitters et al. (2000) uses the Analytical Tools Interface for Landscape Assessments (ATtILA) software which uses a moving window analysis to categorize fragmentation types. The second method uses the CONEFOR software with the GUIDOS Toolbox to determine the fragmentation and connectivity classes. The results will then be reviewed and one method will be selected to analyze forest fragmentation across the entire country of Mexico with data from 1997, 2002 and 2007. The results will then be overlaid with Mexico's protected areas which will provide insight into fragmentation over time in and around protected areas. This information will be valuable to researchers and forest authorities and can be used in various interdisciplinary studies.

### ***Beta-Glucoggalin Suppresses Lipopolysacchrde-Induced Inflammatory Markers by Aldose Reductase Inhibition in Murine Macrophages and Ocular Tissues***

Kun-Che Chang, Toxicology, AMC - School of  
Pharmacy

Faculty Sponsor: Dr. J. MARK PETRASH,  
AMC - School of Medicine

*Activity Type:* Graduate Research

Aldose reductase (AR) reduces toxic lipid aldehydes and mediates inflammatory signals triggered by lipopolysaccharide (LPS).  $\alpha$ -glucogallin (BGG), a recently described AR inhibitor, was purified from extracts of the Indian gooseberry (*Emblica officinalis*). In this study, we found BGG shows low cytotoxicity in Raw264.7 murine macrophages and effectively inhibits AR activity as measured by suppression of sorbitol accumulation. In addition, BGG-mediated inhibition of AR prevented LPS-induced cytokines release, activation of JNK, p38 and lowered ROS levels, which could inhibit LPS-induced apoptosis. Uveitis is disease of the eye associated with chronic inflammation. In this study, we also demonstrated that BGG suppresses the infiltration of inflammatory cells into the ocular media of mice with experimental uveitis. To understand why AR inhibition suppresses LPS-induced uveitis, we investigated the morphology and migration of macrophages. We demonstrated that BGG attenuates LPS-induced cellular morphological change and migration. We further proved that BGG inhibits LPS-induced MMP-9 activation, which plays an important role for macrophages to migrate to the site of inflammation. Accordingly, these results suggest BGG is a potential therapeutic for inflammatory diseases.

### ***Effect of Inter-Domain Linker Length on Lateral Diffusion of Synaptotagmin C2AB Domains***

Kan Chantranuvatana, Chemistry, DC - Graduate School

Joseph Vasquez, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Jefferson Knight, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Synaptotagmin 7 (Syt7) is a membrane-targeting protein involved in insulin secretion from pancreatic  $\beta$  cells. It binds membranes via two Calcium dependent membrane docking domains called C2A and C2B, which are linked by an 8 amino acid residue chain. Here, we investigate the random diffusion of the C2AB tandem domain on planar lipid membranes, in order to understand whether the C2A and C2B domains interact with each other directly or only via the 8-amino acid linker. Based on prior data, it was predicted that the diffusion rates of mutant C2AB domains with longer linker regions should be slower than that of the Wild Type (WT) tandem unless the C2A and C2B domains directly interact. Using site-directed mutagenesis, we have produced and purified mutant versions in which the linker region is extended by two (SS) and four (GSSS) serine and/or glycine residues. The WT and two mutant (SS and GSSS) proteins have been tagged with a brightly fluorescent dye and docked to supported lipid bilayers in the presence of calcium. The random diffusion of these individual protein molecules is then measured using Total Internal Reflection Fluorescence Microscopy (TIRFM). Preliminary results indicate similar diffusion values of these three protein variants, where the differences between the measured values are smaller than the sample-to-sample variability. Future research directions include efforts to decrease this variability and determine its origins, as well as using even longer linker regions that should have larger effects on C2AB diffusion rates.

### ***Improvements to Lumbar Spine Fusion Using Patient-Specific Information***

Lillian Chatham, Mechanical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Dana Carpenter, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Lumbar spine fusion is a treatment for extreme cases of disc degenerative disease. Currently, there is a high risk of re-operation and complications. To help reduce complications, there is a need for patient specific selection of device components. The purpose of this research is to investigate subject-specific differences in strain levels in the lumbar spine after interbody fusion with posterior instrumentation. The effect of implant material properties is also being taken into account. Finite element models of the L4 and L5 vertebrae have been developed using computed tomography data of two cadaveric lumbar spines. Models were created from the image data and then integrated with computer generated models of the spacer, screws and rods. Homogeneous material properties were applied to the instrumentation while the material properties of the vertebrae were based off of bone mineral density. This study has observed poly (ether-ether-ketone) (PEEK) and titanium as material properties of the spacer because these are currently used in surgery. The posterior instrumentation was treated as titanium for all the models. Finite element models were executed with a pressure applied to the superior endplate of L4 and the inferior endplate of L5 was fixed. Subjects experienced different responses to spacer implant materials, showing that subject variation is an important consideration when selecting the instrumentation used in lumbar spine fusion. Future analyses will hone in on specific factors, such as gender and body mass index that play a role in the variation of strain levels and response to materials.

## **Graduate Students**

### ***Zar Proteins Regulate Translation in *Xenopus* Oocytes***

Jonathan Cook, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Amanda Charlesworth, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

*Xenopus laevis*, the African clawed frog, is a common model organism for studying early development. The mechanisms that regulate the involved processes are highly conserved among animals, and the frog's oocytes and eggs are very large, making them easy to manipulate. An oocyte is an immature form of the matured egg that is not yet able to be fertilized. Maturation and very early development are regulated entirely at the translation (making protein from mRNA) level as the DNA is not available for copying at this time. In translation regulation, proteins are recruited to specific sequences in the mRNA and control how much protein is produced. Zar proteins bind to the Translation Control Sequence (TCS) in certain developmental mRNAs and regulate protein production. When Zar proteins are tethered to a reporter mRNA, the amount of protein produced is reduced in immature oocytes, but not in matured eggs. It is hypothesized that Zar proteins repress translation of mRNA by recruiting other proteins (translation factors). Zar proteins-and the proteins that bind to them-will be purified from oocytes and eggs using GST pull-down methods and identified by mass spectrometry. Once identified, these protein interactions will be verified using other methods, such as co-immunoprecipitation and western blot. A better understanding of Zar protein function is important to a better understanding of fertility, as well as of translation regulation in general, which plays a role in many other biological processes.

### ***Extra-Disciplinary Wanderings: The Benefits of Coloring Outside Epistemological Lines***

Ian Danielson, PhD in Public Administration, DC - School of Public Affairs

Faculty Sponsor: Dr. Mary Guy, DC - School of Public Affairs

*Activity Type:* Graduate Creative Activity

This presentation takes a trip through time and space in an engaging tour of the fascinating ways in which some key ideas in philosophy, moral reasoning, politics, and ways of learning and knowing have evolved. I construct an epistemological genealogy of Anne Schneider and Helen Ingram's (1993) Social Construction Framework of the public policy process, and present this "family tree" of ideas in an innovative presentation format intended to interest and entertain a variety of audiences. Rather than merely describing how the main ideas of the framework have evolved, I provide a visual map of two parallel lines of epistemology that converge at the development of social constructionism and Schneider and Ingram's application of the concept to public policy. This visualization illustrates the development of these lines of epistemology in reference to two axes: The horizontal axis ranges from the years 1400 to 2000, while the vertical axis represents an epistemological spectrum-with pure empiricism at the lower extreme, and pure rationalism at the upper extreme. The presentation takes viewers on a tour of epistemological space and time to illustrate the benefits of relaxing disciplinary boundaries in academia, pointing to key theoretical developments in the study of public affairs-and in the social sciences in general-that resulted from the extra-disciplinary wanderings of adventurous scholars such as Schneider and Ingram.

***The Efficiency-Consumption Paradox: Fuel Efficiency Effects Consumption Patterns in Modern Times***

Neal Dawes, Non-Degree, DC - College of Engineering and Applied Science

Alexander Haeger, MS Civil, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Indrani Pal, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

In a world of increasing human population, burgeoning demand for energy resources, and growing awareness of environmental degradation it is important to develop a broad understanding of the many pressing issues we are faced with, which are key determinants for sustainable socio-economic development and human well-being. This study looks at one such important issue-the efficiency-consumption paradox, commonly known as the Jevons Paradox, with respect to classical and modern issues. The Jevons Paradox occurs when efficiency increases are lost to increases in consumption, and with efficiency issues at the center of current sustainability debate, it is an important concept to consider. In this study we explore the historical background of the paradox, which came about during the post-industrial revolution era in Britain, and provide examples and context for important terminology such as rebound effect and backfire. We then consider proposed improvements to vehicle fuel efficiency and the predicted effects on consumption based on historical and current societal trends, and the outcome of a survey which we conducted. Interestingly, one of our key findings is that the paradox identified over 1½ centuries ago is still applicable in the modern times as human perception/behavior tends to alter towards consumption patterns with efficiency changes... Hence, Jevons Paradox holds true and should be considered in developing sustainable solutions and related policies, which will require more detailed study to understand when, where and how it should be considered and what factors including human perception/behavior make it true.

