

# WELCOME

## RESEARCH and CREATIVE ACTIVITIES SYMPOSIUM April 15, 2011

I welcome you to the 14<sup>th</sup> Annual Research and Creative Activities Symposium (RaCAS). This is the third joint RaCAS between the Downtown Denver and Anschutz Medical Campuses, and we are here to celebrate our student's accomplishments. Over 125 students are displaying 80 exhibits at this symposium.

Discovery and creativity in learning is critical for the future of our students at the University of Colorado Denver (UCDenver). The discovery based and creative works on display today are representative examples of the kind of activity we want all UCDenver students to experience. We are also particularly pleased to welcome our Keynote Speaker today – Dr. Bryan Willson, who will share with us his experience in our keynote speech entitled "*Making a Difference: Student Research + Enterprise = Global Impact*".

Many other individuals have demonstrated strong support for this symposium and are with us today, such as Provost Dr. Rod Nairn, and our Chancellor, Jerry Wartgow. 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 of 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.*  
*Professor*  
*Vice Chancellor for Research*  
*University of Colorado Denver | Anschutz*



University of Colorado  
Denver | Anschutz Medical Campus

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## **SPONSORS**

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## JUDGES

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<b>Dan Connors</b>	<i>Electrical Engineering, College of Liberal Arts and Sciences</i>
<b>Laura Cuetara</b>	<i>Theater, Film &amp; Video Production, College of Liberal Arts and Sciences</i>
<b>Colleen Donnelly</b>	<i>English, College of Liberal Arts and Sciences</i>
<b>Mark Douse</b>	<i>IACUC Director, School of Medicine</i>
<b>Douglas Dyckes</b>	<i>Chemistry, College of Liberal Arts and Sciences</i>
<b>Michelle Engel</b>	<i>Biology, College of Liberal Arts and Sciences</i>
<b>Jana Everett</b>	<i>Political Science, College of Liberal Arts and Sciences</i>
<b>John Freed</b>	<i>Integrative Biology, College of Liberal Arts and Sciences</i>
<b>Karen Gieseke</b>	<i>Public Health and Epidemiology, School of Medicine</i>
<b>Jim Hageman</b>	<i>Research Administration</i>
<b>Ju He</b>	<i>Pharmacology, School of Medicine</i>
<b>Jeffrey Hebert</b>	<i>Physical Medicine &amp; Rehabilitation, School of Medicine</i>
<b>Cathy Jaynes</b>	<i>Nursing, College of Nursing</i>
<b>Karen Jonscher</b>	<i>Anesthesiology, School of Medicine</i>
<b>Donna Langston</b>	<i>Ethnic Studies, College of Liberal Arts and Sciences</i>
<b>John Lanning</b>	<i>Undergraduate Experiences, Chemistry, College of Liberal Arts and Sciences</i>

## **Judges** (continued)

<b>Shi-Long Lu</b>	<i>Otolaryngology, School of Medicine</i>
<b>Ann Martin</b>	<i>Accounting, Business School</i>
<b>Raphael Moreno</b>	<i>Geography &amp; Environmental Sciences, College of Liberal Arts and Sciences</i>
<b>Suzanne Osoriolujan</b>	<i>Veterinary Medicine, Children's Hospital</i>
<b>Kimberley Regier</b>	<i>Integrative Biology, College of Liberal Arts and Sciences</i>
<b>Timberley Roane</b>	<i>Integrative Biology, College of Liberal Arts and Sciences</i>
<b>Candice Shelby</b>	<i>Philosophy, College of Liberal Arts and Sciences</i>
<b>Barry Shur</b>	<i>Dean, Graduate School</i>
<b>Ellen Stevens</b>	<i>Faculty Services Center</i>
<b>Martin Stonehouse</b>	<i>Asst. Biosafety Officer, Environmental Health Sciences</i>
<b>Moshen Tadi</b>	<i>Mechanical Engineering, College of Liberal Arts and Sciences</i>
<b>Enrique Torchia</b>	<i>Dermatology, School of Medicine</i>
<b>Travis Vermilye</b>	<i>Medical Illustration, Visual Arts</i>
<b>Tarik Walker</b>	<i>Family Medicine, CREATE Health Scholars Assoc.</i>
<b>Min Wang</b>	<i>Chemistry, College of Liberal Arts and Sciences</i>
<b>Lora Wilson</b>	<i>Cardiology/Pulmonary, University of Colorado Denver Health Sciences</i>



**WELCOME TO THE 2011  
UNIVERSITY OF COLORADO DENVER  
RESEARCH AND CREATIVE ACTIVITIES SYMPOSIUM**

**Friday, April 15, 2011      North Classroom Atrium  
Downtown Campus**

**8:30am – 10:30am:      Judging for Chancellor’s Awards**

**10:45am – 12:45pm:      GENERAL SESSION – North Classroom 1130**

10:45am - 10:55am      **OPENING REMARKS:** Provost Rod Nairn

10:55am – 11:00am      **Keynote Address Introduction**  
Richard J. Traystman, PhD, Vice Chancellor for Research

11:00am – 11:30am      **KEYNOTE ADDRESS:**  
**Speaker:** Dr. Bryan Willson  
*“Making a Difference: Student Research + Enterprise = Global Impact”*

**11:45am – 12:45pm:      STUDENT PRESENTATIONS**  
**Outstanding Research and Creative Activity Award Winners**  
**Introduction:** Jim Hageman, P.D., Assoc. Vice Chancellor for Research

11:45am – 12:00pm      Ingrid Ludeke: Archaeology, College of Liberal Arts and Sciences  
*“Contrasting Neanderthal and Homo sapiens use of space at Riparo Bombrini, Italy”*

12:00pm – 12:15pm      Mia Smith: Pre-Veterinary, College of Liberal Arts and Sciences  
*“Quantum Effect Can be Important to Chloride Ion Channel/Transporter Mechanism: A Computational Study”*

12:15pm – 12:30pm      Sarah Brannnon: Health and Behavioral Science, College of Liberal Arts and Sciences  
*“A Weighty Matter: Do health behaviors affect the neurocognitive health of obese adults?”*

12:30pm – 12:45pm      Manuchehr Aminian: Mathematics, College of Liberal Arts and Sciences  
*“Algorithms for Generalized Image Segmentation”*

**1:00pm – 3:00pm:      STUDENT EXHIBITS – North Classroom Atrium**  
Students will present their research and creative projects in an informal setting  
Lunch will be served

**3:00pm – 4:00pm:      AWARDS CEREMONY – North Classroom 1130**

- Dr. Jerry Wartgow, Chancellor, presenting the RaCAS Chancellor’s Awards
- Dr. Jim Hageman, Assoc. Vice Chancellor for Research, presenting the Award for Outstanding Student Mentor
- Jim Hageman, Assoc. Vice Chancellor for Research, presenting the Outstanding Research and Creative Activities Awards
- Dr. John Lanning, Asst. Vice Chancellor, Undergraduate Experiences, UROP Chair, presenting the UROP Awards
- Dr. Sonia C. Flores, Labcoats Program Director, presenting the Labcoats Award

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## Graduate Students

### **Lipid Activation of Src During Xenopus Fertilization**

**Ryan Bates**, Biology, DC - Graduate School

**Colbey Fees**, Biology, DC – Graduate School

**Faculty Sponsor:** Dr. Brad Stith, Biology, DC – Graduate School

*Activity Type:* Graduate Research

Fertilization involves membrane fusion events and production and hydrolysis of phospholipids. Our prior work shows an increase in choline and 1,2-DAG during fertilization, suggests that PLD production of PA plays a role in fertilization. PA may play a role in sperm-egg merger, the subsequent DAG increase and release of calcium. PA may activate Src, which in turn activates PLC $\beta$ , which increases IP3 and intracellular calcium to induce fertilization. Using HPLC and ELS mass detection, PA mass increased early after insemination and addition of synthetic PA to oocytes or eggs induced calcium-dependent fertilization events, Src and PLC $\beta$  activation, raised IP3 mass to levels achieved by sperm. Control anionic lipids had no effect. PA action was inhibited by IP3 receptor blocker 2-APB, a PLC inhibitor, or 6 different tyrosine kinase inhibitors. PA specifically bound Xenopus Src but not PLC $\beta$ . As compared with other lipids (e.g., PIP2, PI4P, and 12 other major phospholipids), Src binding to PA showed the lowest Kd. Other anionic lipids PS or LPA did not stimulate or bind to Xenopus Src or PLC $\beta$ . 1-butanol treatment of eggs inhibited the PA increase at fertilization and blocked fertilization events whereas 2-butanol (which is unable to inhibit phospholipase D) did not. FIPI, a potent and specific inhibitor of phospholipase D, did not prevent sperm activation or transient binding to the egg (with a localized calcium release) but inhibited Src activation, induction of the fertilization calcium wave and subsequent fertilization events (see videos using Fluo-4/Calcium Green 2 as an intracellular calcium sensor).

### **An alpine treeline ecosystem response to the decline of a keystone conifer, Pinus albicaulis**

**Sarah Blakeslee**, Biology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Graduate Research

Whitebark pine (*Pinus albicaulis*) is an upper subalpine and treeline conifer in decline as a result of several factors: mountain pine beetle, fire suppression, and the introduced fungal pathogen white pine blister rust (*Cronartium ribicola*). East of the Rocky Mountain Continental Divide in the alpine treeline ecotone (ATE), whitebark pine holds keystone and foundational roles by establishing first and providing microsites in which less hardy, wind dispersed conifers can germinate. This process facilitates tree island development. Global climate change is predicted to cause an upward elevational shift of treeline. Loss of ATE whitebark pine due to blister rust could prevent treeline from responding to warming temperatures in an appropriate and timely manner. The goal of this study is to determine both the functional role whitebark plays in facilitating tree island development and how the mortality of whitebark pine from blister rust may affect ecosystem functions. First, microclimate leeward of whitebark pine will be compared to other common ATE microsites to determine if whitebark microsites provide more moderate conditions to developing conifers. Then seeds and seedlings of wind dispersed conifers will be planted leeward of whitebark pine and other common ATE microsites to determine if whitebark microsites are associated with a greater germination and survival rates. Growth parameters of solitary small trees of whitebark and the other two prevalent treeline species will be compared. Lastly, blister rust will be simulated on whitebark pine at the windward position of established tree islands and vigor and growth of leeward conifers will be measured.

## **A Weighty Matter: Do health behaviors affect the neurocognitive health of obese adults?**

**Sarah Brannon**, Health and Behavioral Science, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Mary Coussons-Read, Psychology, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

### **2011 Outstanding RaCAS Award Winner**

Growing evidence suggests that obesity may increase risk of cognitive decline and Alzheimer's disease. It is also known that neurocognitive health is affected by insulin sensitivity, hypothalamic-pituitary adrenal (HPA) axis function, inflammation and neurotrophins, each of which is dysregulated in obesity. These factors are influenced by diet, physical activity and stress. We investigated the hypothesis that behavioral factors modulate adult neurocognitive function and these potential physiological mechanisms. Study 1 used cross-sectional data collected from 5138 adults aged 20-59 years as part of the Third National Health And Nutrition Examination Survey (NHANES-III) to determine whether a) adiposity and cognitive function is linked in adults, b) the association interacts with diet, physical activity and social support and c) there are differences in potential physiological mediators. Early results of regression analyses are discussed in light of clinical significance. Study 2 investigated in humans the effects of a dietary intervention shown to improve neurocognitive health in animals. Twenty-five obese adults were randomized to 8 weeks of either a standard calorically restricted diet (-400kcal) or Intermittent Fasting (IF), in which participants ate ad libitum one day but fasted completely the next. At baseline, week 1 and week 8 in-patient visits, we measured cognitive performance, adiposity, insulin sensitivity, inflammatory markers, neurotrophin (BDNF), and salivary cortisol. We hypothesize that the IF diet provides a mild metabolic stress that may improve HPA axis and other physiological functions related to neurocognitive health. Evidence of mechanisms and protective factors may provide valuable opportunities for prevention of cognitive decline.

## **Cynomys says: Characteristics of Black-tailed Prairie Dog (Cynomys ludovicianus) Alarm Calls in Response to Simulated Predator Stimuli**

**Rebecca Bryan**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Mike Wunder - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

We presented four different simulated predators as potential threats to a colony of black-tailed prairie dogs (*Cynomys ludovicianus*) in Boulder County, Colorado and recorded the subsequent vocalized alarm calls for comparison. Here, we describe the characteristics of prairie dog vocalizations in response to those four potential threats, including a simulated snake, a simulated owl, a domestic dog, and a human on foot. For each trial, we analyzed various characteristics of the sonogram for the first distinct bark in response to the stimulus. These characteristics included the duration of the bark (time in seconds), the central, low, and high frequencies (Hz) of the vocalization, the first and third quartile frequencies (Hz), the total energy in each vocalization (db), and the average power of the vocalization. These structural characteristics of the alarm calls were distinct for each stimulus type, and suggested that prairie dogs perceived the simulated snake as a more imminent, localized and urgent threat than the other potential predators.

## Graduate Students

### **Protein Membrane Interactions of C2 Domains Involved in Insulin Secretion**

**Kan Chantranuvatana**, Chemistry, DC - Graduate School

**Matthew Coffman**, Biology, DC - College of Liberal Arts and Sciences

**Tatyana Liakhova**, Chemistry/Biology, DC - College of Liberal Arts and Sciences

**Devin Brandt**

**Faculty Sponsor:** Dr. Jefferson Knight, Chemistry, College of Arts and Sciences

*Activity Type:* Graduate Research

Membrane-targeting proteins are important components of many cell signaling pathways. These pathways include exocytosis, the process by which biological substances such as hormones are secreted out of cells. For example, many membrane-targeting proteins are involved in the regulation of insulin secretion, which is centrally important for proper glucose metabolism throughout the body. Membrane-targeting proteins essential for insulin exocytosis include synaptotagmin (SYT) 7, SYT 9, and granuphilin. These proteins play important roles in the docking of vesicles to the plasma membrane (granuphilin) and/or calcium-mediated secretory vesicle fusion (SYT 7 and SYT 9). Thus, it is fundamental to understand how these proteins interact with membranes in order to understand how insulin exits the cell. The listed proteins contain two conserved membrane-targeting C2 domains, termed C2A and C2B, that are highly homologous to the well-studied C2A and C2B domains of SYT 1. While SYT 1 is known to be responsible for extremely fast exocytosis in neurons, it is SYT 7, SYT 9, and granuphilin that likely play analogous roles in the somewhat slower process of insulin secretion. The Knight lab seeks to characterize these C2 domain-membrane interactions kinetically and thermodynamically using fluorescence spectroscopy and microscopy methods. The preliminary data displayed here indicate that there are significant differences in membrane binding properties between these proteins and their neuronal counterpart SYT 1. Overall, these studies will shed light on important molecular interactions in insulin secretion that so far are incompletely understood.

