University of Colorado
Denver | Anschutz Medical Campus

20th Annual Student

Research and Creative Activities Symposium

Friday, April 28, 2017
Student Commons Building

WELCOME TO THE 20th Annual
RESEARCH and CREATIVE ACTIVITIES SYMPOSIUM

SYMPOSIUM SCHEDULE

9:00 – 10:00 **Check-in, Set-up, Support** **Lynx Desk, Student Commons Building (SC)**
Registration is not necessary this year; support staff will be available to answer questions.

10:00 – 12:00 **Poster Sessions**

10:00-11:00 **Session 1**: Presentations 1001-1099, odd-numbers
Student Commons 1st floor hallways
Session 3: Presentations 2001-2099, odd-numbers
Student Commons 2st floor hallways

11:00-12:00 **Session 2**: Presentations 1001-1099, even-numbers
Student Commons 1st floor hallways
Session 4: Presentations 2001-2099, even-numbers
Student Commons 2st floor hallways

10:00 – 11:45 **Session I: Ecology and the Environment** (1101-1107) **SC 1401**
Students will deliver oral presentations showcasing their scholarly activities during Sessions I-VIII.

10:00 – 11:30 **Session V: Education** (2111-2116) **SC 2018**

10:00 – 11:15 **Session VI: Cell, Molecular, & Developmental Biology** (2121-2125) **SC 2500**

10:00 – 11:30 **Session VIII: Art History** (2141-2146) **SC 2504**

12:00 – 1:00 **Session II: History Panel: Denver's Liberal Turn** (1111-1114) **SC 1401**

11:00 – 1:00 **LUNCH** **SC 2600**

11:30 – 12:45 **Session VI: Cell, Molecular, & Developmental Biology** (2126-2130) **SC 2500**

12:15 – 2:15 **Session IV: Social Sciences** (2101-2108) **SC 2000**

12:15 – 2:15 **Poster Sessions**

12:15-1:15 **Session 1**: Presentations 1001-1099, odd-numbers
Student Commons 1st floor hallways
Session 3: Presentations 2001-2099, odd-numbers
Student Commons 2st floor hallways

1:15-2:15 **Session 2**: Presentations 1001-1099, even-numbers
Student Commons 1st floor hallways
Session 4: Presentations 2001-2099, even-numbers
Student Commons 2st floor hallways

1:00 – 2:15 **Session VII: Human Biology & Public Health** (2131-2135) **SC 2500**

1:15 – 2:15 **Session III: History Panel: Constructing Racial Identity** (1121-1124) **SC 1401**

2:30 – 3:30 **Convened Session** Associate Vice Chancellor Jeff Franklin **SC 2600**

Welcome Vice Chancellor Richard J. Traystman, Office of Research
Mentor Award Chancellor Don Elliman, CU Anschutz Medical Campus
LYNx Talk Students and Mentors Co-Navigating 21st Century Challenges in Digital and Mobile Solutions to Promote Health
Dr. Sheana Bull, Community and Behavioral Health, Colorado School of Public Health
Awards Associate Vice Chancellor Jeff Franklin, Office of Undergraduate Experiences; Dean Pamela Jansma, College of Liberal Arts and Sciences; Associate Dean Marjorie Levine-Clark, CLAS

3:30 – 5:30 **Wonder Women of STEM** **SC 2500**
Panel of STEM professionals each describing her career path and experiences that have helped them to succeed in their careers. Sponsored by CU Denver WiSTEM student organization.

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University of Colorado Denver

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Happy Birthday, RaCAS, which turns 20 today! Congratulations to the dedicated faculty of CU Denver who for two decades have given their time, knowledge, and care to mentor students in research and creative activities. And congratulations to the students who have undertaken the challenging and rewarding work of apprenticing themselves in order to learn and prepare for future work and life. Yay, RaCAS!

RaCAS is a truly multidisciplinary event that honors undergraduate and graduate student scholarly activities of all types from all disciplines. With representation from the College of Engineering and Applied Sciences and College of Arts and Media through the School of Medicine and the Colorado School of Public Health, this year's symposium continues to attract participants from CU Denver and CU AMC, celebrating all student research, creative, and other scholarly activities.

Today, RaCAS will showcase the scholarly work of over 200 undergraduate and graduate students delivering over 150 presentations in an increasingly professionally relevant setting. This year, students will be communicating their scholarly activities through oral presentations, moderated panel discussions, films, posters, and other exhibits. RaCAS provides students who present with an opportunity to taste what it's like to be a professional in the discipline, while providing other students with an opportunity to become inspired, connect with a mentor, and start toward presenting at next year's symposium.