***Small-Scale Agriculture as an Alternative to Mechanized Fields of Monoculture***

Amy DePierre, ENVS, DC - Graduate School

Faculty Sponsor: Dr. Bryan Wee, DC - Graduate School

*Activity Type:* Graduate Research

My research seeks to further understand small-scale agriculture with particular attention to agriculture in Japan. Japanese agriculture is currently struggling between two agendas - the first, to proceed with modernization in the way the United States have through mechanization and monoculture and the second, incentivizing small-scale agriculture that requires intensive labor. Due to ever-increasing constraints from limited land space and an expanding population, Japan may be forced to utilize small-scale urban agriculture if they intend to continue providing sustenance to their population. My main research questions are 1) What does small-scale farming in Japan look like? 2) How do communities support or hinder agriculture? 3) Is it possible to bridge the large-scale agenda of mechanized agricultural modernization with the small-scale agenda of natural farming? To answer these questions, I spent December 28 through January 19th in Japan for a study abroad Geography by Rail course, independent travel and a stay on an organic farm. I connected with a small-scale organic farm through the Worldwide Opportunities on Organic Farms (WWOOF) website that agreed to host me for a week in January 2013 in order to participate and observe firsthand the methods of small-scale farming. From my time in country, as well as through ample secondary research, I found that small-scale farming operations are highly diversified, community oriented and widely in use throughout Japan.

## **Graduate Students**

### ***MCAT Study Academy: A Team Based Approach to MCAT Preparation in Underrepresented Medical School Candidates***

Jim Do, Medicine, AMC - School of Medicine

Tim Ung, Medicine, AMC - School of Medicine

Faculty Sponsor: Dr. Ozzie Grenardo, AMC - School of Medicine

*Activity Type:* Graduate Research

Background: The MCAT is a standardized examination that must be taken by all students who wish to pursue professional medical education. Success on this examination is predictive of matriculation into a medical school. Historically, underrepresented students have failed to perform adequately on this exam, a limiting factor in increasing diversity in medicine education. The MCAT Study Academy [MCATSA] is an innovative approach to the MCAT test preparation with special emphasis on collaboration and the mentorship of students. Methods: Founded in 2012, the MCATSA is a free medical student run MCAT preparatory program based on the idea of team based learning, adequate examination preparation without the financial burden of traditional programs. Populations targeted by the program are financially disadvantaged, socio-economic diverse, and culturally diverse students who anticipate applying to medical school in the next two years. The program consists of weekly lectures, team meetings, online activities as well as medical student mentorship. Results: After the first year of the program, students have displayed overall satisfaction with the program. Objectively, student initially performed an average score of 18 on AAMC practice exams. Progression through the program was associated with a linear increase in scores. Students finished with a final average score of 28 on AAMC practice exams. Conclusion: Although in its infancy, the MCATSA's team based approach to preparation for the MCAT has supported an increase in scores as well as confidence in underrepresented groups. This may lead to an increase in the matriculation of diverse students.

### ***Sustainability Assessment of the San Luis Valley***

Jonathan Dubinsky, Civil-Sustainable Infrastructure, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Arun Karunanithi, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Decision making with regards to sustainability at a regional/local government level is being increasingly recognized as an important issue. The goal of this research project is to develop a comprehensive set of metrics that can provide information needed for sustainability assessment and informed policy making, at a regional scale. This pilot study focuses on the geographic location of San Luis Valley, with an objective of enabling local government/community development plans and implement actions towards sustainable growth. The specific goals include 1) Methodological development of sustainability metrics such as ecological footprint, Energy, Water footprint etc. 2) Calculation of these metrics for the valley 3) Develop future scenarios of the valley considering large-scale initiatives and land use changes such as solar, wind, geothermal, farming practices etc. 4) Conduct annual focus groups and workshops in the valley to enable stakeholders to use these metrics and the data sets for policy and land management decisions.. This work is highly relevant to policy makers and planners and these metrics, taken together, will provide the community with all the necessary tools to make policy choices for sustainable growth in the valley. The goal is that these tools will then be used at a regional scale in many different parts of the country and the world.

### ***Bike Share Equity and Efficiency: A Mixed Methods Approach***

Samuel Gallaher, Public Affairs, DC - School of Public Affairs

Alessandro Rigolon, Env. Design; Travis Flohr, Sustainable & Healthy Env.; Pawinee Chuayprakong, Public Affairs

Faculty Sponsor: Dr. Nancy Leech, DC - School of Education and Human Development

*Activity Type:* Graduate Research

Cities in the United States are implementing plans to decrease their carbon footprints and improve citizen health, in other words becoming more sustainable. Not all cities are making the same decisions in terms of sustainable programs or using the same criteria for decision-making. The focus of this study is one type of sustainable infrastructure: bike-share stations. Bicycle sharing is receiving increasing attention from residents, politicians, and transportation planners. The goal of this research is to understand and examine the decision-making processes and measure if the bike-share stations are being distributed equitably and efficiently. Two cases are presented in this work: Denver's b-cycle and Washington D.C.'s Capital Bikeshare bike-sharing programs. Geographic Information System mapping of station locations and census block demographics, qualitative analysis of city council meetings and other station decision processes, content analysis of web-published documents by stakeholders about the programs, and financial analysis of each program were used to answer the research question: How does decision-making processes influence the location of bike-sharing stations in Denver, CO and Washington, D.C.? The study finds that the decision for the initial bike-share locations in each city were economically driven and resulted in bike-share stations in more affluent neighborhoods, thus creating unequal access to sustainable and healthy transportation. The results of this study will help better understand the complex process of city level sustainable infrastructure decisions and whether these processes lead to the equitable distribution and investment in sustainable infrastructure.

### ***Biomass Assessment of Local Food Wastes for Anaerobic Digestion***

Michael Garcia, Environmental Science, DC - College of Engineering and Applied Science

Faculty Sponsor: Ms. Amanda Weaver, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Anaerobic digestion of municipal solid waste is a proven and popular waste management technology. Compared to conventional waste disposal, advantages of anaerobic digestion are ample and include: reduction on greenhouse gas emissions, sustainable generation of renewable energy, reduction in waste sent to landfills, nutrient recovery in the form of highly enriched compost, and utilization of a highly abundant, untapped resource. Previous assessments of biomass resources in the United States generally have not specifically included contributions from food waste. The objective of this study is to estimate food waste resources in the City of Denver and surrounding areas, for use as feedstock in methane gas production by anaerobic digestion. To accomplish this objective, a geospatial analysis of US Census, waste characterization, biochemical methane potential, climate, ecological, and City and State data will be conducted using GIS. This research also aims to promote anaerobic digestion for sustainable energy generation in the United States through life-cycle analysis of environmental, social, and economic impacts. This thesis research is currently in the proposal process.

## **Graduate Students**

### ***Using Technology to Promote Interdisciplinary Learning in Colorado Middle Schools***

Thomas Hraha, Bioengineering, DC - College of Engineering and Applied Science

Nili Krausz, Mechanical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Bryan Wee, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

The University of Colorado Denver's GK-12: Transforming Experiences program is unique in that it partners graduate students from applied sciences and mathematics with math and science middle school teachers to bring interdisciplinary STEM experiences to the classroom. The GK-12 Fellows act as content and research experts who can enhance the curriculum, provide exciting real-world applications, and act as positive role models. This work represents an example of the powerful impact of these partnerships in classrooms. Eighth grade physical science students in Colorado are expected to be able predict and evaluate the movement of an object through the forces applied to it, and to understand how energy can be transferred in the form of waves. Through the partnership between two GK-12 Fellows and a teacher, two interactive activities were created towards these standards. The first involved the study of bridge types and the forces that impact bridges. Students researched how shapes affect structure and strength, followed by an online bridge-building simulation. Teams then built model truss bridges out of paper and tested them. The second dealt with how plate tectonics and seismology relate to waves and energy transfer. Students used online simulations to determine earthquake strength and epicenter. Teams then designed and built model towers capable of withstanding a severe simulated earthquake. By integrating math and applied science into challenging and applicable lessons utilizing computer simulations, not only were education standards surpassed, but skills relating to critical thinking, experimental design and teamwork were reinforced.