### **Luminol Chemiluminescent Detection of Nitrogen Dioxide in Air**

**Katie Cofrin**, Chemistry, DC - College of Liberal Arts and Sciences

**Faculty Sponsor,** Dr. Larry Anderson, , Chemistry, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

Nitrogen dioxide is of interest to atmospheric scientists because it is found in ambient air as a result of industrial and vehicular combustion processes. Nationally, about 58% of nitrogen dioxide emissions come from on- and off-road vehicles. The health effects associated with elevated exposure to nitrogen dioxide include minor respiratory distress. Other negative effects reported are degradation of vegetation and clothing. Denver's visibility problems stem from nitrate aerosols, which also contribute to acid rain and successively, damage to plant life as the nitric acid falls to the ground via wet deposition. There are several published methods in which NO<sub>2</sub> can be measured. Many of these techniques involve converting NO<sub>2</sub> to NO, which is what is actually measured, rather than directly measuring NO<sub>2</sub>. Some of these conversion techniques will convert other nitrogen containing compounds to NO, not just NO<sub>2</sub>, which is a problem because the signal is not representative of the concentration of nitrogen dioxide, but a mixture of compounds. The technique of reacting NO<sub>2</sub> with luminol has been used because of its specificity for NO<sub>2</sub>, and its sensitivity. This method involves reacting NO<sub>2</sub> with a solution containing luminol (5-amino-2,3-dihydro-1,4-phthalazine dione) which produces a chemiluminescence. Ambient air samples enter the back of the instrument and then proceed through a luminol chamber. Any NO<sub>2</sub> in the air will react with the luminol in this chamber and produce light. The chemiluminescence is detected by the analyzer, which generates a signal that is proportional to the mixing ratio of NO<sub>2</sub> in the sample air.

## Potential Mechanism for Inteferon-beta Induced Interferon Gamma Receptor Downregulation

**Christine Delgado**, Immunology, AMC - Graduate School

**Faculty Sponsor**, Dr. Laura Lenz, Immunology, AMC - Graduate School

*Activity Type*: Graduate Research

Immune cells communicate with one another by secreting and detecting cytokines, chemokines and other proteins. Interferon gamma (IFN-g) and Interferon-beta (IFN-b) are two potent cytokines that produce distinct responses and, in some cases, counteract one another. Dysfunctional or insufficient production of these cytokines can result in an immunocompromised state, or can contribute to inflammatory autoimmune diseases such as Multiple Sclerosis (MS) and Lupus. The amount of Interferon gamma receptor (IFNGR) on the cell surface directly correlates with the response induced. Recent studies from our lab have demonstrated that exogenous IFN-b treatment induces downregulation of IFNGR surface expression on macrophages and other antigen presenting cells. Currently it is unclear how IFN-b causes a decrease in IFNGR. Therefore, this study focuses on identifying key players in this phenomenon. Recently we found that pharmacological inhibition of the serine threonine kinase, casein kinase II (CK2), prevents IFN-b induced IFNGR downregulation. Treatment with either of two CK2 inhibitors prevented IFNGR downregulation by IFN-b. However, neither inhibitor blocked transcription from STAT1 and STAT2 dependent Interferon Sequence Response Elements (ISRE), or Gamma Activated Sequences (GAS). These data suggest that IFN-b downregulated IFNGR expression via CK2 and independent of STAT1 or 2. Consistent with this model, STAT1-/- macrophages and macrophages with ShRNA knock down of STAT2 both downregulated IFNGR expression in response to IFN-b. Moreover, CK2 alpha or alpha prime subunit knock down greatly diminished the amount of IFNGR downregulation. These results suggest a novel mechanism of suppressive IFN-ab signaling with relevance to infectious and autoimmune diseases.

## Using tissue isotope values ( $\delta^{13}C$ and $\delta^{15}N$ ) to characterize a population level diet transition and to estimate arrival times of dunlin

**Andrew Doll**, Integrative Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor**: Dr. Michael Wunder, Integrative Biology, DC - College of Liberal Arts and Sciences

*Activity Type*: Graduate Research

The use of stable isotope analysis in ecological studies has increased dramatically in the last three decades. Originally used to study geochemical cycles, biologists and ecologists have begun to utilize stable isotopes to provide insight into phenomena that cannot otherwise be observed due to issues of scale and general logistical impediments. The intent of this study is to refine methods for using stable isotope ratios to investigate issues of migration and resource use. By collecting blood samples from dunlin (*Calidris alpina arctica*) in their Alaskan breeding grounds I am able to characterize the transition of isotope ratios of carbon and nitrogen as this species incorporates local resources into their tissues. This species forages in coastal environments while migrating from Southeast Asia then shifts to a terrestrial environment while nesting on the Arctic tundra. These two environments are isotopically distinct and as dunlin consume prey they proportionally incorporate these isotopes into their tissues. By accurately characterizing the turnover rate as dunlin transition between distinct diets, I can use the isotope values from individual birds to estimate the time of arrival to the terrestrial environment. Developing a reliable method for doing so provides a useful tool for ecological research and wildlife management. Such techniques present useful insight into aspects of animal life histories that are otherwise unobservable. This method can be used in developing conservation strategies as well as for tracking changes in migration times that may be impacted by global climate change.

## Graduate Students

### **Measurement of pediatric lung airway morphology using CT scans**

**Stephen Humphries**, Bioengineering, DC - College of Engineering and Applied Science

**Faculty Sponsor:** Dr. Robin Shandas, Bioengineering, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Quantitative analysis of airway morphology may yield meaningful information about lung health in pediatric patients. Studies indicate features like lumen wall thickness and cross-sectional area correlate with some measures of pulmonary function. Other features, such as airway angle, have not been studied extensively but may reflect airway function. Computed tomography (CT) scans are acquired routinely during diagnosis and treatment of some pulmonary diseases in children. However, manual direct measurement of morphology requires advanced, often cumbersome, software and is not generally performed in the clinical setting. There is very little published data on typical values of airway measures. The intent of this project is to develop and validate software tools for efficient quantitative analysis of airways in CT scans. The software will be used on a data series that includes scans of disease-control children and those with confirmed cystic fibrosis. Morphologic analysis is performed with a series of image processing steps including segmentation and skeletonization. Segmentation is the process of delineating the boundaries of airway structures in the scans. The current approach uses a level set algorithm which models segmentation surfaces as evolving wave fronts and is particularly well suited to structures with bifurcations. Skeletonization is performed using a fast-marching algorithm and reduces segmented objects to line primitives which enables calculation of airway centerlines, bifurcation points and perpendicular planes. Initial efforts implemented using MATLAB are under evaluation by clinicians with the eventual goal of an open source tool to be shared with other researchers.

### **The Encoding of The Acoustical Cues to Sound Location by Neurons in The Inferior Colliculus as A Function of Source Distance using Virtual Space Stimulation**

**Heath Jones**, Neuroscience, AMC - Graduate School

**Faculty Sponsor:** Dr. Daniel J. Tollin, Physiology, AMC – Graduate School

*Activity Type:* Graduate Research

Our ability to localize sound sources arises from the integration of three main acoustical cues. For localizing source along the horizontal plane, the difference in the arrival between the two ears (interaural time difference or ITD) and the difference in the sound pressure level (SPL, i.e. the intensity) between the two ears (interaural level difference ILD) are the main cues to source location. These cues are encoded and processed separately in many areas of the ascending auditory pathway; however one area, the Inferior Colliculus (IC), is a major relay station of all ascending auditory information, and as such, is an optimal site for examinations of acoustical cue processing. This study in particular sets out to address a frequently overlooked dimension of spatial hearing (distance) and the encoding of ILDs with regards to this dimension. Although the auditory system has the capacity to determine sound location in 3-dimensions - azimuth, elevation and distance - most neurophysiological studies have examined only the neural encoding of the localization cues themselves or have used free-field or virtual space (VS) techniques to measure neural spatial receptive fields (SRFs) for sources at a fixed distance. This study is the first to look at the response rates of single units within the IC to presentations of sound sources along the horizontal plane at various distances. In general the results show that ILD-sensitive IC neurons can encode source azimuth over a range of physiologically-plausible source distances, but that the neural representation of azimuth is not invariant with distance.

## **The Eroticization of Service Work and the Struggle for Power**

**Brandon Kilgore**, Sociology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Candan Duran-Aydintug, Sociology, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

In this research I seek to understand how power is distributed in eroticizing service work jobs, both in regards of how it compares to their conventional counterpart occupations, but also to see how erotic service workers compare to one another on an individual level in regards to what they do. In this phenomenological qualitative study I explore how erotic service workers experience the potential empowering and disempowering aspects of their work. This will be done by performing in-depth interviews about erotic service workers's interactions with clients and their thoughts and feelings about the demands of the occupation. I seek to learn what erotic service workers find comforting and alienating in the work they do.

## **Contrasting Neanderthal and Homo sapiens use of space at Riparo Bombrini, Italy**

**Ingrid Ludeke**, Archaeology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Graduate Research

### **2011 Outstanding RaCAS Award Winner**

One of the recurrent claims about how the archaeological record of behaviorally modern Homo sapiens differs from that of Neanderthals concerns the use of space within the sites they occupied: Modern human sites are often claimed to show patterned use of space and the separation of activity areas, whereas Neanderthal sites are usually argued to lack this separation. While the use of space has been investigated in sites associated with Neanderthals or modern humans, it has rarely been studied at sites containing occupations by both groups of hominins. The site of Riparo Bombrini, a collapsed rock shelter in Liguria, Italy, offers a high-resolution spatial dataset accumulated sequentially over the course of the Middle-to-Upper-Paleolithic transition, with only a few hundred years separating Neanderthal and early European Homo sapiens occupations. It thus offers a rare opportunity to compare Neanderthal and Homo sapiens behavioral patterns in the same spatial context. We present an analysis of the spatial distribution of various classes of piece-plotted archaeological finds, including hearths, chipped stone, animal bone, shell, and ochre, in both Mousterian and proto-Aurignacian deposits at the site. While there is spatial variability within both periods potentially related to site-use patterns only the Aurignacian levels show patterns of artifact distribution that can be interpreted as indicating different activity areas. We conclude by discussing some of the implications of our findings for the Middle-to-Upper-Paleolithic transition on the Mediterranean coast.

## Graduate Students

### **Ganado Blessing**

**Paula Marchionda**, MPH, AMC - Colorado School of Public Health

**Faculty Sponsor:** Dr. Carolyn DiGuseppi, Preventive Medicine/Epidemiology, AMC - Colorado School of Public Health

*Activity Type:* Creative Activity

Ganado Blessing is the culmination of different experiences in my life. For nearly 20 years I have lived in the Southwest US and been exposed to many different Native American cultures. While on, and near, the Navajo reservation I developed a love for their weavings. A Navajo rug's origin can be determined by its pattern and colors, as each area uses specific motifs and colors from their local environment. I was struck by the intense black, red, and white so prominent in the weavings from Ganado, and the feather motifs present in the textiles of many areas. My Navajo, or Diné, friends explained to me that the feather motif represents the "blessing way". The notion of the blessing way can be translated several ways. It often connotes good health, good luck, and good hope. Singing of a blessing way chant may be done just prior to the birth of a new life, or for a young man heading to war, whenever a blessing is bestowed. For this piece I combined these colors and motifs with the technique of fused glass. Different colors of sheet glass were cut, layered and fused to create the desired pattern. I chose the red star-like center to symbolize the heart, and surrounded that with the feather motif extending to the four corners. Thus, from the heart comes the blessing way. This represents the essence of healing I try to practice as a physician.

### **Quantifying the Morphology of Colloid Deposition in Granular Media Using Fractal Dimension**

**Michael Mont-Eton**, Civil Engineering  
College: DC - College of Engineering and Applied Science

**Faculty Sponsor,** Dr. David Mays, Civil Engineering  
College: DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

In order to clean contaminated water, a sand filter bed is sometimes used to trap small particles. As the bed becomes clogged, the hydraulic conductivity of the bed decreases and the head drop per length of travel increases. By finding the fractal dimension of the clogging and comparing it to the changing head drop, a method can be devised to accurately measure the effectiveness of a pollutant filter. This study uses a glass cylinder to hold a clear filter material (Nafion), with a fluid containing nanoparticles flowing at a constant speed through it from the top down. The nanoparticles clog the spaces between the grains of Nafion, and the head drop is measured across two points in the cell, while a laser sends light through the cell. Scattered light from the laser is measured for intensity by a detector like the one in a digital camera. By plotting the intensity versus the angle a line is formed, which defines the fractal dimension of the clusters of nanoparticles. As the amount of clogging reaches a limit, along with the morphology of the nanoparticle deposits (measured as a fractal dimension), a basis is made for knowing when the contaminant-removing filter needs to be cleaned or replaced. Other researchers have used a test tube with particles in it to measure the fractal dimension statically, but this is the first time that these observations are being made while the water is running.

## **The Effect of Increased Bicyclist Volumes on Individualized Bicyclist Risk**

**Krista Nordback**, Civil Engineering, DDC – College of Engineering and Applied Sciences

**Faculty Sponsor:** Dr. Wesley Marshall, Civil Engineering, DDC – College of Engineering and Applied Sciences

*Activity Type:* Graduate Research

Little is known about the relationship between the number of bicyclists on a roadway and the number of crashes involving bicyclists. However, studies from Europe have found that with increased ridership comes increased safety in the form of a reduction in the number of crashes per cyclist. Our study examines whether these trends can also be found in the U.S. and to what extent does this hypothesis hold. We conducted this research in Boulder, Colorado using average cyclists per peak hour based on manual bicycle counts on corridors with both high and low bicycle traffic and related that to five years of bicycle-related crash data. The data suggests that while bicycle crashes do typically increase with motor-vehicle volumes and bicycle volumes, crashes per bicyclist decrease with bicycle volume. In other words, more bicyclists on the road can help reduce the crash risk of each bicyclist.