RaCAS depends this year, as in previous years, on the support of Dr. Richard J. Traystman, Distinguished University Professor and Vice Chancellor for Research. We also thank Provost Roderick Nairn, whose support has been unwavering, Chancellors Horrell and Elliman, who funded the Award for Outstanding Mentoring of Student Research and Creative Activities, and the staff of the Experiential Learning Center — they have been instrumental in making RaCAS happen. Finally, we thank the faculty who mentor our students in these High-Impact Practices (HIPs), experiences through which student learning is accelerated by engaging with real-world problems and opportunities. RaCAS truly celebrates *Learning with Purpose*, the CU Denver way. Together we are continuing to make RaCAS one of the most exciting annual events on the University calendar.

That excitement will culminate this afternoon in the awarding of approximately $4000 to students whose preparation and presentation are judged to be outstanding. That includes up to four awards totaling $400 from the College of Liberal Arts & Sciences (CLAS) Math and Science Learning and Education Signature Area; four awards totaling $2000 for students representing the four CLAS disciplinary divisions; four awards totaling $500 from the CLAS Interdisciplinary Directors' Council and the CLAS Council on Diversity and Inclusion; and two grand prizes of $500 from RaCAS. Stick around for the award presentations, and if you see Dean Pamela Jansma of CLAS or Dr. Traystman, please thank them for funding these awards.

Let's spend today learning, critiquing, admiring, questioning, and marveling at the work that our students, and the faculty members who mentor them, have accomplished. RaCAS shows us what is possible, what the future promises, and what the fruits of university learning look like at their best.

Dr. Leo P. Bruederle
Director of Undergraduate Research and Creative Activities

Dr. Jeff Franklin
Associate Vice Chancellor for Undergraduate Experiences

Exploring the Food Environment and Food Related Behavior in Skagway, Alaska

Lindsay C. Adams, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jean Scandlyn, Health and Behavioral Sciences, DC - College of Liberal Arts and Sciences

Abstract:
In my ethnographic study, I assessed the nutritional adequacy of restaurants and grocery stores in Skagway, while also exploring the ways in which Skagway's food environment and seasonal tourist economy effected food related behavior amongst the seasonal employee and local resident population of Skagway. As the number of dietary related diseases in the US continues to increase, many studies have been devoted to addressing food security and factors that influence food related behavior. However, areas such as Skagway, which are heavily reliant on tourism yet geographically isolated, tend to get overlooked. Using a mixed methods approach I learned more about food related behavior within the population through participant observation and semi-structured interviews. To assess the consumer nutrition environments in Skagway, I used a Nutrition Environment Measures Survey (NEMS), which scores food outlets on the availability, quality, and cost of fresh fruits and vegetables. I was able to gain further insight as to how the population of Skagway perceived the nutrition environment by administering surveys. Many food outlets had a low NEMS scoring, but the food environment had less of an impact on behavior than I had anticipated. My findings suggest that food choice was influenced more by social and occupational factors. Individuals with strong social bonds (and therefore people to cook and share food with) reported having diets comprised of high quality foods, such as fruits and vegetables; in comparison to individuals that reported a lack of social connectedness, as they opted for more low quality and prepackaged foods.

Using ArcGIS to Analyze the Chihuahuan Biogeographic Element in Colorado

Genevieve Barron, Masters Integrated Sciences, College of Liberal Arts and Sciences
DC - Graduate School

Jay Pecenka, Biology
DC - College of Liberal Arts and Sciences

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

Abstract:
The flora of Colorado is currently recognized as comprising eight biogeographic elements, including the Chihuahuan element. However, there is little research documenting this element in Colorado. As the largest desert in North America, the Chihuahuan Desert extends from northern Zacatecas, Mexico to central New Mexico and Arizona. The desert encompasses extreme changes in landscape ranging from the massive Sierra Madre Occidental and Sierra Madre Oriental to the many valleys below. Here, we describe research documenting the Chihuahuan biogeographic element in Colorado, specifically. To accomplish this goal, we analyzed a floristic list for the Chihuahuan Desert comprising 2326 taxa compiled by the Southwestern Environmental Information Network (SEINet). Geographic Information Systems (ArcGIS and ArcMap) were then used to isolate those species that occurred both within the traditional geographic perimeter of the Chihuahuan Desert, as well as within the boundaries of the state of Colorado.