### ***Microwave-Induced Thermoacoustic Tomography Experimental Study and FDTD Modeling***

Ryan Jacobs, Electrical Engineering, DC - College of Engineering and Applied Science

Xiaoye Chen, Electrical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Yiming Deng, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Microwave imaging is an imaging technique that gives high image contrast but poor image resolution (due to its relatively long wave length). Conversely ultrasonography has high image resolution (with a diagnostic frequency of up to 20 MHz) and poor image contrast of similar soft tissues. So by combining these two techniques one is able to create an imaging technique with high contrast and high resolution, this method of imaging is Microwave-Induced Thermoacoustic Tomography (MI-TAT). This noninvasive hybrid modality, improves contrast by using thermoelastic wave generation induced by microwave absorption. Samples are illuminated with sub-microsecond electromagnetic microwave pulses inducing the acoustic wave in the sample that are then received with an unfocused transducer. The advantage of this technique lies in combining the high contrast of microwave absorption coefficients for different biological tissues and the superior spatial resolution of ultrasonic waves. Such technology is important in providing a low-cost alternative to MRI or for Non-Destructive Testing (NDT). The MI-TAT simulation setup shows that the samples with a higher conductivity emit a stronger acoustic signal. We introduce a redesigned experimental setup with an updated FDTD model that accurately represents the experimental setup. Shielding has been improved to minimize radiation leakage into the environment and to the transducer. Samples tested in the experimental setup include simulated tissue phantoms to concrete samples. The tissue samples are used to determine the effectiveness for medical imaging applications and the concrete is to test the nondestructive testing (NDT) applications.

## ***Endothelin-Converting Enzyme-1 (Ece1) Function in Zebrafish Craniofacial Development***

Marisol King, DDS, AMC - School of Dental Medicine

Faculty Sponsor: Dr. David Clouthier, AMC - School of Dental Medicine

*Activity Type:* Graduate Research

Bone and cartilage of the face arise from cranial neural crest cells (NCCs). NCCs populate the pharyngeal arches, where they differentiate into final facial structures. Endothelin signaling is crucial in this process, with endothelin-1 (Edn1) initiating endothelin-A receptor in NCCs, thus establishing the identity and fate of NCCs in the pharyngeal arches. Edn1 is produced in an inactive form before being activated by endothelin converting enzyme-1 (Ece1), creating the active form of Edn1. While Ece1 function in mouse has been examined, Ece1 has not been identified or studied in zebrafish. Objectives: Determine the function of Ece1 in zebrafish craniofacial morphogenesis. Methods: Ece1 function was knocked down using antisense oligonucleotides (morpholinos) against ece1. Morpholinos were injected into embryos at the 1-2 cell stage. Resulting embryos (morphants) were stained with alcian blue to detect cartilage at 5 days post-fertilization (dpf), with gene expression examined by whole mount in situ hybridization (ISH). Results: Morphants exhibited severe defects in ventral arch-derived cartilages, including hypoplasia of Meckel's cartilage. In addition, expression of the Edn1 downstream mediator dlx5 was down-regulated in ece1 morphants. In contrast, overexpression of ece1 mRNA had no effect on normal craniofacial development. Conclusion: Zebrafish Ece1 is required for lower jaw morphogenesis by acting in the Edn1 pathway. Ece1 loss disrupts endothelin signaling and thus molecular regulation of mandible development while also functioning later in dorsal jaw development. Increased Ece1 levels do not disrupt lower jaw development, suggesting that Ece1 does not control the extent of Edn1 activity during NCC patterning.

## ***Quantifying the Phosphorus Footprint and Interventions for Urban Areas***

Joshua Knight, Civil Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Anu Ramaswami, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Phosphorus is an important element that's becoming scarce. As a vital nutrient for growth, it's found in fertilizer, plants, food and supplements. It's also found in many other products, and large phosphorous flows go to detergents and infrastructure materials (steel, concrete, coal). On the opposite end of the life cycle, wasted phosphorus in our waterways causes eutrophication which can kill the life within them. Approaches are necessary to solve both these problems of global scarcity and regional environmental degradation with improved phosphorus management, recovery and reuse. This project quantifies for the first time the phosphorus footprint (including direct in-boundary flows as well as indirect flows) for an urban area (Denver, Colorado), and evaluates interventions for reducing that footprint, including wastewater recovery and other sector measures.



## **Graduate Students**

### ***Neandertal Sexual Division of Labor***

Kelsey Knox, Anthropology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Julien Riel-Salvatore, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

With the 2006 paper "What is a Mother to do? The Division of Labor among Neandertals and Modern Humans in Eurasia." Kuhn and Stiner put forth the theory that Neandertals did not have sexual division of labor, and this lack of specialization along gender lines led to their extinction. The support for this argument is based on the fact that Neandertals "exhibit little evidence for the kinds of distinct economic roles typically fulfilled by women in recent hunter-gatherer groups." (Kuhn and Stiner 2006: 953); instead Neandertals had very narrow and fragile foraging regimes, no artifacts for processing plants, and a lack of complex, costly, high investment artifacts that would indicate female technology specialization. However, after a review of the literature, many of these behaviors argued to be missing from the Neandertal record are actually present, indicating that sexual division of labor may have an origin deeper in time than previously thought.

### ***Assimilation of Fire Perimeter Data into the Fire Spread Model SFIRE Coupled with the WRF Model***

Volodymyr Kondratenko, Applied Mathematics, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Jan Mandel, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Fire simulation starts from an ignition point, and when fire perimeter data are assimilated, the state of the fire spread model is changed to become closer to the data. This, however, presents a difficulty in coupled fire-atmosphere models. The fire has a very strong effect on the atmosphere and changes in atmospheric state due to the fire take time to develop, so the existing atmospheric circulation is no longer compatible with the modified fire. Moreover, linearized changes to the atmospheric state have no hope of establishing the properly changed circulation in a physical balance. We have recently developed a technique for fire ignition from perimeter data, which goes back in time and replays an approximate fire history to allow the proper atmospheric circulation patterns to develop. Here, we extend this technique to the assimilation of a fire perimeter into a developed fire state with an established atmospheric state. The SFIRE model uses the level set method to simulate the fire spread. Our data assimilation approach takes advantage of the manipulation of the fire state through level set functions, which is much easier than manipulating the fire areas directly.

## ***Design of an Open Source Multi Degree-of-Freedom Prosthetic Hand***

Nili Krausz, Mechanical Engineering, DC -  
College of Engineering and Applied Science

Faculty Sponsor: Dr. Ronald Rorrer, DC -  
College of Engineering and Applied Science

*Activity Type:* Graduate Research

Currently, most electric prostheses are controlled using electromyography (or EMG), which is the measure of the electrical signals that are produced when voluntary muscle is contracted. However, one of the major problems with the use of EMG for control is that there are a limited number of muscular control sites that can be used, and this in turn limits the complexity of the hands that are controllable. Therefore, most amputees are limited to the use of very simple prostheses that simply open and close, and many upper-limb prosthetics researchers are focused on searching for methods to simply and effectively control complex prosthetic hands. However, a significant number of these researchers have utilized virtual hands and other simulations to perform testing of these control algorithms (oftentimes on able bodied subjects). Thus, these control techniques remain firmly planted in the virtual realm, and without testing on a physical hand it is difficult to determine how effective any control scheme truly would be for use with a real prosthesis. Therefore, we postulate that the use of a physical hand would help to establish whether or not a given control scheme is realistically applicable for use by amputees, and thus the development of such a hand could be quite beneficial for researchers in the field. A six degree-of-freedom hand was developed with such a purpose in mind, and two of the major goals of the project were that the hand be inexpensive and "open sourced".