## **Testing Inductive-loop Bicycle Counters on Shared Roadways**

**Krista Nordback**, Civil Engineering, DC – College of Engineering and Applied Sciences

**Faculty Sponsor:** Dr. Bruce Janson, Civil Engineering, DDC – College of Engineering and Applied Sciences

*Activity Type:* Graduate Research

Inductive loops are commonly used for bicycle detection both on- and off- street, but until recently, few such detectors are able to differentiate between bicycles and motor vehicles. For this reason, automated bicycle counting is usually confined to off-street locations. With bicycle use increasing around the nation, particularly on shared roadway facilities such as bicycle boulevards, there is a growing need to detect bicycles in on-street traffic conditions. This study tests the accuracy of an off-the-shelf inductive-loop technology that is designed to count bicycles in mixed traffic, and compares this accuracy to that of similar inductive loop technology for detection on separated bicycle facilities. The results show that inductive loop technology is capable of differentiating bicycles from motor vehicles and does count bicycles in traffic with reasonable accuracy, but an individual bicycle may be undetected or counted more than once. Overall, there was a 3% undercount for the counter on the separated path and a 4% overcount for the counter on the shared roadway. The results show that refinements in inductive loop detector/counter software and set up have made it possible to distinguish bicycles from motor vehicles; however, care must be taken in installation, calibration, and maintenance to ensure that the counters are and continue to be accurate.

## Graduate Students

### Smooth Muscle-Macrophage Cross-Talk in Restenosis

**Allison Ostriker**, Pharmacology, AMC – Graduate School

**Faculty Sponsor:** Dr. Raphael Nemenoff, Renal, AMC – School of Medicine

*Activity Type:* Graduate Research

Blockage of arteries is a burgeoning problem which is largely characterized by the proliferation and migration of vascular smooth muscle cells (SMCs) from the medial wall to form an intimal lesion. Angioplasty with stenting, a procedure where this plaque is removed and the artery held open with a stent, as well as bypass grafting procedures have greatly increased survival in patients with these arterial blockages. However, a persistent problem with this approach is the recurrent blockage of these cleared arteries due to renewed proliferation of SMCs is a process called restenosis. As these cells grow they eventually occlude the lumen of the artery and prevent blood flow. Our laboratory focuses on understanding the mechanisms mediating SMC proliferation after angioplasty-induced injury with the goal of defining new therapeutic strategies. It is clear that both innate and adaptive immune cells interact with SMC and contribute to restenosis. My studies are focused on the role of macrophages in this process, and defining cross-talk between these cells and SMC. Using co-cultures in which SMC and bone marrow-derived macrophages can interact, I have shown that macrophages are able to increase proliferation of SMCs, and induce secretion of pro-inflammatory cytokines and chemokines from SMCs. Furthermore, macrophages show enhanced adherence to activated SMCs compared to controls. These findings suggest that the interaction of macrophages with SMCs may be a critical step in restenosis. Future studies will focus on identifying how this interaction can be disrupted in order to develop new therapies for treating this disease.

### Measurement of Ca<sup>2+</sup> Kinetics and Localization in Olfactory Sensory Neurons

**Baris Ozbay**, Bioengineering, DC - College of Engineering and Applied Science

**Faculty Sponsor**, Emily Gibson, Bioengineering, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Olfactory sensory neurons (OSN) take advantage of a signaling cascade on their cilia that uses Ca<sup>2+</sup> as a secondary messenger. It has been shown that Ca<sup>2+</sup> is organized into spatially localized microdomains, but the kinetics and spatial Ca<sup>2+</sup> distribution are less well understood. The localization of Ca<sup>2+</sup> would limit the distribution of Ca<sup>2+</sup> activated membrane proteins to these discrete domains. Furthermore, the organization of chemotransduction proteins along the ciliary membrane is important in understanding the process of vertebrate olfactory transduction. Analytical and numerical computational methods are used to approximate the system of buffer reactions and diffusion mechanics within the geometries of the cilia. Using specialized optical techniques, the kinetics and diffusion characteristics of Ca<sup>2+</sup> can be measured within the OSN cilium. Additionally, STED microscopy, which is a super resolution optical technique, can be used to measure the spatial distribution of these microdomains, which has not been accomplished with diffraction limited optical techniques. These results can then be correlated with the computational results to verify the mechanics of the Ca<sup>2+</sup> distribution.

## Measurement of Posthilar Stress-Strain Curves through Pressure Diameter Studies in Healthy and Hypertensive Calf Pulmonary Arteries

**Mark Reusser**, BioEngineering, DC - College of Engineering and Applied Science

**Faculty Sponsor:** Dr. Kendall Hunter, BioEngineering, DC - College of Engineering and Applied Science

*Activity Type:* Graduate Research

Pulmonary hypertension (PH), defined as a mean pulmonary arterial pressure above 25mmHg, leads to increased loading on the right ventricle of the heart, high rates of morbidity and death. Because the pathophysiology and progression of the disease are not well understood, prognosis, diagnosis and treatments are very limited, focusing primarily on changes at the level of very small (peripheral) resistance vessels. Recent studies have shown that measurements of large artery capacitance provide better prognosis and diagnosis than tests of resistance alone. Decreased arterial capacitance increases the load to the heart, and is the direct result of increased stiffness and elastic modulus of the arterial wall. Here we determine stiffness throughout the larger arteries of the lung with measured pressure-diameter curves of excised, posthilar pulmonary arteries. The arteries are from healthy and hypertensive calves, chosen for their physiological similarity to humans. From the measured curves, elastic modulus and stiffness can then be determined using a thick-walled tube approximation. This study will improve the pathophysiological understanding of capacitance changes in pulmonary hypertension by quantifying the mechanical changes of the arteries as a function of disease and artery diameter, improving the prognostic and diagnostic utility of capacitance studies. Furthermore, by more closely modeling the in-vivo state than prior mechanical tests, this study will provide validation of in-vivo pressure diameter studies in the diagnosis of pulmonary hypertension. Finally, comparisons between pressure diameter results and tensile strain test results will validate this testing methodology to measure smaller arteries than have previously been tested.

## Determining Clark's Nutcracker Use of Whitebark Pine Communities in the Waterton-Glacier International Peace Park

**Jennifer Scott**, Biology, College: DC - College of Liberal Arts and Sciences

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

*Activity Type:* Graduate Research

With the decline of whitebark pine (*Pinus albicaulis*) in the Crown of the Continent Ecosystem, primarily from infection by white pine blister rust (caused by the exotic fungus *Cronartium ribicola*), seed dispersal by the Clark's Nutcracker (*Nucifraga columbiana*) may also diminish. Nutcrackers are the main seed dispersers for whitebark pine and are thus primarily responsible for whitebark pine regeneration through their seed caching behavior. We are asking whether stands of whitebark pine within five study areas in the Waterton-Glacier International Peace Park are visited by Clark's Nutcrackers. Our objectives are to determine 1) health status and cone production in whitebark pine, and 2) the density of nutcrackers and cones in whitebark pine in our study areas. In 2009 we selected five whitebark pine study areas in Glacier National Park and Waterton Lakes National Park. Within each study area we set up 1 to 3 transects ranging from 0.5 to 1.0 km in length for the purpose of using distance sampling to determine nutcracker densities. For each transect, we established two 50 x10 m plots to determine whitebark pine health status and cone production. We found a blister rust infection rate of 72% to 97% across study areas, with no sign of recent pine beetle infestation. Only 2 out of 93 live trees within our 20 health plots were cone bearing, producing a total of 11 cones. Additionally, in 2010, distance sampling was used to determine cone density and the results were compared to nutcracker densities.

## Graduate Students

### **Refinement of odorant molecule information: Interglomerular neural networks**

**Kyle Sorensen**, Integrative Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Lisa Johansen, Integrative Biology, DC - College of Liberal Arts and Sciences

*Activity Type:* Graduate Research

The sense of smell (olfaction) is one of the most mysterious and fascinating aspects of sensory physiology. Odors have the haunting ability to strongly remind us of vague and distant memories. The olfactory system is activated when an odorant molecule binds to an odorant receptor (OR) located within the nasal cavity. ORs can bind to many different types of odorant molecules that have similar molecular structure. The olfactory system must therefore accommodate for the limited specificity of ORs in order to make odors more distinct. Lateral inhibition is a process which helps make odors more distinct whereby a more strongly activated cell can inhibit a weakly activated cell. Previous models of this phenomenon fail to accommodate experimental data which suggest that lateral inhibition is mediated by neurons within the glomerular layer of the olfactory bulb. We hypothesize that lateral inhibition is mediated by short axon (SA) cells within the glomerular layer of the olfactory bulb. There still remains a question of whether SA cells are excitatory (glutamatergic) or inhibitory (GABAergic). Venus/vesicular GABA transporter (Vgat) transgenic rats have been shown to express green fluorescent protein (GFP) in GABAergic neurons and are therefore a valuable tool in neuron identification. We propose to investigate the molecular identity of SA cells within the olfactory bulb in a venus/Vgat transgenic rat construct.

## Varicella-Zoster Virus and Latency

**Samiat Agunbiade**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Sonia Flores, Pulmonology, AMC - School of Medicine

*Activity Type:* Undergraduate Research

The Varicella Zoster Virus (VZV) is the virus that causes chicken pox upon primary infection and remains dormant in the trigeminal ganglia at the base of the brain, only to reactivate late in life to cause shingles. Some symptoms of shingles may include postherpetic neuralgia (chronic pain), retinal necrosis, zoster sine herpette, and vasculopathy (stroke). The viral genome has at least 68 unique open reading frames. Since the protein IE63 is readily expressed in lytic infection, it is hypothesized that IE63 inhibits the intrinsic apoptotic pathway involving mitochondria. In order to determine what other proteins which could be interacting with IE63, co-immune precipitations were run and immune-blots were run. Human lung fibroblasts (HFL) cells infected with VZV63 and mitochondria were isolated using the Miltenyi Mitochondria Isolation Kit. Infected HFL cells were subjected to affinity column purification with either anti-TOM22 (A protein specific to the outer mitochondrial membrane) micro-beads specific for mitochondria or a more non-specific negative control like anti-Human IgG micro-beads. Lysates were either untreated or sonicated Miltenyi GentleMacs Protein 01 program before affinity column purification. Sonication disrupts sub-cellular associations with mitochondria and other organelles, liberating mitochondria from contaminating organelles such as peroxisomes and lysosomes. The lysates were then immunoblotted for various proteins.

## Latinos, Digital Storytelling and Health Equity in Colorado

**Krystle Alirez**, Anthropology, DC - College of Liberal Arts and Sciences

**Monica Fullmer**, Anthropology, DC - College of Liberal Arts and Sciences

**Hannah Nichols**, International Studies, DC - College of Liberal Arts and Sciences

**Faculty Sponsor,** Dr. Marty Otanez, Anthropology, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Creative Activity

In the 2000s, health practitioners and researchers used digital storytelling to increase voices of community members in social development initiatives and promote healthy behavior among Latinos and other marginalized groups. Because of the increasing use of digital storytelling and new social media forms such as micro-blogging (Twitter), social networking (Facebook) and Internet-based video sharing (YouTube) researchers and health practitioners use digital stories produced by Latinos and other at-risk groups to promote tobacco cessation and cancer control. No systematic research has been conducted on digital stories with themes of tobacco and cancer created to influence smoking behavior, cancer control and survivorship. A paucity of evidence exists on the practical applications of digital stories such as their influence on policymaking. The project seeks to create health-related digital stories with Latino community members, and develop new methods for measuring the influence of digital stories on tobacco use, cancer screening, and early detection among Latinos in Colorado. The project objective is to create and analyze digital stories about tobacco use and cancer survivorship created by Latino adult (>18 years) smokers, former smokers, and cancer survivors in Colorado. Digital stories are autobiographical videos about three minutes long with photographs and background music. The goal of the project is assess ordinary stories about tobacco use and cancer to increase visual imagery about personal experiences with smoking, quit efforts, and cancer prevention and contribute to early screening and tobacco cessation.

## Undergraduate Students

### Algorithms for Generalized Image Segmentation

**Manuchehr Aminian**, Mathematics, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Andrew Knyazev, Mathematical and Statistical Sciences, DC – College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

#### 2011 Outstanding RaCAS Award Winner

The general problem of image segmentation is: given a digital image, how do we pick out what are the significant parts of the image? This is relatively simple to describe in words: we want contiguous objects to be picked out of the image, and the background noise to be ignored. We do this subconsciously all the time as humans, and it is often very easy to do. For example, in a picture with a bowl of fruit, we would probably select out each individual fruit and the bowl itself, and ignore the background. This problem is usually obvious for humans, but how do we instruct a computer to produce results similar to a human? Medical imaging is one of the main applications of image segmentation. The prototypical example is a radiologist examining the results of an X-ray or MRI scan for cancer. Usually the radiologist has no problem assessing an image; it is what they are trained for. The problem is the sheer number of images a radiologist needs to look through. This is where the field of image segmentation comes in; with the ideal algorithm, a radiologist could simply offload all the work to the computer and have all the images processed in a fraction of the time. Our research involves generalizing a class of existing algorithms, so-called "Principal Component Analysis" (PCA) and eigenvalue problems, for image segmentation, which work on 2D images, to three-dimensional images (for example, in a 3D MRI) and animated clips. We have implemented this generalized algorithm using mathematical software packages, MATLAB, HYPRE, and BLOPEX, to produce visible results. We also compare our results for test 3D images to the results by applying the 2D algorithm to each frame of the 3D image to show how the generalized algorithm can give qualitatively better results.

### Characterization of 3-Mercaptopropanoic Acid Monolayers Formed By Self Adsorption As A Function of pH

**Morgan Anderson**, Chemistry, DC - College of Liberal Arts and Sciences

**Faculty Sponsor**, Dr. Mark R. Anderson, Chemistry, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Characterization of chemically modified interfaces is vital to the development and understanding of electrochemical instruments. Several techniques were used to characterize the properties and behavior of an electrode modified by adsorption of 3-mercaptopropanoic acid (3MPA) as a function of the pH of the adjacent solution. AC Impedance Spectroscopy (ACIS) shows that solution pH has a significant role in determining the interfacial behavior. Observing a 3MPA monolayer at an acidic pH, very little change is detected in the overall impedance as a significant amount of 3MPA is removed from the electrode surface by desorption. At neutral pH, however, where nearly all of the 3MPA molecules are deprotonated, a significant increase in the impedance (relative to that observed when the monolayer is protonated) and impedance decreases as some of the monolayer is removed from the electrode surface. ACIS experiments are then compared to results obtained with an ethanethiol monolayer. The ethanethiol monolayer does not exhibit acid/base properties and consequently it shows impedance behavior that is independent of solution pH, as expected. These findings are a result of intermolecular interactions between the constituent molecules of the monolayer. Deprotonation of the acid group on 3MPA results in the introduction of a negative charge. This negative charge induces electrostatic repulsion, causing the monolayer to spread out, exposing substrate to materials in the solution. While the acid groups of 3MPA are protonated, adjacent molecules of the monolayer are able to hydrogen bond and cluster, covering large defects in the monolayer overall.