Evaluation of honey bee health, honey production, and hive maintenance in Flow™ hives and traditional Langstroth hives

Kade G Beem, Geography
DC - College of Liberal Arts and Sciences

Vy Nguyen, Biology
DC - College of Liberal Arts and Sciences

Joseph Primm, Geography
DC - College of Liberal Arts and Sciences

Mentor: Dr. Christy Briles, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

Abstract:
Honeybees (Apis mellifera) are essential pollinators for plants that make up approximately one-third of the global food supply. Currently, honeybees are declining globally due to insecticides, parasites, and harmful pathogens. Many new bee products have hit the market claiming improved honeybee health and easier beekeeping, including Flow™ frames. Flow™ raised 12 million dollars in 2015, with no research to back their claims. Our study tested the Flow™ frames alongside traditional Langstroth frames (10 hives each) to determine if the Flow™ frames were 1) better for the bees 2) easier on the beekeeper, and 3) produced more honey. We examined pollen, honey production, parasitic mite counts, and bee microbiomes (sequencing in progress). The Flow™ frames took more time to construct, did not produce as much honey, and Fall honey did not flow from the frames as advertised. The bees sourced similar types of pollen; however, traditional hives brought in more Tilia and Plantago, indicating that Flow™ frames may result in different food collection. Flow™ frames contained a total of 86 mites, while there were 148 in traditional frames. Total honey harvested was approximately 50% more in traditional frames than Flow™ frames. Six Flow™ and four traditional hives survived through winter. The Flow™ hives experienced less mortality, likely due to bees building up the brood box rather than filling out the Flow™ frames. The study provides information on suburban bee populations along the Colorado Front Range and baseline data for future research on honeybee foraging patterns and health.

2016/2017 ARCH 3600 International Design Build

Alexander K Bender, Architecture
DC - College of Architecture and Planning

Mentor: Ms. Jo Vandenburg, Architecture, DC - College of Architecture and Planning

Abstract:
Through the fall semester of 2016 and interim of 2016, students in the College of Architecture and Planning actively engaged in the design and construction of a community center in the Jalapa Valley of Nicaragua. The fall course focused on establishing: the context of site conditions, investigating current and past issues of culture, politics, environment, building resources, and health and education within Nicaragua. This research helped to inform the design and planning of the community center. Lastly, the students partnered with the non-profit organization Friendship City Projects fundraise $12,000 for construction cost and materials. The winterium portion of the course focused on construction and documentation. Students traveled to Nicaragua to spend 10 full days on site constructing the design developed in the fall course. Students learned firsthand about thinking critically in a real-world construction environment that was relevant to local Nicaraguan cultural context. Lastly, the construction process was documented by mixing different medias such as sketching and digital drawings. We look forward to sharing our experiences with you.

Geographic Distribution and Environmental Factors Contributing to Genetic Variation in Mountain Pine Beetle (Dendroctonus ponderosae) Populations in Western North America

Marianne E Blackburn, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Gregory J. Ragland, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
In North America, millions of forest acres have been impacted by the mountain pine beetle (MPB), which normally exists at low populations and serves a beneficial role in forest health. The MPB tends to target old, weak trees and by killing them, helps future forest regeneration. However, favorable environmental conditions can lead to exponential population growth, resulting in potential epidemic population outbreaks. Larger populations may be attributed to warmer temperatures, extended dry conditions, and greater percentages of mature trees in crowded forests. Even though the most recent epidemic has eased, MPB remains a critical pest species. Dead trees provide dry wood and debris that may be susceptible to wildfire, a great concern to forest managers that strive to monitor and mitigate any hazardous conditions. Here, we apply correlational analysis to identify genetic markers associated with environmental differences across the geographic distribution of MPB. The goal is to identify genetic variants that may predict adaptation to local conditions and that may be predictive of population growth rates, using genome-wide markers previously genotyped for 34 populations distributed from Southern California and Arizona north to Northern Idaho and Washington. We used GIS layers to construct environmental variables for each population, then applied Bayesian and Latent Factor Mixed Model analysis to identify statistical associations between environmental variable and genotypes. We discuss these results in light of geographic population structure and known geographic differences in individual growth rates among MPB populations. Future genetic research may help forest managers predict movements and outbreak dynamics of MPB.

To Model or Not to Model Embryological Development, That is the Educational Question

Briauna Blezinski, Modern Human Anatomy
AMC - School of Medicine

Mentor: Dr. Lisa M.J. Lee, Cell and Developmental Biology, AMC - School of Medicine

Abstract:
Embryology, the study of embryonic development, is perhaps one of the most difficult subjects in anatomical sciences due to: the complex, 4-dimensional processes that occur in a short time frame, the reduction in instructional contact hours in graduate and medical curricula, lack of effective visual resources, and paucity in literature on best embryology educational practices. Thus, the overall goals of the project were to assess the educational value of the virtual and 3D printed heart development models created from 2D textbook diagram, and then to create a complete embryo model based on histological cross-sections. For the first part of this study, first year medical, dental and graduate students were recruited to take a pre-quiz, have an interactive session with the heart models, then complete a post-quiz and survey. Data analyses revealed that interacting with the virtual and/or printed heart models yielded a significant learning outcome. Students perceived both resources to be educationally valuable, with a preference for the 3D printed models. Based on the feedback from the first part of the study, an anatomically accurate, whole embryo model was developed from segmentation of serial embryo tissue slides. The histology slides were segmented and rendered into a 3D virtual model, using FIJI-ImageJ. The virtual model was then imported into Maya for further smoothing and modeling. The completed virtual model dataset was then 3D printed to produce a physical model. Investigating the educational value of the complete embryo model will be an important future direction to propel embryology education forward.