## ***Sustainable Water Management in Agriculture: What are the Advantages and Disadvantages of Local Communities Taking Charge?***

Samantha Larson, Public Affairs, DC - School  
of Public Affairs

Faculty Sponsor: Dr. Indrani Pal, DC - College  
of Engineering and Applied Science

*Activity Type:* Graduate Research

Globally, the total freshwater withdrawal for agriculture is about 70% of the overall. The freshwater availability and quality is a big sustainability concern. Therefore, the water management for agriculture is an important issue to address because unsustainable water management practices are getting bigger in many parts of the world due to population explosion and economic development. Local agricultural water management practices play a pivotal role in local as well as global food supply and commodities, local drinking water supply, global virtual water transport and trade, and maintain the health of environment and hydrological systems to support valuable ecosystem services. To understand whether promoting 'decentralized water management' practices makes more sense in general, this research aims to explore whether greater efficiency of managing water is best achieved through the local communities taking charge. To answer this question, we present a comprehensive review of eight agricultural water management case studies representing both developed and developing nations, and addressing both advantages and disadvantages through analyzing these case studies. Our preliminary findings suggest that the advantages largely outweigh the disadvantages, as local community efforts are able to address the regional differences, involve stakeholders, and result in on-the-ground water management action.

## **Graduate Students**

### ***CD146-Mediated Endothelial Cell Integrity is Lost During Chronic Obstructive Pulmonary Disease (COPD)***

Maike Leberl, Molecular Biology, AMC - School of Medicine

Faculty Sponsor: Dr. Laima Taraseviciene-Stewart, AMC - School of Medicine

*Activity Type:* Graduate Research

The adhesion molecule CD146 is predominantly expressed at endothelial cell junctions, where it mediates cell-cell interactions and contributes to vascular integrity. When cleaved from its intracellular and transmembrane domains, a soluble form (sCD146) consisting of only the extracellular domain circulates in the bloodstream. Because of the importance of CD146 in endothelial barrier integrity, we investigated the role of CD146 in the pathogenesis of cigarette smoke-induced emphysema in humans and in an animal model. We found that lung tissues from smokers exhibiting COPD (a condition including emphysema and chronic bronchitis) and from rats exposed to second hand smoke had significantly decreased levels of CD146. At the same time, both smokers with COPD and experimentally smoked rats had increased levels of sCD146 in their plasma and bronchoalveolar lavage fluid (BALF). Increased plasma levels of sCD146 correlated with the presence of anti-endothelial cell antibodies, both being potentially useful biomarkers for COPD. In CD146 knockout (KO) mice, distinct perivascular edema was seen in the lungs together with an influx of both inflammatory cells and protein, as measured in BALF. Our findings in vivo were supplemented with in vitro studies in rat pulmonary micro- and macrovascular endothelial cells, where treatment with cigarette smoke extract or CD146 silencing decreased CD146 protein expression. This decrease was accompanied by increased endothelial monolayer permeability as well as an enhanced macrophage infiltration. This is the first study to provide evidence that the loss of membrane-bound CD146 on endothelial cells diminishes pulmonary endothelial integrity, suggesting an involvement of CD146 in the pathogenesis of emphysema.

### ***Potential for Low-Carbon Energy Technologies for Colorado***

Ryan Lesar, Public Administration, DC - School of Public Affairs

Kelley Grubbs, Engineering; DC - College of Engineering and Applied Science

Shada Elalem, Engineering; Meg McPherson, Engineering

Faculty Sponsor: Dr. Indrani Pal, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Conventional energy sources have been the main source of electricity and fuel for centuries, but as oil, coal and natural gas reserves dwindle, other sources of energy must become the main suppliers of our energy needs. Low carbon technologies such as solar, wind, biomass and nuclear power could be used to provide most, if not all of Colorado's energy requirements. Utilization of fossil fuels for transportation and electrical generation is causing an increase in greenhouse gas emissions. These energy resources are declining at rates that cannot keep up with current consumption, so finding alternatives is imperative. This study assesses the low carbon technologies and their potential in Colorado, and finally recommends which technologies should be used and to what capacity. Analyses of four low carbon technologies were achieved through a review of literature, and recommendations were made according to our findings. Our results indicate that a combination of all four technologies is necessary to provide Colorado residents with enough energy to maintain their lifestyles. Certain low carbon technologies are better than others. For example, solar and wind power emerged as the two low carbon technologies that will have the most potential in Colorado. Solar can be used during the day due to Colorado's abundant solar resource, and wind power can be used to provide power at night, since that is on average when the wind resource is the strongest. Biomass and nuclear power can be utilized as backup and peak power sources due to intermittent issues with solar and wind.

## ***Designing for Resilience in Corn Belt Agriculture***

Emily Lynam, Landscape Architecture, DC -  
College of Architecture and Planning

Faculty Sponsor: Mr. Joern Langhorst, DC -  
College of Architecture and Planning

*Activity Type:* Graduate Research

Agriculture is the largest and most impactful land use in the United States, and it is in a state of crisis comprising alarming ecological and social degradation. Unless we, as a nation, act soon, we will lose functionality of some of the most productive agricultural land in the world: the Corn Belt. Despite landscape architecture's inherent role in influencing and designing land use, the field has played an overwhelmingly marginal role in effecting this country's most dominant and demanding landscape. This research project creates a model for landscape architects to apply their systems-thinking skills and facilitate an interdisciplinary redesign of the agrifood system. The model applies case study methodology to analyze five different subsystems of the agrifood system and their components at four descending geographical scales: the United States, the Corn Belt, Iowa, and Audubon County; these different scales allow us to closely investigate how each of the subsystems and their components function in the agrifood system. Once we understand how they work, we can see what outside forces (including policy and economics) have contributed to their current dismal state. The final phase of the model is determining what strategies we, as landscape architects, can contribute to the design of a more resilient agrifood system that will increase national food security.

## ***Proposing a New Measure for Mothers with Breast Cancer: The Positive Impact of Children Scale***

Kellie Martens, Clinical Health Psychology, DC  
- College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Kristin Kilbourn, Ph.D.,  
MPH, DC - College of Liberal Arts and  
Sciences

*Activity Type:* Graduate Research

Women under the age of 45 represent a growing population of breast cancer survivors in the United States. Current literature suggests that younger women diagnosed with breast cancer share unique concerns, including distress about dependent children. Thus far, quantitative research has focused on the difficulties of mothers diagnosed with breast cancer. However, qualitative literature suggests that women with children also find benefit in their cancer diagnosis. We designed a 5-item measure of the positive impact that having dependent children has on young women diagnosed with breast cancer. Participants will endorse items such as "My children gave me an appreciation for life" and "Having children helped me focus on the positive" on a 5-point scale (0= not at all, 1= a little bit, 2= somewhat, 3= quite a bit, 4= almost always). Breast cancer survivors ages 19-45 will be recruited from University of Colorado Hospital's Cancer Center, online support groups, message boards and advocacy groups. As part of a larger scale study of young breast cancer survivors' quality of life, the Positive Impact of Children Scale (PICS) will be administered via a web-based survey. Analyses will explore the reliability and validity of the PICS.

## **Graduate Students**

### ***Effects of Short-Term, Early Life Exposure to the Emerging Pollutant Triclosan on the Gastrointestinal Flora of the Fathead Minnow***

Adrienne Narowe, Biology, DC – College of Liberal Arts and Sciences

Munira Albuthi-Lantz, Env. Science - CLAS

Faculty Sponsor: Dr. Christopher S. Miller, DC  
- College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Gastrointestinal (GI) bacteria have been shown to perform functions important to the health of the host organism, including the training and regulation of the immune system, nutrient absorption, and hormone modulation. Thus, disruption of the GI flora may produce long-term effects on the host organism by eliminating or reducing essential microbial functions during key developmental windows. Even transient changes to the flora may have persistent long-term effects on the adult host. Our study examines the impact of the common consumer antimicrobial, Triclosan, on the GI bacterial communities of fathead minnow larvae, an environmental toxicology model organism. We hypothesized that perturbation of the minnow GI flora by Triclosan during early development may noticeably alter the GI microbiota and interfere with important microbially mediated physiological processes. To characterize the bacterial communities associated with the GI tracts of Triclosan-treated and untreated fish, we performed high-throughput DNA sequencing of the 16S rRNA gene, a common marker of bacterial identity. Treated and untreated fish differed in community membership and overall bacterial diversity. These differences increased with time, and persisted after Triclosan exposure ceased. Changes to the treated community included the increased abundance of organisms able to metabolize Triclosan-like compounds. Further research will utilize this initial community structure data to guide exploration into the impact of environmental pollutants on bacterial communities and resultant effects on the host organism. We will combine longitudinal study of the gut flora to define how pollutant induced changes to the fish gut microbiome correlate with physiological outcomes in the adult minnows.