## **An Examination of Art Therapy as a Treatment Approach to Patients with Schizophrenia**

**Meghan Bailey**, Psychology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Mary Coussons-Read, Psychology, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

The use of art therapy as a treatment method for patients with schizophrenia was examined. This study was conducted through literature review through the PsychINFO database. The results suggest that art therapy is an effective treatment method for patients with schizophrenia, in conjunction with the continued usage of antipsychotic medication. Art therapy seems to have a reduction on the negative symptomology of schizophrenia, as well as an increase on the levels of self-esteem and confidence. The results suggest that art therapy is most effective for schizophrenic patients, when presented in a group arrangement. More studies need to be done in order to accurately assess the potential harms the art therapy may present.

## **Molecular Identification of the Presence of the Cpx Cadmium Resistance Gene in Resistant Bacterial Populations**

**Mehdi Bandali**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Timberley Roane, Integrative Biology, DC – College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Information on the distribution of metal resistance genes, in general, is poorly understood, and, in particular, very little is known about the presence of the cpx cadmium-resistance gene in environmentally significant populations. Cadmium is a toxic metal that exerts toxicity in a number of ways including; the displacement of essential metals from their normal binding sites on biological molecules (e.g. competing with zinc), inhibition of enzymatic functioning, and disruption of nucleic acid structure. Our research made novel contributions by isolating and characterizing the level of cadmium-resistance in bacteria isolated from cadmium-contaminated soils. The soils were obtained from areas throughout the Colorado Mineral Belt. Isolates were exposed to different levels of cadmium on Minimal Salts Medium (MSM) and the threshold cadmium concentration that allowed the isolates to express resistance was determined. Isolates that grew in cadmium were then screened for the presence of the cpx gene by the polymerase chain reaction (PCR) using DNA primers specifically designed to detect the cpx gene. There were two sets of primers that were used and these were specific to the cpx gene in *Pseudomonas S8A* and *Escherichia coli*, both of which have the cpx gene. Once the presence of the cpx gene was confirmed, the isolates were then identified using PCR of the 16S rRNA region which is highly conserved among species of bacteria. This study provided an opportunity for understanding metal resistance, specifically cadmium resistance, which upon further investigation, can provide insight into the use of bacteria in metal bioremediation.

## Undergraduate Students

### **Nitric Oxide's effect on CREB**

**Zachery Baud**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Jane Reusch, Endocrinology, AMC - School of Dental Medicine

*Activity Type:* Graduate Research

Heart disease is the number one cause of death in the United States. Diabetes and high blood pressure result in blood vessel dysfunction which can lead to heart disease and heart attack. cAMP response element-binding protein (CREB) is critical for healthy blood vessels and is diminished in the blood vessels of rodent models of diabetes, high blood pressure, aging and metabolic syndrome. Nitric oxide (NO), synthesized by nitric oxide synthase (NOS), has been shown to improve blood vessel function. To see if NO regulates CREB, N-nitro-L-arginine methyl ester (L-NAME), an inhibitor of NOS, was administered to rats. Previous work showed that CREB is reduced in the aorta of rats after 4 weeks of treatment. Since NOS inhibition by L-NAME treatment can cause high blood pressure in a week, a concern is that the downregulation of CREB could have been caused by the increased blood pressure, not directly by reduced NO. A shorter period of treatment (3 or 7 days) was used to determine the effects of L-NAME on CREB and the integrity of mitochondria. CREB was found to be downregulated, while mitochondria were also downregulated as early as three days. This leads to the conclusion that CREB downregulation maybe a direct result of NO removal.

### **Aquaponics**

**Brittney Blanchard**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor,** Dr. Gregory Cronin, Integrative Biological Sciences, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Aquaponics integrates aquaculture and hydroponics in an engineered re-circulating aquatic ecosystem made up of edible species and beneficial bacteria. Recent advances by researchers and growers have used aquaponics as a viable system to produce locally grown vegetables, herbs, and fish. Myriad conditions can influence the success of an aquaponics system including the germination process of seedlings, their transplantation into the system, and the types of vegetation used. It has been found that various herbs and vegetables readily grow at different success rates in growing media such as perlite, vermiculite, grow cubes, and coconut fiber even considering their varying bulk densities. Vermiculite provided better germination results than the other five growing media and perlite was observed as being the poorest growth medium. Out of six different herbs and vegetables, tomatoes had the greatest germination success and green beans had the tallest overall sprout height. Unexpected obstacles presented themselves in the progress of this research including structural weight limitations of the fourth floor greenhouse and restrictions involving vertebrate use. Future experiments that could be performed on the aquaponics system include vegetation production rates and aquatic environment success.

## DNA Sequence Data reveal Subspecific Variation in *Carex magellanica* (Cyperaceae)

**Tayvia Bourret**, Biology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

*Carex magellanica* (Cyperaceae) is one of approximately 30 flowering plant species that exhibit a bipolar distribution, occurring in geographical extremes of both the northern and southern hemispheres. *Carex magellanica* subsp. *irrigua*, which is nearly circumboreal, occupies wetlands throughout boreal and alpine regions of Europe, Asia, and North America, where its southernmost limit reaches Colorado. In contrast, *Carex magellanica* subsp. *magellanica* is a southern subspecies that occurs in alpine wetlands in the Andes, as well as sphagnum wetlands of southern Argentina and Chile. Here, we use molecular systematic techniques to examine the systematics of *Carex magellanica*. Specifically, we test the hypothesis that the two subspecies are systematically distinct, as has been suggested based upon subtle morphological differences. Cladistic analyses (e.g., Bayesian analysis and parsimony) of nuclear and chloroplast DNA sequence data were used to construct phylogenetic trees that support the aforementioned hypothesis and suggest that *Carex magellanica* subsp. *magellanica* was established following long-distance dispersal from the northern hemisphere.

## Melting Points of Common Substances Used to Deice

**Katie Camarata**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor,** Dr. Margaret Bruehl, Chemistry, Biology, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

In Colorado, severe winter weather and low temperatures will create ice on road surfaces, on vehicle windshields or in vehicle radiators. To eliminate the risks associated with these conditions, several different substances are used to eliminate or prevent the formation of ice. In this experiment, three commonly used salts as well as three commonly used commercially produced substances were compared as to their respective melting points. The three salts were compared quantitatively, and the three commercially produced substances were compared qualitatively. Colligative properties of each substance were evaluated and predictions as to the lowest melting points were made. The melting points of the three commercially produced fluids were also compared to the advertised melting points. Previous research on use of these substances was considered when identifying which substance would be the most effective as well as the least costly, most environmentally friendly, least harmful to humans, etc. It was found that out of the salts, magnesium chloride was the most effective. Out of the fluids, the pink deicer was the most effective.

## Undergraduate Students

### ReadyO2- Robotic Arm

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

**Jake Gelfand**, Mechanical Engineering, DC - College of Engineering and Applied Science

**Damon Fleming**, Mechanical Engineering, DC - College of Engineering and Applied Science

**Paul Sukow**, Mechanical Engineering, DC - College of Engineering and Applied Science

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

**Faculty Sponsor**, Dr. Ronald Rorer, Mechanical Engineering, DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

The ReadyO2 is an electrically actuated robotic arm designed to assist wheelchair users with limited upper body strength in lifting and securing an oxygen cylinder to their electric wheelchair. The arm is primarily designed to lift the M-24 oxygen cylinder. However it is also capable of lifting and securing an M-15 oxygen cylinder. The M-24 oxygen cylinder is a medical grade oxygen cylinder capable of holding 24 cubic feet of compressed oxygen. The device is floor-mounted and powered by household 110 V AC. The oxygen cylinder will be secured to a holster, mounted on the side of an electric wheelchair. The holster was designed such that the wheelchair will be able to fit easily through a standard door. The robotic arm has three degrees of freedom; a waist, which provides horizontal rotation and vertical translation, and an end effector used to grasp the oxygen cylinder. Two linear actuators and one servo motor provide the movement of the device. The wheelchair user will position the holster over a target marked on the floor. A simple push button control will attach and detach the oxygen cylinder. The attachment and detachment operation can be completed in approximately 30 s. The robotic arm is designed for use in a home, business, or medical care facility.

### The Politics of Sustainable Energy Initiatives in Hawaii

**Richard Coffin**, Political Science, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Jana Everett,

*Activity Type:* Undergraduate Research

The State of Hawaii is currently the most fossil fuel dependent state in the nation. The Hawaii Clean Energy Initiative (HCEI) aims to achieve an aggressive goal of 70% clean energy by 2030. Legislative reform and development is central to meeting the goals of the HCEI. To gain a better understanding of the HCEI, interviews were conducted with key legislative and non-profit actors in the Hawaiian renewable energy movement. Additional information was acquired from the websites of independent energy consultants, government agencies, and academic journals. We found that factors such as political will and economic pressure, in addition to the potential development of alternative energy sources, makes the goals of the HCEI achievable.

## La Pequeña Voz: social issues through the camera's eye

**James Coulter**, Film, DC - College of Arts and Media

**Clarke Fitzsimmons**, Film, DC - College of Arts and Media

**Scott Jacobson**, Film, DC - College of Arts and Media

**Nicole Didomenico**, Film, DC - College of Arts and Media

**James Espy**, Film, DC - College of Arts and Media

**Faculty Sponsor:** Mr. Hans Rosenwinkel, Film, DC - College of Arts and Media

Using visual storytelling as a tool, La Pequeña Voz looks at the issues of immigration through a retelling of Victor Hugo's timeless *Les Misérables*. This project provided students with a rare opportunity to collaborate on a feature film, that spread awareness of the struggles, that illegal immigrants face. La Pequeña Voz is the story of a man's quest to find freedom and prosperity in America, while dealing with his past choices. This updated interpretation, stands to give a voice to the countless that come to America in search of a better life, only to be persecuted and marginalized.

This was the first time that the College of Arts and Media undertook a feature film and gave the student an opportunity to take on key positions. This meant that students had a unique opportunity to step into a professional role while still having the safe environment of school.

## Immigration

**Bobbianne Doerr**, Sculpture, DC - College of Arts and Media

**Faculty Sponsor**, Ms. Rori Knudston, Digital Design, DC - College of Arts and Media

*Activity Type:* Undergraduate Creative Activity

A television show called 30 Days has an episode called Immigration. In the episode, a minuteman lived with a family of illegal immigrants for 30 days. The minuteman was completely immersed into world of immigration in America. From this experience, a dialogue was created between the American (the minuteman) and the Mexican-American immigrants (the illegal immigrant family). Since it is impossible to recreate this experience for every person in Denver, the student team will use artwork to construct an immersive experience for the Denver viewer using artwork produced by high school aged Mexican-American immigrants. In order to produce an effective immersive experience, multiple disciplines of art are needed. With photography, sculpture, and digital media, the student team will endeavor to create an immersive experience for Denver residents in the world of immigration in America. As a result of this immersive experience, the student team hopes to open a dialogue between both parties. This dialogue will lead to a deeper understanding of what immigration is in America and the problems that accompany it. This project will educate both sides of the issue that might just lead to solutions to solve a complicated issue.

## Undergraduate Students

### Preparation of a Cyclic Dipeptide Analogue

**Anthony Dunlap**, Chemistry, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Douglas Dyckes,, Chemistry, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

The purpose of this research is to investigate synthetic routes for 4-amino-5-oxopyrrolidine-2-carboxylic acid and characterize the final cyclic compound. This compound can be used to form larger rings that are made from one of the enantiomers of the stated compound, and then these rings can be stacked to form hypercyclic rings that have a pharmaceutical potential of sequestering or transporting small molecules or ions. The current synthetic route begins with the transformation of glutaric acid to an alpha, alpha-dibromodicarboxylic acid derivative through the Hell-Volhard-Zelinsky reaction and work-up with water. An amino group is substituted for each bromine using ammonium hydroxide, to make a dicarboxyl/diamino compound. The previous attempts to cyclize the compound used the dimethyl ester in basic conditions, but the yields were very small. In an attempt to increase the yield of the cyclic compound it is proposed that the carboxylic acid groups should be turned into a reactive acid chloride with the addition of thionyl chloride in DMF, to increase its reactivity and hopefully, to increase the yield of the final cyclic compound. The results of different combinations of these conditions are reported.

### Looking for Resolution: Radiometric Calibration of CCD Camera

**Rebecca Dutcher**, Physics, DC - College of Liberal Arts and Sciences

**Timothy Hatchett**, Physics, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. John Carlson, Physics, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

The purpose of this study is to estimate the quantum efficiency of a CCD camera which allows for absolute radiometry or photometry rather than relative. Since the onset of photographs and cameras, absolute measurements have been used infrequently in the scientific community, owing in part to the difficulty in finding the emittance of photons as a function of wavelength. When the instrument is detecting, no photographic devices respond to every incident photon. The QE or response of the device is wavelength dependent. Because of these issues, science essays usually quote photometric measurements in units of "Relative Intensity". In our study, we implement a process to derive a standard method to calibrate a CCD camera using standard LED™s. The presented method includes: off-the-shelf LEDs, an integrating sphere, a CCD camera and a spectrometer. We measure the total counts on our camera caused by the incident photons and the total number of photons emitted per wavelength using the spectrometer. Using deconvolution methodology, we estimate the quantum efficiency curve which allows for absolute photometry or absolute radiometry.

## **Acquisition of Cocaine Self-Administration: Effects of NMDA receptor antagonism**

**Amanda Hackley**, Psychology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

The problem of addiction as an epidemic within our nation is of great concern. Drug addiction is characterized by a strong compulsion to seek and consume the drug, followed by an increase in intake and loss of control in limiting one's intake. Learning and specific neurobiological mechanisms are hypothesized to play an important role in the development of addiction. More specifically, NMDA receptors and the excitatory neurotransmitter glutamate are thought to be essential in learning and memory. Acquisition studies using the animal self-administration model provide a means for studying the process of addiction with good predictive validity. Previous studies have demonstrated the importance of these mechanisms through the use of a non-competitive NMDA antagonist, MK-801. Despite these findings, the answer remains inconclusive. In order to eliminate inconsistencies in previous data, we assessed the antagonistic effects of MK-801 on acquisition delivered at a continuous concentration through the use of a mini-pump. This study, specifically focusing on the early stages of acquisition will provide valuable information regarding the interaction between the antagonist and the NMDA receptors, and assist in the development of improved human treatment and prevention of drug addiction.