Draft Genomes of Four Novel Nitrite-oxidizing Bacteria Enriched from Aquatic Environments

Andrew Boddicker, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Annika C. Mosier, Department of Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Nitrification is a critical, rate-limiting step in the removal of nitrogen pollution from freshwater systems. Nitrite-oxidizing bacteria (NOB) carry out an important regulatory function in the environment by converting nitrite to nitrate, which is utilized by many microbes to facilitate nitrogen loss to the atmosphere. Very few NOB representatives have been cultured in the lab due to long incubation times and heterotrophic contaminants. However, recent genetic techniques have revealed the presence of diverse new NOB, including the Nitrolancea and Nitrotoga genera. Here, we describe the cultivation of novel freshwater Nitrotoga species, as well as the first reported Nitrotoga genomes. Four NOB enrichment cultures were initiated from water column and sediment samples from Colorado rivers in 2015. Nitrite oxidation rates in each culture ranged from 3.4-5.9 μM nitrite/hr. Genomes were assembled using an iterative strategy with MEGAHIT and SPAdes. Assembled 16S rRNA gene sequences revealed that each of the four enrichment cultures contain a single NOB with >99% identity to the three published Nitrotoga enrichment cultures, and genome completeness estimates ranged from 97.0%-98.18%. Comparisons among the four draft genomes using average nucleotide identity calculations revealed four distinct organisms ranging in identity from 83.4%-92.4%. Future efforts will be aimed at genome annotation, comparative genomics among the Nitrotoga species and other nitrite oxidizers, and RNA and protein expression studies. Our work will considerably expand our knowledge of Nitrotoga and will ultimately improve our understanding of their role in the environment and how they might respond to environmental change.

A Geometric Morphometric Analysis of Pollical Metacarpal Shaft Morphology in Pan, Gorilla, and Homo

Lucyna A. Bowland, Anthropology, College of Liberal Arts and Sciences
DC - Graduate School

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

Abstract:
A powerful, robust thumb capable of precision grasping is one of the hallmarks of humanity, and tracing its evolution can provide important information about the history of modern human hands. Muscle enthesis morphology (attachment sites for soft tissue) has long been used as a proxy for functional behaviors within extinct organisms, particularly for the muscles of the hand, which can provide information on the origins of tool use and bipedality. This paper employs 3D virtual renderings (derived from laser, CT, and μCT scans) of the first metacarpal from Pan (chimpanzees and bonobos, n=40), Gorilla (n=36), and Homo sapiens (modern humans, n=45) to accurately quantify aspects of the first metacarpal shaft morphology as it relates to muscle enthesis development (opponens pollicis and first dorsal interosseous) and overall robusticity. The results demonstrate variation both within and between the sample in muscle enthesis morphology and shaft breadth, and will hopefully prove helpful in future attempts to quantify shape differences of the thumb in primates. Moreover, the results have important functional implications for understanding the evolution of the opposable thumb present in modern humans and the powerful precision grasping that facilitated tool usage within the hominin lineage.

Sleep Quality & Maternal Attachment

Chelsey Brown, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jonathan Shaffer, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Attachment, a bond formed during the infancy period is the bond that predicts the quality of future development (Malekpour, 2007). Therefore, it is essential that mothers are emotionally available, sensitive, and coherent as their infants endure this first stage of life. It is vital that mothers are attentive to their infant's needs, and are consistent with such attentiveness, because if not, an infant's sleep quality among other developmental areas can be negatively affected. My study examines different mother-infant attachment styles and how each style affects overall infant sleep quality. I hypothesize that an insecure attachment between the mother and infant have more negative effects on the infant's sleep quality, than a secure attachment between the mother and infant. This is an important problem to analyze, as some studies have shown that infants who are less securely attached are more likely to meet the clinical criteria of sleep disorders at only six months, than their secure counterparts. In essence, my study will help to inform the population of first-time mothers to be more sensitive, emotionally coherent, and available for their infant so that less infants experience poor sleep quality. For my study, specifically, poor sleep quality is defined as frequent night wakings and sleep disorders/disturbances. Overall, my study aims to explore if there is a strong relationship between an insecure attachment and poor infant sleep quality.