### ***Innate Immune Stimulation Contributes to T-Cell Resistance to Tolerance and Pancreatic Islet Allograft Rejection***

Michelle Nelsen, Immunology, AMC -  
Graduate School

Faculty Sponsor: Dr. Ronald G. Gill, AMC -  
School of Medicine

*Activity Type:* Graduate Research

Even with intensive insulin therapy, type 1 diabetics often cannot control their blood glucose. For better disease management, transplantation of insulin-producing pancreatic islet can restore normal blood glucose levels. However, such transplants are subject to rejection by the immune system. This problem requires chronic immune suppressive drug treatment of the recipient. Because such long-term drug treatment is known to have significant toxicity, our goal is to induce specific immune tolerance to the graft. We know that durable donor-specific tolerance develops after brief treatment with tolerance-promoting agents (therapies that target cell surface molecules with major roles in immune function). Unfortunately, as host tolerance to the islet graft evolves, the process is vulnerable to disruption by microbial infections. This susceptibility may be due either to innate immune stimulation driven by pathogen-associated molecular patterns, or to interference from pathogen-specific memory T cells; in this study, we aimed to determine which immune response is a greater barrier to allograft tolerance. We model pathogen exposure through host immunization with egg-white protein (ovalbumin) and an innate immune stimulant (adjuvant) that mimics the inflammation induced from viral infection. Our results indicate that innate immune stimulation, without concurrent immune responses to pathogen-derived antigens, triggers rapid islet allograft rejection despite recipient treatment with tolerance-promoting therapies. Importantly, this disruption of tolerance is time-dependent: Early (day 2 post-transplant) but not late (day 60) adjuvant treatment inhibits tolerance. Thus, innate immune stimulation impairs the early outcome of graft-reactive cells, inducing immunity rather than tolerance following treatment with tolerance-promoting agents.

***Product Reputation Manipulation:  
The Impact of Shill Reviews on  
Perceived Quality***

Toan Ong, Computer Science and Information Systems, DC - Business School

Faculty Sponsor: Dr. Michael Mannino, DC - Business School

*Activity Type:* Graduate Research

Online reviews have become a popular method for consumers to express personal evaluation about products. Ecommerce firms have invested heavily into reputation systems because of the impact of product reviews on product sales and shopping behavior. However, the usage of product reviews is undermined by the increasing appearance of shill or fake reviews. As initial steps to deter and detect shill reviews, this study attempts to understand characteristics of shill reviews and influences of shill reviews on product quality and shopping behavior. To reveal the linguistic characteristics of shill reviews, this study compares shill reviews and normal reviews on informativeness, readability and subjectivity level. The results show that these features can be used as reliable measurements to separate shill reviews from normal reviews. To understand the impact of shill reviews, an experiment was conducted measure the impact of shill reviews on perceived product quality. The results showed positive shill reviews significantly increased quality perceptions of consumers for thinly reviewed products. This finding provides strong evidence about the risks of shill reviews and emphasizes the need to develop effective detection and prevention methods.

***Role of Microsite Type, Cache Pilferage, and Elevation in Whitebark Pine (*Pinus albicaulis* Engelm) Regeneration in the Northern Rocky Mountains***

Elizabeth Pansing, Integrative Biology, DC - College of Liberal Arts and Sciences

Aaron Wagner, Integrative Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Diana F. Tomback, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Whitebark pine is a keystone and foundation species found in the upper subalpine and treeline. It plays a key role in treeline dynamics by initiating tree island development. Whitebark pine seed dispersal is accomplished almost entirely through seed-caching behavior of Clark's nutcracker. Whitebark pine is declining because of an exotic fungal disease, white pine blister rust, mountain pine beetle outbreaks and fire suppression, threatening the persistence of whitebark pine and these treeline ecosystems. Whitebark pines' survival depends on both natural regeneration and active restoration. To understand whitebark pine regeneration and test a developing restoration methodology, in 2012 we began three interrelated studies at White Calf Mountain, Glacier National Park, Montana, and Tibbs Butte, Shoshone National Forest, Wyoming. We tested the following hypotheses: 1) whitebark pine exhibits highest germination and early seedling survival in protected microsites, 2) germination and early seedling survival decrease with elevation, and 3) granivorous rodents are secondary dispersers of whitebark pine seeds. We also quantified granivorous rodent abundance and density. In the subalpine and treeline zones, we placed 734 simulated nutcracker caches in six different microsite types, and in 2013, we will quantify germination and early seedling survival rates, as well as the proportion of seeds pilfered from simulated caches by granivorous rodents. We will also determine whether these rodents will locate and recache seeds. Species trapped included *Peromyscus maniculatus*, *Zapus princeps*, and *Tamias* spp. Preliminary 95% confidence intervals of abundance estimates are 101.6-34.7 and 32- 46.8 individuals on White Calf Mountain and Tibbs Butte, respectively.

## **Graduate Students**

### ***Systematics of Carex Section Scirpinae Tuckerman (Cyperaceae)***

James Pembrook, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Leo P. Bruederle, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Despite great effort, cladistics of the large genus *Carex* L. (sedges; Cyperaceae) is relatively incomplete due to the magnitude and complexity of the genus, with molecular examinations at the subgeneric, specific, and subspecific levels still lacking for many groups. Therefore, a study of the molecular systematics of *Carex* section *Scirpinae* Tuckerman was undertaken. *Carex* section *Scirpinae* (Cyperaceae) is a small, predominately North American section distinguished by a dioecious breeding system and unispicate inflorescences. Dunlop's (1990, 1997) treatments of the section recognize two species: *Carex scirpoidea* Michaux and *C. curatorum* Stacey, with the former including ssp. *scirpoidea*, ssp. *convoluta* (Kükenthal) Dunlop, ssp. *pseudoscirpoidea* (Rydberg) Dunlop, and ssp. *stenochlaena* (Holm) Löve & Löve. In order to generate phylogenetic hypotheses for the section, total genomic DNA was extracted, amplified, sequenced, and analyzed from samples that included Dunlop's voucher specimens, utilizing nuclear (ETS, ITS) and chloroplast (ATP, rpS16) regions. *Carex scabriuscula*, which was excluded from section *Scirpinae* by Dunlop, forms a monophyletic clade with strong bootstrap support (100%) in cpDNA and combined phylogenies, wherein *C. scabriuscula* segregates at the basal node of the section. Although not evident from the combined gene trees, ITS phylogenies show different taxa, as well as populations of the widespread ssp. *scirpoidea*, east of the Rocky Mountains segregating from western populations with weak support. Although clear morphological differences separate species and subspecies, none of the taxa within the section as delimited by Dunlop segregate independently in any phylogeny. This includes *C. curatorum*. This may reflect incomplete lineage sorting or hybridization.

### ***Climate Change, Droughts, and Low Stream Flow Conditions in the Major River Basins in the U.S.***

Maryam Pournasiri Poshtiri, Environment & Sustainability, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Indrani Pal, DC - College of Engineering and Applied Science (co-author)

*Activity Type:* Graduate Research

Drought is one of the most expensive natural disasters worldwide and the United States is not an exception. During the past 2000 years, U.S. has experienced widespread and prolonged droughts with devastating negative impacts on the socio-economy and environment. Though the droughts are generally regional phenomena and associated with the regional land-atmosphere system, these regional phenomena might also be associated with remote connections (teleconnections) with large-scale climate system. Interesting enough, the climate of a River Basin in the U.S. could be very sensitive to what happens over the oceans. Despite recent progress in seasonal to annual hydro-climate predictions based on ocean-atmosphere teleconnections, little is known about how such connections affect local weather and water availability at different time scales such as seasonal/yearly/multi-year/multi-decadal droughts. In this research, we aim to discuss how climate, regional droughts, and water availability interact with each other in the major river basins in the U.S. acknowledging the past and recent findings. Starting with an introduction of the major river basins considered in this study and their "average" hydro-climatic conditions, we mainly aim to discuss historical droughts, their established connections with the oceans and how the low river flow conditions in each of those basins are connected with the both. These findings not only provide important information for understanding the flow variability for an important river, but also present potential prediction opportunities of the same. In addition, many more outstanding research questions important for water sustainability issues are spotted and will be considered for the further study.