## **Discover the Relationship between State Avenue and Internet Usage**

**Xuan Han**, Economics, DC - College of Liberal Arts and Sciences

**Lanxin Chen**, Economics, DC - College of Liberal Arts and Sciences

**Faculty Sponsor,** Dr. Shu Lin, Economics, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

This research discovers the relationship between State Revenue and internet usage in recent years. It will focus on the time trend of internet usage in United States, the state revenue data analysis in recent years, and associating state revenue data with time trend of internet usage. Several surveys did among the Auraria Campus showing how internet related to student's life will be presented to convey the idea that how internet drives the economic growth in nowadays. Overall, the main purpose of the presentation is to convince the audience that internet usage is strongly related to State Revenue.

## Undergraduate Students

### **The Effects of Unemployment Rates on Marital Outcomes**

**Jessilyn Harper**, Economics, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Hani Mansour, Economics, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

This study investigates the impact of fluctuations in unemployment rates before high school graduation on subsequent marital outcomes. Previous studies have shown that while higher unemployment rates may encourage increased educational attainment of young individuals, they also have an adverse long-term impact on career outcomes. Both of these channels may impact future marital outcomes. Understanding the impact on marital outcomes is important in order to assess the life-time social cost of experiencing poor economic conditions at early stages in life. The study uses data drawn from the National Longitudinal Survey of Youth 1979 (NLSY79). The NLSY79 is a nationally representative sample of women and men who were first interviewed between the ages of 14 and 22 in 1979. Follow-up surveys were conducted since then. The NLSY79 data is combined with information on national unemployment rates for the years 1974-1982, when the cohorts under study were 17 years old. The results indicate that women who face higher unemployment rates at age 17 are less likely to be married in the year 2000, compared to their peers who face better economic conditions at the same age. The impact appears to be larger among women who have attended some college or obtained a Bachelor's degree. The estimated impact on marriage remains intact even when considering racial or ethnic background, parents' education, number of siblings, and a measure of cognitive abilities. We find no such effects for men.

### **Regular exercise traffics excess nutrients away from energetically efficient pathways of lipid deposition during weight regain after long term weight loss**

**Jordan Houser**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Paul S. MacLean, Endocrinology, Metabolism, and Diabetes, AMC - Graduate School

*Activity Type:* Undergraduate Research

Obesity continues to be one of the biggest epidemics that Americans face today. There are numerous programs available to help lose weight; however, maintenance after weight reduction is challenging and continues to be an issue for most people. Less than 20% of Americans who diet are able to achieve and maintain a 10% reduction in body weight after a year. One reason for this high rate of obesity recidivism is that there are a number of biological adaptations that stem from the weight loss process, which coordinately act to facilitate rapid weight regain. Appetite goes up while energy expenditure goes down, and the body becomes highly efficient at storing the excess ingested energy. During relapse from the weight reduced state, carbohydrates are preferentially oxidized leaving fat to be trafficked into storage. In this study we show that regular exercise attenuates these biological adaptations by reducing the urge to overfeed, promoting fat oxidation, and manipulating where fat is stored. These effects on the biological drive to regain weight may explain why exercise is an important part of a weight maintenance strategy, facilitating long term weight loss.

## Structure determination of Neuroplation-65 Ig1 domain

**Chi Huynh**, Chemistry, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Elan Eisenmesser, Molecular Genetics and Biochemistry, AMC – Graduate School

*Activity Type:* Undergraduate Research

Neuroplastin (Np) is a protein that belongs to the immunoglobulin (Ig) superfamily. Two isoforms are expressed in the human brain, Np-55 and Np-65. Np-55 is abundant in many human tissues, while Np-65 specifically in the human cerebellum. Np-65 is a transmembrane protein comprised of three extracellular Ig-like domains, Ig1, Ig2, and Ig3 while Np-55 is comprised of only Ig2 and Ig3 domains. A high-resolution crystal structure of Np-55 has been solved but a crystal structure of Np-65 has not been elucidated. Our goal is to obtain a high-resolution crystal structure of the Np-65 Ig1 domain. Furthermore, we will be using NMR spectroscopy and size exclusion chromatography to characterize Np-65 Ig1 domain in solution. The protein was expressed using a bacterial expression system and purified using a combination of affinity and size exclusion chromatography. Analytical size exclusion chromatography was used to determine if Np-65 Ig1 domain exists as a monomer or dimer in solution. CD147 Ig0 domain, a homologue of Np-65 Ig1 domain, is a dimer in solution and residues involved in dimer formation of CD147 Ig0 are conserved within the Np-65 Ig1. Thus, we predict that Np-65 Ig1 domain is a dimer in solution. However, an analytical size exclusion chromatography surprisingly measured Np-65 Ig1 domain to be a monomer in solution. Crystal screens will be set up using the purified Np-65 Ig1 domain to obtain crystals for high-resolution structure determination. The purified <sup>15</sup>N labeled Np-65 Ig1 will be used for NMR spectroscopy to determine if the protein is folded in solution.

## Quantum Effect Can be Important to Chloride Ion Channel/Transporter Mechanism: A Computational Study

**Jeffrey Jaskunas**, PSYS, DC – College School of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Richard Allen, PSYC, DC – College School of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Butorphanol and morphine are commonly used in medical settings for their ability to treat pain. Some preclinical studies have indicated butorphanol's abuse potential as less than that of morphine. A reduction in butorphanol's ability to produce a conditioned place preference and lower efficacy at mu opioid receptors are two lines of support for this idea. The extent of conditioned place preference (CPP) development is thought to be a reflection of a drug's reinforcing properties. Clocinnamox (0.5 mg/ml), an insurmountable mu receptor antagonist, was administered prior to morphine (3.0 mg/ml) or butorphanol (0.1 mg/ml) administration, so that the antagonistic effects of clocinnamox on CPP could be described. Measurement of the rate of conditioned place preference development after clocinnamox administration was done to describe the mu opioid receptor efficacy requirement for CPP. The two doses of opioid were confirmed as equi-effective with the absence of a significant effect of opioid in a repeated measure ANOVA. Clocinnamox was shown to successfully antagonize the development of a conditioned place preference with a significant effect of clocinnamox in a repeated measure ANOVA. A significant effect of day was not found in the clocinnamox-experimental group, which prevented the statistical consideration of the efficacy requirement needed to produce CPP.

## Undergraduate Students

### **Inhibition of only VEGF 164 Isoform is Sufficient to Inhibit Atherosclerosis with Less Interference of VEGF Maintenance Functions in Endothelium**

**Ashley Johns**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Karen Moulton, Cardiology  
College: AMC - School of Medicine

*Activity Type:* Undergraduate Research

Objective: Previous studies have shown that VEGF164 is a major pathologic VEGF-A isoform involved in atherosclerosis. We tested the hypothesis that selective inhibition of only VEGF164 will inhibit atherosclerosis. Methods: Atherosclerosis-prone (Ldlr<sup>-/-</sup>;Apob<sup>tm25gy</sup>) mice were fed a 0.15% cholesterol diet for 14 and 26 weeks to develop early and late-stage atheromas, respectively. Early stage mice were treated for 14 weeks with VEGF164 Aptamer or PEG vehicle, while late-stage mice were first fed a cholesterol diet for 12 weeks to initiate atheromas before receiving the same treatments. Results: The VEGF164 aptamer inhibited mean plaque areas in the aortic sinus by 44% (P=0.0005) and 52% (P=0.0001) in early and late-stage groups, respectively. The relative areas of atheromas in descending aortas were inhibited by 48% (P=0.0104) in late-stage treated mice. VEGF164 aptamer also inhibited macrophage contents in early (P=0.048) and late-stage (P=0.047) aortic sinus atheromas. Conclusion: Selective inhibition of only VEGF164 was sufficient to inhibit macrophage contents and progression of atherosclerosis.

### **The Impact of Social Dominance Orientation on Implicit Leadership Theory**

**Courtney Jones**, International Business  
College: DC - Business School

**Faculty Sponsor:** Dr. Stefanie Johnson,  
Management, DC - Business School

*Activity Type:* Undergraduate Research

The purpose of this project was to explore the correlation between social dominance orientation and the preference for specific leader characteristics. In particular, this research served to draw conclusions about the implications of leadership qualities that facilitate social hierarchy according to the social dominance theory. As a researcher, I sought to subjectively analyze my sample's proclivity for choosing leaders who contribute to the maintenance of social hierarchy. This project examined attitudes towards prototypes of leaders and followers with an emphasis on gender differentiation. I tested my subjects level social dominance orientation and how this correlated to implicit leadership and followership theories tests. Each survey asked the participant to consider an effective male leader, an effective female leader, or just an effective leader. This distinction was an important variable in my research because implicit leadership theory categorizes masculinity as one of eight leadership characteristics. My project studies leadership from a new angle, through social psychology. Through the study of two previously unrelated ideas I hope to contribute findings that can be built upon to increase our understanding of leadership and social order.

## Arts in Community Development

**Sinjin Jones**, Theatre, Film and Video Production, DC - College of Arts and Media

**Marianna Chavez**, Theatre, Film and Video Production, DC - College of Arts and Media

**Faculty Sponsor:** Ms. Carol Bloom, Theatre, Film and Video Production, DC - College of Arts and Media

*Activity Type:* Undergraduate Creative Activity

The question of how the arts affect community development is one that is complex and varied. The goal of this project was to analyze this effect in the small town of Silverton, Colorado - year round population 400. In a town where 90% of kids participate in the Silverton Summer Youth Program, an eight week theatre camp for kids, our goal was to participate and learn what actual impact growing up in a community driven by theatre has on youth and in the development of the community itself. The multimedia presentation of poetry, a video of the summer program, and a poster of our findings is geared toward displaying our results in a truly artistic forum. Can the arts profoundly affect a community? We think: absolutely.

## Computational Study of Gold-Thiol Complexes and Their Implication on Nanotoxicity

**Kevin Kim**, Chemistry, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

Nanotechnology is widely believed to be one of the central technologies of the 21st century. Nanoparticles can be defined as molecules or complexes in size of nanometers (10-9 m), e.g., the well-known Bucky-ball made of carbon atoms. Nanoparticles have many great applications including the health care industry. However, the potential negative effects of the nanoparticles on the environment and on the human health are largely unknown or under-explored. As the nano-industry grows rapidly nowadays, it is clear that investigations of the toxicology of nanoparticles are in urgent needs. In this work, we carry out quantum-chemistry model computation of gold-thiol complexes in the dimension of nanometers. In contrast to bulk gold, which is very inert (and therefore used as currency for thousands of years without worries), gold nanoparticles can be quite reactive. Our calculations explore the different geometric configurations and energetics of gold-thiol complexes. Those properties are useful information that deepens our understanding of the gold nanotoxicity.

## Undergraduate Students

### Reactivity of Alumina with Oxalic Acid

**Nathan Knowles**, Geography-Earth Science, DC - College of Liberal Arts and Sciences

**Faculty Sponsor**, Dr. Ryan Sincavage, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Aluminum metal is one of the most widely used commercial and industrial materials on Earth. Most production of aluminum comes from the clay mineral bauxite via the Bayer Process and the energy-intensive Hall-Heroult Process. Some experts report that one percent of all the energy used in the United States is used in smelting aluminum. The purpose of this research is to explore a lower-energy pathway for the industrial preparation of this metal. First, we propose to determine the optimal conditions of concentrations, pH and temperature for the reaction of aluminum oxide (alumina) and of aluminum hydroxide with oxalic acid as described by the equations:  $\text{Al}_2\text{O}_3 + 3\text{C}_2\text{O}_4\text{H}_2 \rightarrow \text{Al}_2(\text{C}_2\text{O}_4)_3 + 3\text{H}_2\text{O}$  and  $2\text{Al}(\text{OH})_3 + 3\text{C}_2\text{O}_4\text{H}_2 \rightarrow \text{Al}_2(\text{C}_2\text{O}_4)_3 + 6\text{H}_2\text{O}$ , respectively. Second, we propose to cause the disproportionation (internal redox reaction) of aluminum oxalate to metallic aluminum and carbon dioxide. The methods used will entail heating a test tube of aluminum oxalate [ $\text{Al}_2(\text{C}_2\text{O}_4)_3$ ] in air or under nitrogen to a temperature near 3000 C. We have conducted an initial qualitative experiment which demonstrated that simple heating of a quartz tube containing aluminum oxalate over a Fischer burner formed a globule of metallic aluminum. That the globule was aluminum rather than its oxide was confirmed by the release of hydrogen gas when concentrated hydrochloric acid was added to the globule in a test tube, apparently following the equation:  $\text{Al}_2(\text{C}_2\text{O}_4)_3 \rightarrow 2\text{Al} + 6\text{CO}_2$ . Further experiments are now underway to quantify the percent conversion of a weighed amount of aluminum oxalate to aluminum.

### Cinaciguat, a Soluble Guanylate Cyclase (sGC) Activator, Augments Growth, Tube Formation, and Cyclic GMP (cGMP) Production in Fetal Pulmonary Artery Endothelial Cells (PAEC) In Vitro

**Emily Lich**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor**, Pediatrics, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Prematurity occurs in 12.5% of U.S. births and can lead to increased morbidity, mortality, and chronic lung disease, known as bronchopulmonary dysplasia (BPD). Studies suggest that inhaled nitric oxide (NO) may improve respiratory outcomes in premature newborns with BPD, but not all are responsive to NO treatment. This may be due to a defect in the NO signaling pathway which involves abnormalities of its key target, the enzyme soluble guanylate cyclase (sGC). Since stimulation of sGC is required for NO to exert positive effects on the lung, we hypothesized that decreased NO responsiveness may be due to impaired sGC activity in endothelial cells from blood vessels of the preterm lung. To test this, we studied the effects of Cinaciguat (Bay58-2667), a sGC activator, on pulmonary artery endothelial cells (PAEC) growth and tube formation, an experiment that mimics vessel formation. We found Cinaciguat increases growth in room air (RA) and hyperoxia (50% oxygen), increases tube formation in RA, and increases sGC protein expression in PAEC. Both SNP (a drug that releases NO) and Cinaciguat increase cGMP content (a downstream product of sGC) in PAECs in RA. However, Cinaciguat increased cGMP content more than SNP during exposure to hyperoxia, suggesting that Cinaciguat may improve lung vessels better than NO when exposed to oxygen levels often used on preterm newborns. Since high oxygen contributes to the development of BPD in premature newborns, we speculate that Cinaciguat may be a novel drug to prevent BPD in premature infants, especially those not responsive to NO.