What About the Children

Vanessa Buck, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Esther Sullivan, Sociology, DC - College of Liberal Arts and Sciences

Abstract:
Within the Northeast Denver area there lies the neighborhood of Swansea; however, it remains unknown to most due to its out-of-sight location under the I-70 highway. Swansea is currently facing many inequalities that are affecting the quality of life for its residents; one such inequality is the lack of high-quality walkways. Although this inequality affects everyone within the neighborhood, children that attend Swansea Elementary are severely affected. This research study investigates Swansea's walkway sites and conditions while also examining how the children's safety is affected by these poor conditions. In depth interviews with four families of Swansea Elementary are incorporated with video footage of the walkways to create a digital ethnography that portrays the families concerns and suggestions while the viewer is able to experience a walk through Swansea in the children's shoes. The purpose of this research study is to investigate and report on the need for improved walkways in Swansea. While the City of Denver has plans to expand the I-70 highway, a construction that will displace 40 homes in Swansea, it is important for the city to recognize other projects that could improve the quality of life for the residents within Swansea, and in this case, especially the children.

Fabric-Cast Concrete: Textile Waste as Eco-Formwork

Emilia Cabeza de Baca, Architecture
DC - College of Architecture and Planning

Mentor: Ms. Julee Herdt, Architecture, DC - College of Architecture and Planning

Abstract:
From robust slab foundation to slender biomorphic arches and beams, concrete is a highly adaptable and resilient material. Although it could be classified as earthen due to its predominant composition of minerals, stone, gravel and sand, concrete is a highly engineered material that carries with it great environmental cost. Life Cycle Analyses of concrete uncover human health hazards from inhalation of toxic particulate, as well detrimental ecological fallout from depletion and pollution of massive amounts of potable water, high fuel consumption from industrial machinery and overuse of wood and steel in forming and internal structure. However, much of this impact can be mitigated with conscientious abandon of antiquated, costly practices in favor of emerging sustainable construction technology. One such intervention is the use of flexible oil-based fabric as formwork in which to cast concrete. My goal was to achieve equivalent performance from sustainable concrete structures reinforced without caustic products and formed with reclaimed textile waste. Exp

FGF SIGNALING GUIDES MUSCLE PATHFINDING

Katrina Cable, Cell Biology, Stem Cells, and Development, School of Medicine
AMC - Graduate School

Mentor: Dr. Aaron N. Johnson, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
During organogenesis and regeneration it is critical that cells develop and maintain their proper patterning. Skeletal muscle patterning requires myotubes to elongate and then target the correct tendon attachment sites, in a process that resembles axon guidance. However, the mechanisms that control myotube pathfinding remain largely unknown. We hypothesize that a tendon-myotube signaling axis guides myotube pathfinding, and have used the simple yet robust embryonic body wall muscles in Drosophila as a model to understand muscle patterning. We performed RNA-seq on FACS-sorted tendons and myotubes, and found FGF signaling components are significantly enriched in nascent myotubes. FGF signaling plays important roles in cell migration and elongation, and we found that two FGF8-like ligands are expressed in tendon cells by in situ hybridization. FGF8 null embryos showed a complete loss of myotube outgrowth and elongation, as did embryos with a strong mutation in the FGF receptor Heartless. At the cellular level, FGF signaling regulates filopodial dynamics and orients filopodia at the myotube leading edge toward tendon attachment sites. Mechanistically, FGFs activate AKT signaling during myotube pathfinding, which is a well-characterized regulator of actin dynamics. This study highlights the essential role that tendon-myotube signaling plays during muscle morphogenesis, and will be the basis for future studies that investigate the mechanisms by which myofibers ultimately acquire the correct form and function.

Constructing Racial Identity in the British Empire and the American West

Rose Campbell, History, College of Liberal Arts and Sciences
DC - Graduate School

Micaela Cruce (moderator), History
DC - College of Liberal Arts and Sciences

Neil Ramirez, History, College of Liberal Arts and Sciences
DC - Graduate School

Samuel Irving, History, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Wiliam Wagner, History, DC - College of Liberal Arts and Sciences

Abstract:
This panel will explore the social and cultural construction of race in three different historical contexts. Neil Ramirez's "Education as Colonialism: The Rhodes Scholarship and the Manufacture of Colonial Masculinity in the British Empire" probes how South African mining magnate Cecil Rhodes used his Last Will and Testament to promote his vision of Anglo-Saxon manhood. By creating a scholarship for young men throughout the British Empire, Ramirez argues, Rhodes hoped to mold a new generation of colonial leaders, capable of spreading Anglo-Saxon civilization around the globe. Sam Irving's "Plowing Up the Middle Ground: The Meeker Massacre and the Changing Role of Indian Agents in the Nineteenth-Century West" examines the simmering tensions that led a band of Ute Indians to murder their Indian agent, Moses Meeker, and ten others in 1879. According to Irving, Meeker represented a new breed of Indian agent, less skilled in negotiation and more committed to aggressive assimilation than their predecessors. These characteristics put Meeker on a collision course with the Utes, who were intent on maintaining their equestrian culture. Finally, Rose Campbell's "Walt Conley and the Development of Colorado's Popular Folk Revival, 1957-1965" explores how a prominent African-American folk artist navigated the shifting racial terrain of Colorado during the mid-nineteenth century. By drawing connections between these three disparate stories, this panel aims to offer new insights into the social and cultural processes involved in the fashioning of racial hierarchies.