***Zygote Arrest Proteins Bind and Regulate Developmentally Important Maternal mRNA***

Heidi Rienstra, Integrative Biology, DC - Graduate School

Faculty Sponsor: Dr. Amanda Charlesworth, DC - Graduate School

*Activity Type:* Graduate Research

Zygote arrest proteins (Zar) are found within the oocytes of vertebrates and have been discovered to be a key factor in early embryo development. However, neither the role nor mechanism of Zar proteins has been fully elucidated. It has been previously shown that Zar proteins play a key role in the translational regulation of maternal messenger RNAs (mRNA) such as *wee1*, which requires translational regulation in order for the embryo to continue through development. In addition, Zar proteins have been shown to contain a highly conserved C-terminal sequence that is responsible for binding to a Translational Control Sequence (TCS) within the 3' untranslated region (3' UTR) of maternal transcript targets. A list of maternal mRNAs containing a TCS, and therefore potential targets of Zar, is nonexistent. The goal of my research is to identify and assemble a list of maternal mRNAs that are under Zar translational regulation. In the first phase of identifying target maternal mRNAs, cross-linked immunoprecipitation conditions were determined and optimized. This enables progress to the second phase which includes sequence analysis of Zar bound maternal mRNAs using High Throughput Sequencing (HITS-CLIP). If Zar proteins serve as translational regulators of developmentally important maternal mRNAs, then identification of these maternal mRNAs should help us to understand the role Zar proteins play in vertebrate development.

***Advocacy in Action: Big City Mountaineers***

Robin Roche, Counseling, DC - School of Education and Human Development

Faculty Sponsor: Dr. Edward Cannon, DC - School of Education and Human Development

*Activity Type:* Graduate Creative Activity

This poster presentation focuses on the value of social advocacy, as demonstrated through wilderness experience programs. Experiential programs, such as Big City Mountaineers, offer valuable therapeutic benefits in non-traditional counseling settings. Big City Mountaineers advocates for urban, at-risk teens by providing them with the opportunity to participate in week-long backpacking trips in the mountains. The chance to engage teenagers beyond the boundaries of a traditional counseling setting provides an unparalleled growth experience for mentors and teens alike. Mentoring relationships foster growth and bolster self-efficacy. Further, aftercare and reconnection can enhance the lives of the youth who participate in wilderness experiences. As an instructor for Big City Mountaineers, I am called to draw upon my experience in the field of environmental education as well as my current graduate studies in counseling. My education at UC Denver is providing me with a body of knowledge in counseling, which serves to enhance wilderness experience programs.



## **Graduate Students**

### ***Targeted Community Outreach Raises Institutional Diversity Awareness and Bridges Campus-Community Relations***

Sheri Rosen, Medicine, AMC - School of Medicine

Nicholas Birdsey, AMC - Colorado School of Public Health

Faculty Sponsor: Ms. Lia Nelson-James, AMC - Graduate School

*Activity Type:* Graduate Creative Activity

Efforts should be made by medical school campuses to engage their surrounding communities. The University of Colorado School of Medicine has made many such efforts since establishing a new campus in Aurora, CO in 2007. A firm bridge between community and campus remains elusive, and many challenges to community engagement remain. Cultural diversity in the Aurora community is much greater than that seen on campus.

Socioeconomic barriers to health coverage and health access are prevalent in Aurora, making outreach through University Hospital and other campus clinics difficult. Here we present an interprofessional effort to establish a campus presence at the neighborhood elementary school. With the support of the Anschutz Senate Committee, Paris Elementary, and the Office of Diversity, we have developed an educational program for underprivileged elementary students in the Aurora community as part of our campus' ongoing community outreach efforts. The Creative Writing and Reading Partnership Program was held on Saturdays between January and April 2013, and allowed students practice with writing and reading, in some cases learning English along the way. Volunteers were in turn exposed to a diverse group of children in the Aurora community, allowing them to practice their mentorship and leadership in a multicultural world while instilling diversity into the institutional consciousness.

### ***Profiling Metal-Tolerant Bacterial Communities from Two Colorado Metal-Impacted Sites***

Joshua Sackett, Biology, DC - Graduate School

Faculty Sponsor: Dr. Timberley Roane, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

This study analyzed the microbial communities associated with two metal-impacted systems: Standard Mine, a 133-year-old anthropogenically-contaminated site, and the Mt. Emmons fen, an 8,000-year-old endogenously metal-impacted site. Our aim was to determine bacterial community diversity in response to long-term versus short-term metal exposure. We compared the microbial community profiles of each site, and, for both communities and individual isolates, identified the maximum-resistance levels (MRL) to aluminum (Al), cadmium (Cd), and zinc (Zn). Composite sediment samples were collected from both Standard Mine and the Mt. Emmons fen along source-to-outfall transects. Bacterial community profiles were generated using 16S rDNA denaturing gradient gel electrophoresis. Additionally, aliquots from each sediment sample were incubated in media amended with salts of Al, Cd, and Zn to determine the MRL for each site community/isolate. Bacterial community profiles revealed complexity at, and within, each site; with community structure changing along the sampling transects. Based on cultural assays, the community from the Standard Mine showed growth in up to 100 mg/L of Al, Cd, and Zn, while the community from the Mt. Emmons fen was capable of growth in up to 100 mg/L Al, 1 mg/L Cd and 50 mg/L Zn. Isolates showed variable growth responses to each metal. Bacterial community profiles were diverse in each metal-impacted system regardless of the source of metal stress. Further molecular microbiome analyses will potentially identify novel bacterial species, reveal insights into the evolutionary processes associated with bacterial metal resistance, and provide information on new bacterial approaches to metal bioremediation.

***snAPP: Students' Novel Approach to Practice Problems: A Mobile Application Improves Exam Performance among First Year Medical Students***

Emilee Sandsmark, Medicine, AMC - School of Medicine

Monica Davern, AMC - School of Medicine

Faculty Sponsor: Dr. Matthew Taylor, AMC - School of Medicine

*Activity Type:* Graduate Research

Test taking is a well-evidenced, potent learning experience superior to repeated studying and content vocalization (1-4). Technology-based learning platforms offer rapid content delivery and heightened user focus (2-3). While both modalities are hotly researched, little is known about learning efficacy when testing and technology are combined. Students and faculty at the University of Colorado School of Medicine used a mobile application to deploy multiple-choice questions to students. This study provides preliminary implementation results from one, first-year curricular block. Collaborators revised over 3400 student-written study questions. Daily deployment of mobile quizzes and weekly deployment of answer keys was concurrent with course schedules. All content was simultaneously available online for students without a compatible mobile device. Usage, performance and question quality were associated with performance on course examinations. A feedback survey assessed student satisfaction. More than 88% of students utilized mobile or online quizzes (alpha reliability = 0.9, mean question performance = 0.71). Cumulative course performance correlated significantly with number of quizzes completed with the highest quartile of quiz completers performing significantly better than students who completed none (means = 88.75%, 84.80%; SD = 5.67;  $t = 2.36$ ;  $df = 49$ ;  $p = 0.02$ ). Over 48% of students considered continuation of snAPP 'extremely important' to their medical education. Results suggest a meaningful improvement in performance and a high degree of student satisfaction. Further data collection on snAPP quizzes, written exams, MCAT and USMLE scores is underway.

***Leakage in Payment for Ecosystem Services and Fragmentation of the Forests in Mexico***

Kara Silbernagel, MURP, DC - College of Architecture and Planning

Faculty Sponsor: Dr. Rafael Moreno Sanchez, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Payments for Ecosystem Services (PES), also known as payments for environmental services (or benefits), is the practice of offering incentives to farmers or landowners in exchange for managing their land to provide an ecological service. PES are defined as "transparent system(s) for the additional provision of environmental services through conditional payments to voluntary providers' in an effort to promote the conservation of natural resources within the marketplace. Similarly, forest fragmentation is a common concern for both land managers and researchers. There is general agreement that there is a need to quantify the level of fragmentation of the forests and to integrate these estimations into management plans and simulations. This will assist managers and researchers in better understanding the interactions among human activities, forest features, and ecological processes. It is argued that in "leakage" is a direct effect of PES. "Leakage" refers to when efforts utilized to enhance ecosystem services provision in one location leads to increased human and environmental pressures in another area. If leakage risk is expected to be high, the scope of the monitoring and accounting framework for PES may need to be expanded so to detect, and consequently address, leakage. This research will use estimations of the change in the fragmentation of the forests in and around areas that have received PES to evaluate if leakage is occurring in Mexico ecosystem.