## Improving the Quality and Efficiency of Western Blot Analysis

**Gregory Mahaffey**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Subbiah Pugazhenthii, Endocrinology, AMC - School of Medicine

*Activity Type:* Undergraduate Research

Western Blotting is a technique that is vitally important in a research laboratory as a reliable way of measuring the levels of target proteins in response to a variety of treatments in vitro and in vivo. This procedure, however, can be time consuming, difficult, and involves use of costly antibodies. Over two years of training as a research assistant I have learned several steps that may improve the quality and accuracy of these analyses. Such steps are not generally published and therefore unavailable to newcomers in the field. They are as follows: (a) extreme caution must be used in protein assay and gel loading to ensure equal protein loading that will result in even bands of  $^{125}$ I-Actin. (b) The use of Ponceau Stain after transfer provides assurance that all lanes of a gel were loaded equally and allows the blot to be trimmed so that less antibody may be used. (c) Insufficient dissolution of milk powder in the blocking agent can produce spots on an image. (d) Preparation of antibodies in a solution of 5% albumin bovine serum and 0.3% sodium azide in TBS-Tween allows their reuse up to 6 times. (e) To develop signals by a chemiluminescent method, CDP-Star is more sensitive than ECL reagent. (f) Placement of the blots at multiple locations of a cassette for varying times yields signals at different intensities and allows us to select images with optimal signal intensity.

## Expression Patterns of PAPP-A2 in the Developing Human Placenta

**Anne Mailhot**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor,** Aimee Bernard, Biology, DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Preeclampsia is a pregnancy-associated disease occurring in 4-8% of human pregnancies, and is characterized by high blood pressure and protein in the urine after 20 weeks gestation. It is one of the leading causes of maternal death worldwide. Currently, delivery is the only cure resulting in 15% of preterm births. The etiology of this disease is not completely understood, but clearly requires the presence of the placenta. Specifically, it is thought that impaired formation of the placenta at the maternal-fetal interface contributes to the pathogenesis of preeclampsia. Recently, it was determined that Pregnancy-Associated Plasma Protein-A2 (PAPP-A2) was expressed in the placenta at the maternal-fetal interface. The goal was to determine the expression pattern of PAPP-A2 throughout pregnancy in controls and determine whether PAPP-A2 is elevated in preeclamptic placentas. By using immunohistochemistry and Western blot analysis, we were able to localize cells expressing the protein and determine the associated protein levels in the placenta. PAPP-A2 is expressed by trophoblasts, specialized cells of the placenta, exhibiting an "on/off/on again" pattern over the course of pregnancy. PAPP-A2 protein levels are elevated in preeclamptic placentas. These results demonstrate that PAPP-A2 is regulated during placental development and aberrantly expressed in preeclampsia. This pattern of expression is consistent with PAPP-A2 having a potential role in the pathogenesis of preeclampsia.

## Undergraduate Students

### **Statistical Analysis of CT Scans to Further Quantify Emphysema**

**Alexander McKenzie**, Physics / Applied Mathematics, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

Computerized tomography (CT) scans clearly show if a patient has emphysema, but in order to quantify the degree of the disease, other tests are needed. Our goal is to create a method which can accurately diagnose and determine emphysema severity levels in patients based solely on analysis of CT scans. This method involves performing a number of statistical calculations using data taken from CT scan images of several patients representing a wide range of severity of the disease. These analyses include an examination of the deviation from a normal distribution curve to determine skewness, a commonly used statistical parameter. Our preliminary results show that this method of assessment appears to be more consistent and robust than currently utilized methods which involve looking at percentages of radiodensities in the lung. We are also working to determine if this method can be performed on X-Rays of the lung, which would decrease both cost and radiation exposure.

### **Entropy**

**Melonie Mulkey**, Fine Arts, DC - College of Arts and Media

**Faculty Sponsor:** Mr. Michael Brohman, Sculpture, DC – College of Arts and Media

*Activity Type:* Undergraduate Creative Activity

Freezing a moment in time with creative sculptural installations is the main mission of this research. I want to create works of art that involve the integration between fine arts and liberal sciences. By using chemistry to create alternative processes in photography, I am able to visually show this connecting language. I also have constructed a large scale origami mobile consisting of 1103 handmade paper cranes and over 20,000 beads that is on display in the Tivoli. This window of opportunity has given me a chance to explore the many possibilities in speaking your voice in the art world, and the hard work it takes to get your work out there for an audience to enjoy. This experience has only opened new doors for me to share my work with the community and become more involved in institutions dedicated to art and creative thought.

**Patients with Severe Pulmonary Arterial Hypertension Exhibit an Increase in the Number of Lymphatic Vessels**  
**Presentation Activity:**  
**Undergraduate Research**

**Meheret Nega**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor**, Dr. Sonia Flores, Pulmonary and Critical Care Medicine, AMC – School of Medicine

*Activity Type:* Undergraduate Research

Patients with Severe Pulmonary Arterial Hypertension Exhibit an Increase in the Number of Lymphatic Vessels Meheret Nega, Collage of Liberal Arts and Sciences Faculty Mentor: Dr. Michael Yeager, Department of Pediatrics Critical care  
Activity Type: Undergraduate Research  
Pulmonary arterial hypertension (PAH) is a progressive and fatal disorder that is characterized by abnormally high blood pressure in the pulmonary artery, usually resulting in right heart failure. Patients with PAH are typically diagnosed in the late stages of this disease since many of the symptoms associated with PAH tend to be nonspecific. Patients also exhibit extensive remodeling of vessels, as well as accumulation of immune cells/ lymphocytes around or within their vessels. In many parts of the body, the lymphatic system plays an important role in fluid transport and maintenance of the immune system. The aim of this study is to inspect whether or not the lymphatic system plays a role in PAH and if there is a significant increase of lymphatic vessels in patients with PAH. Rats with induced PAH were used to examine vascular changes, as well as to survey the increase in the number of lymphatic vessels compared to normal rats. Staining of tissue samples and quantification of proteins from PAH rats showed high localization, as well as increase in the expression of these markers in rats with PAH. Thus, we believe that the increase in lymphatic vessels may serve as an important tool in fluid transport to prevent Inflammation and to possibly carry immune cells away and towards remodeled vessels in an attempt to maintain homeostasis.

**Protocols for Continuous Growth and RNA Isolation of the Diatom *Phaeodactylum tricornutum* for use in Novice Laboratories**

**Jessica Ober**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Randall Tagg, Physics, DC – College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

*Phaeodactylum tricornutum* is a member of the diatom group, the Bacillariophyta. These eukaryotic organisms are photosynthetic, which makes them an important primary producer among the other microorganisms in plankton. Diatoms with their silica frustules are important to the oceans silicon cycle, although this species is unique in that it can grow without silicon in the lab. It is the second diatom to have its genome mapped and is a popular choice for the study of diatoms. This species can form three morphotypes under different environmental conditions: oval, triradiate and fusiform. Cells can either be free floating, planktonic, or adherent which form biofilms. Adherent algae like this pose problems for ships as they can cause biofouling, which can cause significant resistance on their hulls. Protocols for the study of this organism including growth of cultures and RNA isolation can provide a solid understanding of many introductory laboratory techniques for undergraduates and high school students in labs with limited resources. These protocols, intended to be utilized by inexperienced researchers, act as a guide with helpful advice and information about essential techniques. By researching an organism that takes up little space and inexpensive growing mediums, they can be used in a variety of labs with limited funding. These protocols also set the foundation for more dedicated and in depth research for algal species at all levels. By knowing how and where to start, along with solutions to common problems growing this species, students can focus on their research objectives.

## Undergraduate Students

### **Investigation of the Effects of Decorin on Neurite Outgrowth by Embryonic Cortical Neurons**

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

**Faculty Sponsor:** Dr. Stephen Davies, Neurosurgery, AMC - Graduate School

*Activity Type:* Undergraduate Research

Decorin is a naturally occurring molecule that is known to be a powerful anti-inflammatory agent that promotes wound healing and regeneration in many tissue types. Research conducted by the Davies lab has shown that in addition to suppressing spinal cord scar formation, decorin promotes robust neurite outgrowth by adult sensory neurons grown in vitro on substrates rich in axon growth inhibitory chondroitin sulfate proteoglycans (CSPGs) - molecules commonly found within scar tissue as sites of central nervous system injury. The main focus of my research project is to investigate the ability of decorin to promote neurite outgrowth by embryonic (E18) rat cortical neurons on various substrates, including laminin, fibronectin, and mixes of these growth supportive molecules with inhibitory CSPGs. Preliminary experiments were conducted to optimize substrate and growth conditions to develop a working in-vitro model for testing the effects of decorin on neurite growth. Neurite outgrowth was measured for  $\beta$ -tubulin immune-stained neurons at 24 and 48 hour time points for decorin treated and untreated cultures. Three parameters of neurite outgrowth were measured: total neurite outgrowth, neurite length from the cell body, and neurite branching.

### **Glucocorticoid receptor allele frequency in a population of caregivers**

**Samuel Philips**, Biology  
College: AMC - School of Medicine

**Faculty Sponsor:** Dr. Mark Laudenslager, Psychiatry  
College: AMC - School of Medicine

*Activity Type:* Undergraduate Research

Caregivers of blood or marrow transplant recipients undergo a stressful experience providing care for their patient. How the body deals with this stress is related to stress hormones that can lead to changes in immune function and inflammation. Glucocorticoid receptors bind cortisol and other glucocorticoids. Genetic variations in this receptor may affect how an individual responds physiologically to stress. All individuals may have a genetic predisposition to how they deal with stress. We look at three single nucleotide polymorphisms (SNP) in three alleles: ER 22/23 EK, N363S and BclI on chromosome 5. These SNPs were selected because each has been identified as critical in glucocorticoid responses and responses to acute stressors as well as metabolic syndrome a long term stress outcome. DNA was isolated from whole blood using a Qiagen kit; long-range touchdown Polymerase Chain Reaction (PCR) was performed to amplify the target segment of DNA. The target DNA was sequenced and analyzed to determine the genotype of the three candidate alleles. Understanding how these SNPs relate to a caregiver stress is on-going research question in this lab and knowing overall SNP frequencies is important for future studies. Herein we will report SNP prevalence and compare these caregivers to larger population data.

## **Battery Powered Rope Ascension Device for Recreational Use and Rescue**

**Jack Peszek**, Mechanical Engineering, DC - College of Engineering and Applied Science

**John Schminky**, Mechanical Engineering, DC - College of Engineering and Applied Science

**Annie Frederick**, Mechanical Engineering, DC - College of Engineering and Applied Science

**Rebekah Graumann**, Mechanical Engineering, DC - College of Engineering and Applied Science

**Erin Daily**, Mechanical Engineering, DC - College of Engineering and Applied Science

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

*Activity Type:* Undergraduate Research

Battery Powered Rope Ascension Device for Recreational Use and Rescue Required  
Accommodations: Easel and table  
Abstract: A battery powered rope ascension device, the Raven, capable of climbing an anchored rope, with loads of up to 300 lbs has been designed and a prototype has been built. Every outdoor climbing, firefighters, search and rescue teams, and military personnel need devices that will aid in emergency. The Raven offers a means of rapid rope ascent capable of speeds of up to 6 ft/s to mechanically extricate individuals under emergency conditions, in situations that would normally require the individual to physically climb. It is sturdy enough for extended and regular operation with failsafe operations integrated into the construction. Many of the rope-ascending products available on the market today are cost prohibitive for most recreational users and are strictly limited to civically-funded public safety organizations. The Raven offers a low cost alternative that will meet the needs of these and other groups'™ daily climbing operations. The device is powerful, driven by an electric motor linked to a 10:1 planetary gear reducer for optimal power, and controlled by a variable speed trigger. It is lightweight, weighing only 40 lbs. It is reliable, designed with safety mechanisms on all integral components, and has an overall safety factor of over 10. Factors of safety of 10 are used on equipment where failure could maim or kill the user,

whereas factors of safety of 2-3 are used on consumer products, where only the product will not survive. The Raven is also rechargeable and environmentally friendly. The multi-faceted uses of the Raven will be demonstrated as well as an in-depth look into the purpose and selection of each component will be provided.

## Undergraduate Students

### **Measuring the Integrity of Lipid Bilayer Coatings on Silica Nanoparticles**

**Aundria Piper**, Chemistry, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

C-reactive protein (CRP) is a serum protein whose level rises in response to inflammation. CRP levels are currently used as a biomarker to determine the risk of coronary artery disease. CRP binds to the phosphocholine headgroups of oxidized low-density lipoproteins (LDL) and to the membranes of apoptotic cells. Binding of CRP to oxidized lipid membranes causes isoform conversion from native pentameric CRP (pCRP) to a modified form, termed mCRP. mCRP expresses neoepitopes and is believed to be pro-atherogenic and pro-inflammatory, hence, it is of great importance to cardiovascular research. In this investigation, lipid coated silica nanoparticles (PC-SiNPs) are synthesized as biological cell mimics to allow for the elucidation of the role of membrane curvature and pCRP binding, as an oxidized membrane will have a higher radius of curvature than its non-oxidized counterpart. In particular, the research focused on methods to determine the packing density, uniformity, and number of layers of lipids around the SiNP. Loading and encapsulation of SiNP with calcein dye was achieved using a mixed liposome containing phosphatidylcholine and cholesterol. After encapsulation, PC-SiNP stability was determined by calcein leakage studies, followed by induced membrane leakage on stable PC-SiNPs. Thermogravimetric analysis was used to determine the number of lipids present in the sample and allow calculation of degree of coverage of the nanoparticles.

### **Identification and Characterization of Oligoclonal Band Specificity in Multiple Sclerosis**

**Tiffany Pointon**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Xiaoli Yu, Medicine, AMC – School of Medicine

*Activity Type:* Undergraduate Research

Multiple sclerosis (MS) is characterized by persistence of oligoclonal immunoglobulin G (IgG) bands. Oligoclonal bands (OCBs) are defined as IgG bands in the CSF but not in the corresponding serum of the same patient. OCBs in chronic infectious CNS diseases are antibodies directed against the causative agents of disease. The specificity of OCBs in MS remains unknown. Phage-displayed random peptide libraries were previously used in our lab to identify peptides specific to IgG in MS patients. In the present study, we applied phage-mediated real-time immuno-PCR (IPCR) and isoelectric focusing electrophoresis (IEF) to characterize phage peptide interactions with MS IgG. We demonstrated that the peptides had higher binding affinity for the corresponding patient's CSF than serum. Although no single peptide shared binding specificity among multiple MS CSF, cross reactivity between 2 pairs of patients was confirmed. We further performed MS IgG deglycosylation on three longitudinal patients with the hypothesis that OCBs are due to IgG glycosylation. After complete deglycosylation, oligoclonal band shifting was observed in both CSF and sera of two patients. A slight reduction of bands in addition to shifting was observed in the third patient. Complete band collapsing did not occur in any of the patients, suggesting that glycosylation is not a contributing factor to the characteristic oligoclonal banding seen in MS. Determination of the nature of OCBs in MS will further our understanding of autoantibody pathogenesis, provide the potential to determine the cause of disease, and lead to development of strategies for diagnostic and therapeutic intervention.