The Associations Among Awareness of HPV Infection, Sociodemographic Factors and Health Resources among Adult Women in the National Health and Nutrition Examination Survey, 2009-2012

Alaina L. Carr, Clinical Health Psychology, College of Liberal Arts and Sciences
DC - Graduate School

DC - David Avram, Clinical Health Psychology, College of Liberal Arts and Sciences
Graduate School

Lauren Languido, Clinical Health Psychology, College of Liberal Arts and Sciences
DC - Graduate School

Molly Huston, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jonathan A. Shaffer, Clinical Health Psychology , DC - College of Liberal Arts and Sciences

Abstract:
Human papilloma virus (HPV) is a highly prevalent asymptomatic sexually transmitted infection and the leading cause of cervical cancer in the United States. Research has yet to consider factors that may identify women with high risk HPV who are unaware of their infection. We addressed this gap in the literature using data from the 2009-2012 cycles of the National Health and Nutrition Examination Survey. Only women aged 18-59 with complete data were included in the analysis (N=591). A multivariable logistic regression model was developed in which awareness of high risk HPV infection was the dependent variable, and sociodemographic characteristics, health resources, and the number of lifetime male sexual partners were predictors. Approximately 88% of women with a high risk HPV infection were unaware of their infection. Factors that were associated with reduced odds of being unaware of an HPV infection included identifying as an other racial or ethnic group (OR=0.31, 95% CI, 0.15-0.64), having at least a high school education (OR=0.30, 95% CI, 0.13-0.69), having an income to poverty ratio greater than 350% (OR=0.42, 95% CI, 0.19-0.92) and having more lifetime male sexual partners (OR=0.96, 95% CI, 0.94-0.99). The single factor associated with increased odds of being unaware of an HPV infection was older age (i.e., 38-59 years) (OR=3.72, 05% CI, 2.02-6.82). These data indicate that most women aged 18-59 years with high risk HPV are unaware of their infection. In addition, a number of factors are associated with infection awareness, which could inform public health initiatives.

Role of nest-site vegetation in reproductive success of grassland birds

Amber R. Carver, Integrative and Systems Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Michael B. Wunder, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Bird species that occupy the same habitat have diverged with respect to microhabitat use. In breeding birds, this niche differentiation includes nest-site vegetation. Specialization in nest microhabitat suggest that there is an adaptive benefit to nesting in specific vegetation. Differences in nest microhabitat characteristics among bird species suggest that individual vegetation attributes affect species differently. This project focused on the adaptive benefit of nest-site vegetation, using grassland birds as a model community. During 2014-2016, we measured the reproductive success of ground-nesting birds at the Central Plains Experimental Range in northern Colorado. For this study, we focused on nests that failed due to predation, because this is the primary cause of nest failure in breeding birds and therefore a probable driver for nest-site distinctions. We characterized nest-site vegetation for each species, and we modeled the relationship between nest-site vegetation and nest survival probability. We found that nest-site microhabitat differed among bird species, with cover by taller grass and non-grass plant species being the primary distinction. However, vegetation was unimportant to nest survival, while maximum daily temperature and rainfall played a stronger role for some bird species. Nest-site divergence is likely driven by other life-history characteristics, such as parenting strategy, rather than by passive predator avoidance. Upcoming 2017 research will investigate other potential influences to nest-site vegetation, such as nest activity budget and defense strategy.

Computational Study in CtBP1 Protein towards Inhibitor Design

Nara L. Chon, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Eunbie Shin, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
The C-terminal binding protein 1 (CtBP1) transcriptional repressor plays a key role as a metabolic sensor. It controls cell survival and migration by binding a highly conserved Pro-X-Asp-Leu-Ser (PXDLS, X = usually hydrophobic residues) motif located close to its C-terminus in the sequence-specific DNA-binding proteins. The CtBP1-induced cellular response is also regulated by NAD+/NADH and increases the likelihood that the CtBP serves as a nuclear redox sensor. The CtBP1 dimerization occurs in response to elevated NADH levels, resulting in epigenetic regulation of multiple genes that control the cycles of cancer cells, including proliferation, survival, migration, and death.[1,2] Here, our goal is the development of peptides as CtBP1 inhibitors. As a first step, we performed the molecular mechanics energies combined with the Poisson-Boltzmann or generalized Born and surface area continuum solvation (MM/PBSA and MM/GBSA) methods for a series of peptides that contain the PXDLS motif and compared with experimental data. Acknowledgments: This work is supported by University of Colorado Denver of Research Services and Dreyfus Foundation (TH-14-028), and uses computational resources of XSEDE (140070 to the Lin lab and 160138 to Nara Chon) and NERSC (m2495). Nara Chon thanks Butcher Innovation Seed Grant Award at the BioFrontiers Institute, NSF GRFP (2016 Honorable Mention), and Kisslinger Award at the CU Retired Faculty Association for supports. Helps by our collaborators, Dr. Rui Zhao and Melanie Blevins, are greatly appreciated.