## **Graduate Students**

### ***Water Quality in India: Climate Change and Cultural Influences***

Sherry Stout, Civil Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Indrani Pal, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

India is facing a crisis of both water quantity and quality. Many scientists point to a change in global climate as the main cause for the reduced quantity of surface waters.[i] However, the issues impacting water surface quality may stem from more than just climate change. There are a variety of factors influencing surface water degradation in India. Climate change almost certainly plays a role in changes in water quality. For example, reduced precipitation can reduce stream flow volume. This reduced flow can, in turn, concentrate pollutants within the waterway. Also, major flood events are becoming more common. These floods can cause sediment (and therefore pollutant) mobilization into waterways. Other sources of water quality degradation in India are cultural or societal. Unique to India are also mass bathing events where as many as 80 Million people bath in the same river in just a few days. Waste disposal practice often includes throwing waste directly into rivers or other waterways. Many such cultural practices may be a result of a lack of education on pollution issues within the general population. The purpose of this project is to understand both climatic and cultural influences on surface water quality. We will present a review of the current research and research gaps in this area. We propose that both climate change and culture work together in tandem to degrade the surface water quality of India.

### ***Assembly of CBX Family Proteins on Nucleosome During Embryonic Stem (ES) Cells Development Using Single-Molecule Imaging Approach***

Roubina Tatavosian, Chemistry, AMC - Graduate School

Ihssan Tokhi, Biology, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Xiaojun Ren, AMC - Graduate School

*Activity Type:* Graduate Research

The purpose of this research is to identify assembly of the chromobox protein homologue (CBX) on the nucleosome during embryonic development using single molecular imaging technique. CBX family proteins (CBX2, CBX4, CB6, CBX7, CBX8) are part of a large protein complex called polycomb repressive complex 1 (PRC1) which they are involved in cell cycle regulation, cell proliferation, and differentiation of embryonic stem ES cells. However; only CBX2, CBX6, and CBX7 are expressed in embryonic stem cells. Identification of the exact mechanism of assembly of CBX family protein will lead us to understand how PRC1 assembles on nucleosome and eventually these will lead us to determine process of repression of gene transcription during ES development.

***Optimization of Vaccine Supply Chain Infrastructure for Environmental and Public Health Benefits***

Chris Thai, Environmental and Sustainability Engineering, DC - College of Engineering and Applied Science

Joshua Martens, Environmental and Sustainability Engineering, DC - College of Engineering and Applied Science

Bahador Mousavi, Environmental and Sustainability Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Arun Karunanithi, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

The aim of this project is two-fold: to see where we can improve the environmental impacts of vaccination networks in developing countries and to see if we can improve the health effects and penetration of vaccines in a population through life cycle assessment. We will focus our analysis on the cold chain, and even more specifically, on the refrigeration at the distribution level. We plan on setting up an experiment in a foreign, remote locality to test for increased levels of vaccination within a local population.

***Seeking Sustainable Livelihoods and Health in SW Guatemala***

Eryka Thorley, Medical Anthropology, DC - College of Liberal Arts and Sciences

Amy Hale, Public Health, DC - College of Liberal Arts and Sciences

Faculty Sponsors: Dr. Jean Scandlyn, DC - College of Liberal Arts and Sciences

Dr. John Brett, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

The UCD Center for Global Health, the Guatemala-based Bolaños Foundation, and the fruit company, Banasa are collaborating toward improving access to health care and by extension, health in the Trifinio region of SW Guatemala. We report here on research conducted through the UCD international studies course, "Field Experience in Sustainable Development and Health Care in Guatemala". As part of a long-term, multi-disciplinary effort, this project extends the results of a rapid health needs assessment to provide a greater understanding of the social-cultural context of health and environmental conditions in this region. Two faculty and nine students conducted a team-based rapid ethnographic study based out of Chiquirines, a small city in the Trifinio. We interviewed 25+ community members in a variety of formal and informal leadership positions. Transcription and coding using the online program Dedoose allowed the elaboration of key insights and concerns of the population. Using the Sustainable Livelihoods Approach as a framework we have identified the livelihood assets and vulnerabilities central to any development work going forward. We focus on water to understand the intersections of environment and health. The concept of "Capital" (natural, social, human, financial, and physical) allows us to graphically represent the population's concerns and perceptions. A central paradox emerged where water is both a curse and a blessing, essential for agricultural livelihoods and well-being yet the source of illness, loss of property, economic hardship because seasonal flooding and scarcity.

## **Graduate Students**

### ***3D Laser Scanning and Virtual Model Construction***

Shane Transue, Computer Science, DC -  
College of Engineering and Applied Science

Faculty Sponsor: Dr. Min-Hyung Choi, DC -  
College of Engineering and Applied Science

*Activity Type:* Graduate Research

In recent years, the introduction of numerous cost efficient 3D scanning devices has provided a basis upon which the widespread adoption of 3D virtual model construction is flourishing. This vast array of devices has begun to provide the necessary infrastructure required to incite a complete revolution in the storage and transmission of physical media. However, the software that facilitates the process of integrating the scan data provided by these devices into a coherent virtual model has not been effectively developed to target this widespread audience. Utilizing a newly designed laser-based scanning device, our research culminates in the development of a software suite that aims to expand this adoption by simplifying this process. Specifically, we aim to increase this adoption rate by presenting a minimalistic approach to constructing a virtual model, which can be performed by novice users. Our software suite provides the applications required to collect and store scan data from larger exterior environments and allows for the integration of individual scans into a coherent model. In this scope, we present the devices, techniques, and tools required to develop the next generation of physically-based modeling applications. Through the extended developments of this research, our approach can be utilized in numerous applications: volumetric calculations of raw materials, previously unobtainable cross-sectional views of solid objects, and environmental planning. Our research provides the groundwork for the beginning of an era in which physical objects are not only virtually stored, but can easily be transferred and reconstructed through the use of 3D printing technologies.

2013 Research and Creative Activities Symposium

### ***Optimizing Subtractive Protein Immunoprecipitation from Drosophila Melanogaster Embryos for Proteomic Analysis***

Juliana Valera, Biology, DC - College of  
Liberal Arts and Sciences

Faculty Sponsor: Dr. Aaron Johnson, DC -  
College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Recent in vivo studies have uncovered tissue-specific expression and function for proteins and enzymatic RNAs that were previously thought to be essential regulators of RNA processing. For example, the RNA binding protein Hoi Polloi (Hoip) was thought to be a general spliceosome component, however developmental studies in *Drosophila melanogaster* have shown Hoip performs muscle-specific functions. Loss-of-function studies demonstrate Hoip is an essential regulator of myogenesis, however the mechanism by which Hoip directs terminal muscle differentiation is largely unknown. To identify proteins that interact with Hoip during muscle differentiation, we are optimizing a co-immunoprecipitation protocol in developing *Drosophila* embryos. First, we are selecting an appropriate tissue-specific driver for the Hoip-HA transgene. This driver will be to direct robust expression of HA-tagged Hoip protein in developing muscle. Second, we are identifying biochemical reagents that will consistently precipitate Hoip-HA from embryo extracts. Third, we are optimizing total protein detection on polyacrylamide gels using various staining techniques. Once protein visualization has been optimized, the precipitated proteins will be submitted for mass spectrometry to identify the proteins bound to Hoip. Specifically, those proteins that precipitate with the wild type transgene will be compared with proteins that fail to precipitate with the non-functional Hoip mutant (Hoip $\Delta$ -HA). We have selected an optimal tissue specific driver for the Hoip-HA transgene and have successfully precipitated HA-tagged proteins. We expect our mass spectrometry analysis to uncover novel mechanisms that regulate protein expression during muscle development.

***Factors Impacting Scientist Identities of Eighth- to Twelfth-Grade CompuGirls Technology Program Participants: Does Grade Level Play a Role?***

Perna Varma, Educational Psychology  
(Research and Evaluation), DC - School of  
Education and Human Development

Faculty Sponsor: Dr. Shelley Zion, DC - School  
of Education and Human Development

*Activity Type:* Graduate Research

Underrepresentation of students of color in the science, technology, engineering, and mathematics (STEM) fields is a national concern. Research evidence suggests development of a strong scientist identity (SI), i.e., perceptions about self as a scientist, has historically allowed underrepresented students of color to become eligible for and persist in STEM Ph.D. programs and Ph.D.-level careers. Considering this, enrichment and research programs (ERPs) have invested significant efforts to help participants of color develop strong SIs. However, there is little consensus regarding the grade level at which participation in an ERP would help participants of color develop the strongest SIs. This study will use a one group pretest-posttest design to examine whether grade level impacts changes in the strength of SIs of participants of color in an ERP. More specifically, it will compare the strength of SIs of eighth- to twelfth-grade female participants of color ( $n = 23$ ) who have participated in the CompuGirls program, a 250-hour long technology program for girls in under-resourced districts, and determine if females in lower grade levels are associated with larger gains in the strength of SIs than females in higher grade levels. A 5 x 2 repeated measures ANOVA will be conducted to test the following hypotheses: (1) strength of SIs will change significantly during the time eighth- to twelfth-grade female participants of color were in the CompuGirls program, and (2) there is a significant difference among the strength of SIs of eighth- to twelfth-grade female participants of color who were in the CompuGirls program.