## **Bone Surface Modification and Depositional Environments of Pliocene Laetoli Fossil Assemblages**

**Madeleine Replogle**, Anthropology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

The Upper Beds at Laetoli in Northern Tanzania contain an abundance of fossilized faunal remains, which exhibit different degrees of bone surface modification due to perimortem and postmortem taphonomic processes. These surface modifications can be caused by faunal interference (including bioturbation and etching), physical exposure, and or the chemical nature of the depositional environment. This study, which was conducted in association with the UCD Tanzania field school, examined markings on 668 bone fragments found at Laetoli in 2010. Following laboratory analysis, the frequency of different taphonomic signatures was recorded, as well as the dimensions and provenience of each fragment. The assemblage displays a high degree of fragmentation, which can be attributed to weathering, trampling, and depositional pressure (not only necessarily restricted to surface specimens). Many bones exhibit desquamation (n=174), staining (n=203), bleaching (n=171), as well as cracking (n=244), pitting (n=144), and flaking (n=237). Faunal agents also affected the assemblage, although less than predicted, resulting in specimens with gnawing marks (n=50), insect burrowing holes (n=101), and trampling marks (n=117). In all, these findings illustrate a complex depositional environment characterized by periods of prolonged exposure prior to complete burial. By interpreting this data in a paleoecological context, this study helps to broaden the basis of paleoenvironmental and paleoanthropological reconstructions.

## **A Comparison of Two Self-Report Measures for the Detection of Postpartum Depression**

**Robin Richards**, Psychology  
College: DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Peter Kaplan, Psychology  
College: DC - College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

Postpartum depression affects up to 15 percent of new mothers, and may go undiagnosed in many more cases as new mothers are reluctant to report symptoms of this disorder (Beck and Gable, 2002). Given these circumstances, it is important for medical practitioners to have fast and reliable diagnostic methods available. In the past, self-report measures such as the Beck Depression Inventory-II (BDI-II) have been used to indicate mothers with postpartum depression. In 2002 however, Beck and Gable developed the Postpartum Depression Screening Scale (PDSS), a 35 item self-report inventory designed to identify the specific symptoms of postpartum depression in new mothers. This study examines the efficacy of the PDSS in comparison to the BDI-II when diagnosing depression in the postpartum period. A sample of 177 mothers was recruited using advertisements placed in a parenting magazine. Each participant's scores for both the BDI-II and the PDSS were compared to a clinical diagnosis determined using a Structured Clinical Interview, which is considered the "gold standard" for clinical diagnosis. Analysis revealed that the PDSS had higher sensitivity in correctly predicting a positive diagnosis (.769), while the BDI-II had higher specificity in correctly predicting a negative diagnosis (.899). A linear regression indicated that after socioeconomic factors were accounted for, the BDI-II accounted for a greater proportion of the variance in diagnosis than did the PDSS. These results indicate that the BDI-II is at least as good a screening tool for postpartum depression as the PDSS.

## Undergraduate Students

### **Evaluating the Ballistic Properties of Levallois Points from 'Ain Difla (Jordan)**

**Patrick Riley**, Anthropology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

Studies of Paleolithic weaponry has recently greatly benefitted from the application of easily calculated measurement to evaluate the ballistic effectiveness of pointed implement. This has allowed renewed and empirically grounded investigations of the origins of projectile weapons in Neanderthals and Homo sapiens. In parallel, however, it has been recognized that ballistic measurements such as tip cross-sectional area (TCSA) and tip cross-sectional perimeter (TCSP) alone are insufficient to establish that given pointed stone tools were used as projectile. Ideally, use-wear, residue, and damage patterns need to be evaluated before a point can be shown to have functioned as part of a projectile weapon. In spite of this, little attention has been paid to why and how TCSA and TCSP are insufficient tools to identify the tips of projectile weapons. To disentangle some of these issues, we examine a set of Levallois points from the Levantine Mousterian site of 'Ain Difla (Jordan) that are known to have been used mainly as cutting implements. Our results suggest that assessing TCSA/P values in terms of assemblage means and medians without considering the range of these values obscures the fact the TCSA/P values of various types of ethnographically-documented point types overlap almost completely. We discuss the implications of the overlap of TCSA/P values for Levallois points known to have been used mainly as knives, perforators and borers and other sets of Paleolithic points recently argued to document the earliest known projectile weapons.

### **Hypoxia-Mediated Alterations In Adenosine Receptor Expression In The Lung**

**Jonas Salys**, Pulmonary and Critical Care Medicine, AMC – School of Medicine

**Faculty Sponsor:** Dr. Laima Taraseviciene – Stewart, Pulmonary and Critical Care Medicine, AMC – School of Medicine

*Activity Type:* Undergraduate Research

Adenosine signaling plays an important role in hypoxia-induced responses in the lung and might be implicated in the pathogenesis of pulmonary arterial hypertension. Here we investigated the adenosine receptor expression profile in the lungs of Sprague Dawley (SD) rats exposed to hypobaric hypoxia as well as in rat pulmonary macro- (pulmonary artery (RPAEC)) and micro-vascular endothelial cells (RPMVEC). Methods: SD rats were exposed to hypobaric hypoxia (18000 ft altitude) for 7 days and 3 weeks. Pulmonary arterial pressures were measured by inserting a pulmonary arterial catheter. The expression levels of different adenosine receptors were determined by real time PCR. RPMVEC and RPAEC were obtained from the University of Southern Alabama and cell proliferation was determined. The signaling pathways were investigated using adenosine receptor specific agonists and antagonists. Results: Three weeks of exposure to hypoxia resulted in a significantly elevated PAH ( $33 \pm 2.3$  versus  $18 \pm 2.3$  at Denver altitude). The A2A receptor was the most abundant in SD rat lungs. The expression of A1 receptor was significantly increased after 7 days and 3 weeks of hypoxic exposure. Moreover, studies in vitro revealed that adenosine receptors are differentially expressed in pulmonary macro- and micro-vascular endothelial cells. Conclusions: Our data demonstrate that chronic hypoxic exposure regulates adenosine receptors expression profile suggesting their involvement in hypoxia-induced pulmonary vascular remodeling. Targeting adenosine receptors might be promising approach to treat PAH. Funded by AHA 0735388N, FAMRI CIA 072053 and Bixler Family Foundation.

## Dual Bile Acid Receptors Agonist INT-767 Prevents Diabetic Nephropathy Through Multiple Mechanisms

**Hannah Santamaria**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr.. Xiaoxin Wang, Renal, AMC – Graduate School

*Activity Type:* Undergraduate Research

Bile acids are ligands for the nuclear hormone receptor farnesoid X receptor (FXR) and the G-protein-coupled receptor TGR5 (also known as GPR131, GPBAR1, M-BAR and BG37). However the functional consequences of bile acid-activated signaling in the pathogenesis of diabetic nephropathy are not known. We administered the novel FXR/TGR5 dual agonist INT-767 to DBA/2J mice with streptozotocin-induced diabetes fed a western diet, and to db-db mice with type 2 diabetes. We found that FXR/TGR5 agonist treatment of diabetic DBA/2J and db-db mice improves proteinuria and prevents podocyte injury, mesangial expansion, and tubulointerstitial fibrosis. INT-767 exerts renal protection through its coordinated effects on multiple pathways, including a) inhibition of the renin-angiotensin-aldosterone system and stimulation of the angiotensin II type 2 receptor and MAS receptor and b) stimulation of AMPK-sirtuin-PGC-1 $\alpha$ -ERR $\alpha$  signaling, as well as c) inhibition of enhanced renal fatty acid and cholesterol metabolism, d) inhibition of oxidative stress, e) inhibition of proinflammatory cytokines and macrophages, and f) inhibition of profibrotic growth factors. These results indicate novel signaling pathways for the bile acid receptors FXR and TGR5 in the kidney which represent promising targets for treatment of diabetic nephropathy.

## The Effects of the NMDA Receptor Antagonist MK-801 on Self-Administration Learning for Cocaine: Exploring Escalation of Intake

**Alyssa Schickedanz**, Psychology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

Cocaine addiction is an expensive and alarming societal burden in the United States. Rat self-administration models are important tools in understanding cocaine consumption. Glutamatergic neurons have previously been shown to block acquisition learning when administered prior to acquisition, but little is known about the role of glutamate after acquisition. The experimental question of this project is whether the NMDA antagonist MK-801 will have an effect on the post-acquisition, dose-dependent escalation of cocaine consumption that characterizes addiction. The novel method of aligning acquisition data on a case-by-case basis to the first day a subject meets criteria and analyzing the following consumption trends with and without MK-801 will allow us to determine the role of NMDA on escalation.

## Undergraduate Students

### Stability of Acyclovir in Space

**Scott Seitz**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Integrative Biology, College of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

It was determined several years ago that herpesvirus reactivation is more frequent when astronauts are exposed to space conditions. As a precaution acyclovir, an antiviral, is now stored within the MIR space station. Since space causes a myriad of effects upon chemical compounds, how could space conditions affect acyclovir? Chemists working for NASA have determined via mass spectrometry that the acyclovir molecule has been changed via space exposure, the question now is does this change its activity biologically. If the drug no longer functions correct, the cost of frequent drug shipment may be astronomical. This experiment outlines the testing of acyclovir and its efficacy post-space exposure to determine if the chemical change is biologically significant.

### Channel/Transporter Mechanism: A Computational Study

**Mia Smith**, Pre-Veterinary, DC – College School of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Hai Lin, Chemistry, DDC – College School of Liberal Arts and Sciences

*Activity Type:* Undergraduate Research

#### 2011 Outstanding RaCAS Award Winner

The CIC Cl<sup>-</sup> channel/transporter is a family of proteins that have been widely found in the cells. They transport Cl<sup>-</sup> ions across membranes, playing important roles in maintaining resting membrane potential, electrolyte transport, and electrical signals. Mutations to those proteins in the human body lead to serious diseases, such as cystic fibrosis and Dent's disease. Despite extensive experimental and theoretical studies, the detailed mechanisms of those channels and transporters are yet to be elucidated. In particular, it remains unclear how quantum mechanics, the laws governing the microscopic world of atoms and molecules, affect the Cl<sup>-</sup> ion binding and transport. In this work, we performed the first quantum-chemistry calculations on a set of model systems for the CIC ion transporter in *E. coli* and for its mutants.[1] The most striking finding is the observation of extensive anion-pi charge transfer along the Cl<sup>-</sup> translocation pore. This finding suggests that the quantum effects of charge delocalization can critically impact the mechanisms of Cl<sup>-</sup> transport proteins and possibly other anion channels as well. Thus, ignoring those quantum effects will likely lead to incomplete understanding of the transport proteins.

[1] Mia Smith and Hai Lin, "Charge delocalization upon chloride ion binding in CIC chloride ion channels/transporters." *Chemical Physics Letters*, 2011, 502, 112-117.

## Molecular Testing for Rapid Cancer Detection

**Marina Stukova**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Lynne Bemis, Medicine, AMC – School of Medicine

*Activity Type:* Undergraduate Research

Cancer patients frequently have genetic changes or mutations, specific to their tumor and type of cancer. Identifying the nature of such mutations predicts individual patient's response to therapy. During the last 5 years, it has become possible to detect such tumor specific genetic changes by molecular testing, using DNA and RNA as biomarkers. One of the mutations that may predict patient's response to therapy is an alteration in KRAS gene. The KRAS protein is a part of the tyrosine kinase signaling pathway that sends signals from cell surface receptors downstream to the nucleus. Single nucleotide substitutions in KRAS gene result in mutations of the KRAS protein, which are found only in cancer cells. Cancer associated alterations in this pathway allow unregulated cell growth and proliferation. Mutated KRAS is found in more than 90% of pancreatic cancers, 40% of colorectal cancers and 33% of non-small cell lung carcinomas. Current techniques available for molecular diagnosis of cancer, caused by KRAS mutation take 1-2 weeks. Patients with stage III or IV cancer must wait up to 14 days to be approved for cancer therapy. The goal of this project is to improve KRAS mutation testing through development of a technique that would allow much more rapid detection, 2 days rather than 2 weeks. Currently KRAS testing assays require fragments of the tumor tissue, which is obtained by an invasive procedure. Our target is to create a molecular test that would use patient's blood sample rather than tissue and be much less invasive.

## How Do You Plan for a Disaster?

**Tyler Svitak**, Geography, College: DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

Although having long standing meaning in ecology, the concept of resilience has only recently emerged as a guiding principle in the emergency/disaster management arena to generally refer to how well a locality can withstand and recover from a hazard event. The translation of resilience to this field of study is expanding rapidly in the U.S. and around the world. In order to gain an increased understanding of resilience and disaster risk reduction activities at the community level, I examined the interconnections amongst the public, private, and non-profit sectors involved with the Disaster Management Plan in Colorado Springs, CO. . To do this, I conducted a case study in Colorado Springs that used key informant, semi-structured interviews aimed at identifying three general areas of interest: 1) knowledge, awareness, and perceptions of the term resilience, 2) activities in which the organizations are involved, and 3) the extent to which the three sectors work together toward achieving disaster resistance. Initial findings show that Colorado Springs has over a hundred organizations involved with designing and implementing an emergency management plan, and interviews have revealed that emergency planning is incredibly convoluted with organizations brought together by an emergency management plan that can be practiced many times, but can never be guaranteed until a disaster unfolds. Furthermore, understanding the connections among organizations is vital to the resilience of any community, and this project greatly contributed to a better understanding of what needs to happen to prepare, mitigate, respond, and recover from a disaster.

## Undergraduate Students

### **Tantric Picasso 10' Record**

**Matt Tanner**, Music, DC - College of Arts and Media

**Marko Melnick**, Music, DC - College of Arts and Media

**Karl Rivers**, Music, DC - College of Arts and Media

**Pablo Cruz**, Music, DC - College of Arts and Media

**Faculty Sponsor**, Dr. Drew Morell, Music, DC – College of Arts and Media

*Activity Type:* Undergraduate Creative Activity

Our presentation will explain the process of recording an analog album from the pre-planning phase all the way to the creation of a vinyl record. We will have the final product available to play for the public (on a turntable), as well as pictures documenting the experience. The presentation will also include a live performance of one of the songs from the album.