Fracking in Argentina: Institutional Changes and Coalition Mobilization

Daniel Costie, Public Affairs, School of Public Affairs
DC - Graduate School

Mentor: Dr. Chris Weible, Public Affairs, DC - School of Public Affairs

Abstract:
Collective action is a strategy used by actors to achieve policy change or maintain policy status quo. Coalition mobilization is one way actors can exercise collective action by cooperating in a non-trivial manner in the pursuit of a common set of goals. The Advocacy Coalition Framework (ACF) can be used to understand how latent coalitions emerge and develop. It is still unclear how these coalitions change as the subsystem matures. Another underdeveloped area is how change occurs as a response to perceived threats and uncertainty. In this work, we ask two questions: what are the positions and levels of agreement of those active within a nascent policy subsystem and how do those attributes change as a result of a major change in institutional rules and norms? Using network analysis, we are able to observe how the coalitions differ in terms of centrality, density, and homophily. Our findings indicate that this nascent subsystem possesses a high level of stability within the pro-fracking coalition. The pro-fracking coalition has more actors in formal leadership positions suggesting that it is a dominant coalition. Lastly, the anti-fracking coalition is less stable over time than the pro-fracking coalition as density and in-group agreement increase immediately after significant institutional change.

The Effects of Differential Housing During Adolescence on Conditioned Fear with a Social Cue

Lamya'a M Dawud, Integrative & Systems Biology, College of Liberal Arts and Sciences
DC - Graduate School

Brian A. Lloyd, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Sondra T. Bland, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
We have developed an innovative animal model for observing social behaviors following a traumatic social event. Post-Traumatic Stress Disorder (PTSD) is a stress-related disorder following a traumatic event characterized by intrusive re-experience of the traumatic event, avoidance behavior, anxiety, and aggressive behaviors. Socially traumatic events can be an underlying cause for developing PTSD. Differential housing conditions during adolescence such as post-weaning social isolation (PSI) are well-accepted animal models of early life adversity and may model vulnerability factors for developing stress-related disorders including PTSD. Previous work in our lab has demonstrated that PSI adolescent rats display more aggressive behaviors than group-housed rats. Here, we isolation-house or group-house male Sprague-Dawley rats for 4 weeks during adolescence. Using our novel model of conditioned social fear (CFS), we used principles of Pavlovian conditioning to pair a social conditioned stimulus with a foot shock unconditioned stimulus. The next day, in a novel context, experimental rats were then given 10 minutes to socially interact with the stimulus rats they were conditioned to fear. Control PSI animals displayed a significant increase in aggressive behavior than control group-housed animals, replicating our previous findings. Group-housed CFS animals displayed a significant increase in aggressive grooming compared with the group-housed controls, and did not differ from PSI animals. Our results are the first to show that a traumatic social event can change an otherwise non-aggressive animal to behave similarly to animals who experienced early life adversity following a traumatic social event which may have implications for understanding socially caused PTSD.

PRECURSOR RIBOSOMAL RNA IS ASSOCIATED WITH SPUTUM CULTURE STATUS IN TUBERCULOSIS: PROOF-OF-CONCEPT FOR A NOVEL MARKER OF TREATMENT RESPONSE

Christian N. Dide-Agossou, Epidemiology
AMC - Colorado School of Public Health

Mentor: Dr. Nicholas Walter, Pulmonary Care Division, AMC - School of Medicine

Abstract:
Tuberculosis (TB) is the leading cause of death from infection worldwide killing 1.4 million people in 2015. There is an urgent need for shorter TB treatment. A major impediment to TB drug trials is lack of early surrogate outcomes. Existing surrogate endpoints are cultured-base and poorly predictive of treatment failure and relapse. This thesis analyzes data from a proof-of-concept study of a novel molecular marker of TB treatment effect. This assay is based on abundance of Mycobacterium tuberculosis precursor ribosomal RNA in sputum. The results provide important preliminary evidence that measurement of precursor ribosomal RNA provides biologically meaningful information about drug effect in human TB.