***Creating Competencies for Supervisors of Paraprofessionals: Evaluation of Process Merit and Needs***

Perna Varma, Educational Psychology  
(Research and Evaluation), DC - School of  
Education and Human Development

Faculty Sponsor: Dr. Ritu Chopra, DC - School  
of Education and Human Development

*Activity Type:* Graduate Research

In Colorado, Developmental Intervention Assistants, also known as early intervention paraprofessionals, provide developmental intervention services to families, infants and toddlers under the supervision of a qualified and licensed early intervention provider. However, Colorado does not have an established set of required competencies, i.e., essential skills, for the licensed early intervention providers for their role as supervisors. This lack of an established set of required competencies renders it difficult for individuals in the supervising position to fully understand how to effectively manage and direct the work of paraprofessionals, and distinguish between supervisor and paraprofessional roles and responsibilities. To address the lack of competencies, the Paraprofessional Resource and Research (PAR<sup>2</sup>A) Center, in collaboration with the statewide Comprehensive Training Opportunities for Paraprofessionals in Early Intervention Services (CO-TOP\*EIS) coalition, has taken up the task of creating the competencies for supervisors, implementing a process evaluation plan that will help assess the merit of the process by which the coalition creates the competencies, and using the results to directly modify and enhance the process by which the coalition creates the competencies. The process evaluation plan will answer the following two questions: (1) Does the process by which the CO-TOP\*EIS coalition creates competencies result in the establishment of a set of competencies that are research-based and address the seven functions delineated in the PAR<sup>2</sup>A Center Supervision Model (i.e., providing orientation, planning, scheduling, delegating, promoting growth and development, monitoring performance, and managing the workplace), and (2) Can the process by which the competencies are created be improved on?

## **Graduate Students**

### ***Focusing, Stand-Alone Mechanical Solar Concentrator***

Noe Villagrana, Mechanical Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. L. Rafael Sanchez Vega, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

A solar concentrator is under development, which is capable of tracking and focusing the solar rays without electric power support. A counterweighted frame moves a Fresnel lens on a predetermined path such as to track and keep the sun's rays perpendicular to the lens during the brightest hours of the day. The tracking system consists of two degrees of freedom, one of which automatically tracks the sun and a second one that is manually adjusted as needed on a daily or weekly basis. The design requires a good understanding and manipulation of the physics involved. Design for safety is rigorously addressed. The development of this system would provide for a very low cost method for using the sun's energy. Without a need for electric power, the system could be used in remote areas. Some potential applications include (i) energy to work conversion via thermal engines, (ii) drinkable water from distillation of dirty or salty water, (iii) producing water vapor at temperatures adequate for fermentation of other organic processes.

### ***Assessment and Evaluation of Visual Logic Maps for Undergraduate College Chemistry***

Duc Vuluong, Chemistry, DC - College of Liberal Arts and Sciences

Ryan Borman, Chemistry, DC - College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Karen Knaus, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

In this presentation, the assessment and evaluation of the Visual Logic Maps project will be discussed. The Visual Logic Map learning method involves teaching students how to construct concept maps with the use of information categorization and use of a symbolic language. It is hypothesized that use of the Visual Logic Maps learning system improves students' reading comprehension skills which are important higher-order thinking skills. A discussion of assessment instruments and the project evaluation will be discussed in this presentation.

***Neandertal Hunting Behavior: Inferences through the Ecology and Behavior of Red Deer (*Cervus elaphus*), Ibex (*Capra ibex*), and Roe Deer (*Capreolus capreolus*)***

Christopher Wernick, Archaeology, DC -  
College of Liberal Arts and Sciences

Faculty Sponsor: Dr. Julien Riel-Salvatore, DC -  
College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Neandertals are often described as generalized 'top predators'. While they are sometimes described as largely opportunistic hunters, archaeological data clearly indicate that Neandertals were highly competent and methodical at procuring specific animals. This paper employs faunal data from four Mousterian sites in west-central Italy to flesh out the hunting strategies of Neandertals in that region. By focusing specifically on the ecology and behaviors of red deer (*Cervus elaphus*), ibex (*Capra ibex*), and roe deer (*Capreolus capreolus*), this study highlights the behavioral adaptations and hunting techniques Neandertals would have needed to successfully hunt and dispatch these animals. This provides new insights into the sophistication of Neandertal hunting culture. Drawing on the habitat requirements and behavioral patterns of these animals (including fight or flight responses), it becomes possible to develop empirically grounded hypotheses about the complexity of Neandertal decision-making that can be tested against the results of agent-based models and new archaeological data sets.

***North Aurora: A Geographical Analysis***

Dan Wheeler, Landscape Architecture, DC -  
College of Architecture and Planning

Desiree Holtz, MLA, DC - College of  
Architecture and Planning

Faculty Sponsor: Dr. Jody Beck, DC - College  
of Architecture and Planning

*Activity Type:* Graduate Research

This report is the culmination of five weeks of student work for the University of Colorado, Denver College of Architecture and Planning, Landscape Architecture Design Studio II. This studio provides students with their first experience in community engagement and contextual issues during their graduate school experience. The students engaged in researching Aurora, Colorado, particularly the North Aurora Neighborhood to understand the complex relationships between community systems, their interactions, and the cause and effect relationships of existing systems and design. An increased understanding of these relationships is achieved through analysis, planning, and design management, enhancing their stewardship of the natural, built, and social environments. Students utilized Geographic Information System (GIS) to inventory and analyze the physical environment of Aurora including topography, hydrology, and location in Colorado. GIS also aided in investigating demographic data provided by the 2010 United States Census including: population, educational attainment, income, race and ethnicity, and age. This information provided a frame of reference between Denver, Aurora, and North Aurora. The class then collected data on foot within North Aurora for vacancy rates of residential and commercial buildings, access to grocery stores, recreation, and public transportation, potential for urban agriculture, and levels of healthy vegetation. Students then uploaded this information to the database, which will aid city council members in focusing on the next phase of Studio research and generate community centered design opportunities for the City of Aurora.



## **Graduate Students**

### ***Recycled Tires as Coarse Aggregate in Concrete Pavement Mixtures***

Yang Zhou, Civil Engineering, DC - College of Engineering and Applied Science

Zongxi Qian, Civil Engineering, DC - College of Engineering and Applied Science

Faculty Sponsor: Dr. Rui Liu, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

A recent research study completed by the University of Colorado Denver indicates fine aggregates could be replaced up to 50% by the crumb rubber. The concrete mixtures could meet CDOT Class P paving concrete requirements. However it is expensive to replace virgin fine aggregates (\$200/ton) with the well processed crumb rubber (\$300~400/ton). This research examines the reuse potential of tire chips (0.5-1.5 in) as coarse aggregate in paving concrete mixes. The coarse aggregate component within concrete was replaced in 0% (control), 15%, 30% and 50% by volume. Both fresh and hardened concrete properties were examined for each mixture. The fresh concrete properties that are being examined include slump (ASTM C 143), unit weight (ASTM C 138), air content (ASTM C 231), and concrete temperature (ASTM C 1064). Hardened concrete properties tested in this research include compressive strength (ASTM C 39), flexural strength (ASTM C78), splitting tensile strength (ASTM C 496), resistance to freezing and thawing (ASTM C666, Procedure A), and rapid chloride ion penetrability (ASTM C 1202). The preliminary test results indicate that the mixture with 10% tire chips meets the structural requirements of CDOT Class P concrete.

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<b>Xiaojun Ren</b>	<i>Chemistry, College of Liberal Arts and Sciences</i>
<b>Candice Shelby</b>	<i>Philosophy, College of Liberal Arts and Sciences</i>
<b>Surinder Singh</b>	<i>Post-Doctoral Fellow, School of Pharmacy</i>
<b>Mohsen Tadi</b>	<i>Mechanical Engineering, College of Engineering and Applied Sciences</i>
<b>Cheng Yong Tang</b>	<i>Decision Sciences, The Business School</i>
<b>Enrique Torchia</b>	<i>Dermatology, School of Medicine</i>
<b>Travis Vermilye</b>	<i>Visual Arts, College of Arts and Media</i>
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