### **Static Light Scattering**

**Ryan Taylor**, Civil Engineering  
College: DC - College of Engineering and Applied Science

**Faculty Sponsor**, Dr. David Mays, Civil Engineering  
College: DC - College of Engineering and Applied Science

*Activity Type:* Undergraduate Research

The clarification of liquids has been a topic of study for generations and plays an important role in civil engineering. More specifically, the morphology of colloid aggregates is crucial in the purification process of potable water, known as the coagulation-flocculation-settling sequence. One method developed to study the morphology of colloid aggregates is referred to as static light scattering. This method utilizes a laser similar to a laser pointer in order to evaluate the scattering of a laser through a cylindrical test sample. However, the standard geometric correction used to obtain viable data is not acceptable for very low scattering angles. Therefore, this poster reports static light scattering measurements used to determine whether a different geometric correction factor needs to be applied during analysis in order to produce viable results at low angles.

## Thermochemistry and Undergraduates: The Catalytic Decomposition of Hydrogen Peroxide

**Tyler Thompson**, Geography and Environmental Science, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

Undergraduate chemistry students often explore the concepts of thermochemistry in the lab through work with a calorimeter. The decomposition of simple household hydrogen peroxide can amply serve this purpose. When this decomposition reaction is performed under the influence of an iron (III) nitrate catalyst, additional concepts of kinetics and catalysis can be introduced to students. Familiarizing students with this suite of topics is valuable not only in the immediate experience given undergraduates with thermochemistry, as prescribed by traditional curriculums, but also provides a fundamental basis in the difficult concepts of chemical kinetics and catalysis. Students often have misconceptions about thermochemistry, kinetics, and catalysis; therefore a laboratory experiment in which all three topics are included serves to give the fledgling chemistry student a stronger footing on these fundamental areas of study. Many variations on this experiment are possible, providing the educator with flexibility in terms of incorporating this experiment in their curriculum. The range of experimental techniques utilized in the experiment likewise is alterable to the needs of the instructor. This decomposition reaction uses household chemicals that students are familiar with while exemplifying a range of valuable chemical knowledge.

## *Penstemon degeneri* *P. griffinii* Species Complex Revealed Using Intersimple Sequence Repeat (ISSR) Markers

**Tabitha Ting**, Biology, DC - College of Liberal Arts and Sciences

**S. James Saunders**, Biology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

*Penstemon degeneri* (Degener's beardtongue) belongs to genus *Penstemon* (Plantaginaceae), which is comprised of over 275 species of perennial plants endemic to North America. *Penstemon degeneri* is a rare Colorado endemic that is confined in geographic distribution to Fremont, Teller, and Custer Counties. Its close sister species, *P. griffinii*, is more widely distributed in the Southern Rocky Mountains with occurrences in south central Colorado and northern New Mexico. Although presumed to be allopatric, with non-overlapping ranges, fieldwork conducted between 2007 and 2009 revealed that the two species may co-occur and hybridize. The purpose of this study was to examine the distribution of genetic diversity within and among populations of the two species using dominant molecular markers known as Intersimple Sequence Repeats (ISSRs) with a goal of identifying systematically significant variation. The ISSR marker technique uses polymerase chain reactions (PCRs) to amplify regions of *Penstemon* DNA that are flanked by microsatellite sequences. Due to a high frequency of ISSRs in the genome, there is a high probability that multiple ISSR sequences will be amplified, producing banding patterns that vary between individuals. In this study, we used three primers to generate a high number of polymorphic bands. Preliminary data revealed a relatively low level of genetic diversity within *P. degeneri* ( $H_t = 0.218$ ), as well as a relatively high inbreeding coefficient ( $F_{is} = 0.576$ ). However species specific bands were not identified.

## Undergraduate Students

### **Erythropoietin improvement of neonatal lung structure after hyperoxia is not dependent on functional endothelial nitric oxide synthase (eNOS)**

**Deandra Walker**, Biology, DC - College of Liberal Arts and Sciences

**Faculty Sponsor:** Dr. Vivek Balasubramaniam, Pediatrics (Heart and Lung Lab), AMC - School of Medicine

*Activity Type:* Undergraduate Research

Background: Bronchopulmonary Dysplasia (BPD) is a chronic lung disease of premature infants characterized by impaired vascular and alveolar growth as a result of lung injury during a critical period of lung development. Hyperoxic Exposure of neonatal mice impairs alveolarization and pulmonary vascular growth similar to human infants with BPD. Increasing lung nitric oxide (NO) production improves lung structure in this model. Erythropoietin (EPO) activates endothelial nitric oxide synthase (eNOS) and through the elaboration of NO, enhances endothelial growth and survival. EPO treatment of improves lung structure during recovery after exposure to neonatal hyperoxia. However, the mechanism by which EPO enhances lung vascular and alveolar growth is still uncertain. Hypothesis: We hypothesized that the mechanism of exogenous EPO on vascular and alveolar growth is dependent on functional eNOS. Methods: Newborn mice were exposed to 75% hyperoxia for 14 days and then treated with DARBE (long acting EPO) or saline every 4 days until 21 days of age Lung tissue was collected and fixed for morphometric analysis. Results: We found improved septation (RAC) and increased lung surface area (decreased MLI) in both eNOS deficient and wild type mice. No change in vessel density was seen. Conclusion: We conclude that EPO treatment after exposure to neonatal hyperoxia improves lung structure in the eNOS deficient mouse. These results suggest that the mechanism by which EPO enhances the recovery of lung structure is not dependent on functional eNOS.

### **Testing the usability and efficacy of bovid calcanei as ecological indicators of habitat preference**

**Acadia Whyte**, Anthropology, DC - College of Liberal Arts and Sciences

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

*Activity Type:* Undergraduate Research

In order to understand the trajectory of human evolution it is necessary to develop a contextual picture of landscape scenarios in which early hominins lived and thrived. My preliminary research, which utilized modern bovid (ie. antelope) hind limb elements as ecomorphological features to predict habitat preferences and positional behavior indicates that there is a relationship between hind limb elements' shape morphology and the animals' habitat preferences. Foot bones such as calcanei can be measured and analyzed to determine the animals' locomotor and habitat preferences, particularly the kind of environment in which they lived (eg. running fast over open terrain typical of savanna environments, maneuvering through obstacles and uneven terrain common to forested environments). As a result, antelope foot elements such as calcanei fossils commonly found at hominin sites in Africa can be used to determine the habitat that was shared by both the bovid and the hominin species at that site. Although further data collection is required to make an accurate conclusion, thus far my statistical analysis of the data indicates that an antelope's calcanei measurements can be used to correctly categorize the animal into one of four habitat types (open, light cover, heavy cover, and forest). Thus, the method used to determine locomotor behavior and habitat preference of living bovids is accurate enough to apply to fossil sister taxa, especially calcanei found at ancient hominin sites for the purpose of determining the type of habitat the fossil species lived in and indirectly providing us with proxy information on hominin paleolandscapes.

## Physical Prototype

**Nicholas Williams**, Mechanical Engineering, DC -  
College of Engineering and Applied Science

**Nikolas Lenski**, Mechanical Engineering, DC -  
College of Engineering and Applied Science

**David Baptiste**, Mechanical Engineering, DC -  
College of Engineering and Applied Science

**Ovidio Perez**, Mechanical Engineering, DC - College  
of Engineering and Applied Science

**Aaron Yi**, Mechanical Engineering, DC - College of  
Engineering and Applied Science

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

*Activity Type:* Undergraduate Research

The goal of this project was to design and build a kit system to convert a street motorcycle into a track driven, ski steered motorcycle. This conversion kit will allow the bike to be ridden on snow covered roads. There are two main assemblies, the front ski and rear track. The front ski will be made of carbon fiber. Its size will allow it to exert the same pressure on the snow as the rear track and will keep the bike stable during operation. It will attach to the existing forks by a rigid mounting bracket. The rear track assembly consists of a swingarm, jack shaft, frame and drive unit. The frame serves as the skeleton onto which the sub-assemblies attach. The swingarm connects the frame to the motorcycle. The jack shaft sits on the corner of the swingarm and serves as an indirect driveline to the drive unit. The drive unit has a drive cog and turns a commercially available snowmobile track. This bolt on system does not require permanent modification to the motorcycle. Thus the owner can install and remove the system in a short time with common tools.

**HIGH SCHOOL STUDENTS**  
**Pathways2Teaching**  
**Intro to Urban Education**  
**Montebello High School DPS**

**Team 1:**

Brianne Butler  
Tayla Conley  
Alexandra Hernandez  
Luke Washington

*Teachers and Professors' Knowledge of Foster Care System*

**Team 2:**

Alexia Covarrubias  
Destiny Darby-Harris  
Diane Hawa  
Deyanira Esquivel  
Raechelle Fields  
Cynthia Hernandez  
Jaqueline Gutierrez  
Ottauna Wiley  
Dominique Williams  
Alyssa Cereceres  
Saenae Roberson  
Michelle Saddler

*Impact of Teenage Pregnancy on Urban Youth*

**Team 3:**

Yadira Martinez  
Cynthia Monares  
Luis Machorro  
Demaekie Hobbs  
Eric Herrera

*"At Risk" Students and School Failure*

**Team 4:**

Kurtiz Warren  
Ryan Mullins  
Hector Briones-Pena  
Alfonso Mendoza-Catarino

*High School Drop-Out Rates and Issues*  
*Impact of the DREAM Act on Urban Youth*

**Team 5:**

Kuliana Fifita  
Tenise Hamilton  
Teresa Ibarra  
Taylor Jimerson

*Impact of Violence & Drugs*  
*Homeless in Urban Communities*

**MIDDLE SCHOOL AWARD WINNERS**  
**Hosted by the College of Liberal Arts**  
**and Sciences**

Twenty-four 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. 450 middle and high school students from the Denver area competed at the fair in February. The College of Liberal Arts and Sciences (CLAS) 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.

**Musaelian Alby**

Stanley British Primary School 6th grade  
Project: (Computer Sciences and Mathematics)  
Cipher: Useful Obfuscation and a Beginning  
Explorations of Cryptography  
Teacher: Sara Stern

**Kelcey Beckman**

American Academy Charter School 8th grade  
Project: (Medicine and Health Sciences) *Visual Abnormalities and the Comparison of Paper-Based and Computer-Based Testing Using Color as the Variable*  
Teacher: Amanda Lane-Cline

**Brooke Cline**

Bromley East Charter School 6th grade  
Project: (Biochemistry, Cellular and Molecular Biology) *Huddling for Heat*  
Teacher: Aubree Markwardt

**Evan Doherty and Journey Simmons**

Stanley British Primary School 7th grade  
Project: (Junior Division Teams) *Think Fast: The Scientific Study of Texting and Reaction Time*  
Teachers: Sara Stern/Heather Graesser

**Isabelle Fries**

Santley British Primary 7th grade  
Project: (Physical Sciences) *Swimming with the Drag*  
Teacher: Sara Stern  
Electricity? No  
Table top or Easel? Table Top

**Bridget Galaty**

Denver School of the Arts (DSA) 6th grade  
Project: (Behavioral and Social Sciences) *Does Personality Have a "Major" Impact?*  
Teacher: John Abbott

**Amonra Garrett-Mills**

Tubman Hilliard Global Academy 6th grade  
Project: (Medicine and Health Sciences) *Do the Chemicals in "Perms" and "Relaxers" Decrease The Strength of Keratin in Human Hair*  
Teacher: Ann Coney

**Tiye Garrett-Mills**

Tubman Hilliard Global Academy 7th grade  
Project: (Biochemistry, Cellular and Molecular Biology) *The Effects of Pesticides on The Deoxyribonucleic Acid of Rubus Idaeus (Prelude Raspberry)*  
Teacher: Ms. Ann Coney

**Kacey Godwin**

Stanley British primary school 7th grade  
Project: (Behavioral and Social Sciences) *The Accent is the Key*  
Teacher: Sara Stern

**Stephen Haag and Chandler Smith**

Cherry Creek Challenge School 8th grade  
Project: (Junior Division Teams) *Do Composite and Corked Wood Bats Improve Play?*  
Teacher: John Wiley

**Emily Holden**

West Jefferson MS 7th grade  
Project: (Earth and Planetary Sciences) *Avoiding the Surging Monster*  
Teacher: Mrs. Pond

**Natalie Hunt**

American Academy 7th grade  
Project: (Physical Sciences) *A Study of Fingerprint Temperatures and Fingerprint Quality*  
Teacher: Smith

**Johann Kailey-Steiner**

Grant Beacon Middle School 6th grade  
Project: (Engineering) *Rocket Design - How Changing Rocket Features Affects the Height of a Rocket's Flight*  
Teacher: Clarissa Miclat

**Mackenzie Mathias**

Stanley British Primary 8th grade  
Project: (Microbiology) *Diatom Algae*  
Teacher: Sara Stern

**Rebecca Moser**

7th grade  
Project: (Chemistry) *Disassembling Water:H<sub>2</sub>O Electrolysis*  
Teacher: Ron Friedrich

**Mehraud Razzaghi**

Challenge School 7th grade  
Project: (Chemistry) *Caught Ya! Capturing Carbon Dioxide*  
Teacher: John Wiley

**Danielle Renaud**

West Jefferson Middle School 7th grade  
Project: (Physical Sciences) *Yeast on a Diet*  
Teacher: Karen Griffen

**Grace Romer**

Stanley British Primary 7th grade  
Project: (Environmental Sciences) *Fountains of Fear*  
Teacher: Sara Stern

**Cailan Rowland**

Hill School of Arts and Sciences 7th grade  
Project: (Junior Division Teams) *The Difference Between Levels of pH, Nitrate and Alkalinity in the Snow from the Streets, Sidewalk, and Lawn*  
Teacher: Ms. Harrell

**Aliza Saper**

Stanley British Primary School 7th grade  
Project: (Earth and Planetary Sciences) *Sop it Up: The Best Way to Clean Up our Oil Spills*  
Teacher: Sara Stern

**Kristina Stilson**

American Academy 7th grade  
Project: (Physical Sciences) *A Comparison of Hair Thickness and its Ability to Hold Static Electricity*  
Teacher: Nikki Smith

**Hannah Urtz**

Challenge School 8th grade  
Project: (Animal Sciences) *Whoa There. Calm Your Horses. The Effect of Human Anxiety on Equines*  
Teacher: John Wiley