Implementation of a NAMD/QMMM Interface

Adam Duster, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Hai Lin, Chemistry, DC - College of Architecture and Planning

Abstract:
An interface to the molecular mechanics (MM) package NAMD[1] was implemented within the program QMMM[2] in order to increase the computational efficiency of MM calculations for the combined quantum-mechanics/molecular-mechanics (QM/MM) simulation of large biomolecular systems (>30,000 atoms). With QM/MM methodologies, a system of interest can be described with high accuracy at the QM level of theory, while embedded in an environment treated with the computationally efficient MM level of theory. Because many calculations must be performed over the course of a simulation, it is necessary to use programs with high computational efficiency to ensure proper sampling of a system. Benchmark calculations for MM molecular dynamics simulations show that the speedup over the Tinker MM package ranges from a factor of 5 to >200 for calculations with approximately 4300 and 176000 atoms, respectively. Algorithms for on-the-fly topology generation were implemented to account for bond forming/breaking processes within the quantum-mechanical (QM) subsystem. These improvements will yield QM/MM simulations of longer time lengths and larger systems. Acknowledgements: This work is supported by the NSF (CHE-1564349), Camille & Henry Dreyfus Foundation (TH-14-028), and NVIDIA Corporation. This work used XSEDE under grant CHE-140070, supported by NSF grant number ACI-1053575, and NERSC under grant m2495.

Energetic and Structural Properties of Liquid Water by Hamiltonian Permuted Adaptive Partitioning QM/MM simulation

Adam Duster, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Chun-Hung Wang, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
A special combined quantum-mechanical/molecular-mechanical (QM/MM) computational method, the Hamiltonian Permuted Adaptive Partitioning (PAP) algorithm, has been applied to investigate the energetic and structural properties of liquid H2O. In PAP, atoms are reclassified as QM or MM on the fly, allowing the QM and MM subsystems to be updated appropriately during dynamics simulations. The involved calculations are interpolated according to a smoothing function to facilitate the smooth reclassification of groups as QM or MM. Here, we implement the Hamiltonian adaptive many-body correction (HAMBC)[1] to counterbalance extra forces due to smoothing functions in an effort to minimize the artifacts caused by these forces. Acknowledgement: This work is supported by the NSF (CHE-1564349), Camille & Henry Dreyfus Foundation (TH-14-028), and NVIDIA Corporation. This work used XSEDE under grant CHE-140070, supported by NSF grant number ACI-1053575, and NERSC under grant m2495.

Characterizing Motivational Changes Resulting from Distinct Behavioral Histories of Sucrose Access

Nihal A. Eltom, Biology, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Erik B. Oleson, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Approximately 2/3 of adults in the United States are either overweight or obese. Studies have shown that on average, Americans consume about 500-800 more calories per day than needed because of the availability of food, more specifically, carbohydrate rich and sucrose enriched foods (Flegal et al, 2000). Characterizing the effects of sucrose access on motivational and neurochemical markers of addiction may help to elucidate the neural basis of obesity. In the present study we are providing rats with either no access, intermittent access or unlimited access to sucrose in their home operant boxes in 23hr cycles over 28 days. Over the 28-day history, we assess for overall and circadian changes in: food intake, sucrose intake, water intake and weight gain. We then use a novel behavioral economic food seeking task and the progressive ratio schedule to assess for changes in motivation for sucrose.

A Meta-Analysis of Social Emotional Learning Outcomes in Challenge Course Programs

Anita Ferrell, School Psychology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Bryn Harris, School Psychology, DC - School of Education and Human Development

Abstract:
The objective of this study was to measure the effectiveness of challenge course programs in building students' skills related to the core competencies of the CASEL model for social emotional learning (SEL) through a meta-analysis of challenge course program studies. The total sample, from twenty control group studies, consisted of 1401 students (697 in control groups, 704 in experimental groups). Outcomes were categorized based on five core competencies of SEL: self-awareness, self-management, social awareness, relationship skills and responsible decision-making. Measures relating to self-awareness across studies had a moderate mean effect (mean d = 0.41), suggesting that challenge course programs may have positive outcomes in constructs underlying the core SEL competency of self-awareness. This study also provides new information that can help provide a framework of common language when considering program outcomes across school, experiential education and therapeutic programs.

MATTER - Expanding the VR Gaming Experience

Robert Fikes, Digital Design
DC - College of Arts and Media

Brandon Cahill, Digital Design
DC - College of Arts and Media

Mentor: Mr. Bryan Leister, Digital Design, DC - College of Arts and Media

Abstract:
Virtual Reality (VR) is being discussed in the news more and more, yet the market for it has not caught on to the level of penetration that smart devices currently have. It has been estimated that 0.5% of Americans own a VR system and the majority use it for gaming. VR has been around since the 1960s, but the main barrier to entry is price. In contrast, 92% of 18-29 year-olds in America own a smartphone or tablet and about half of them play video games on it. Virtual reality gaming is typically a solitary experience, because using a head-mounted display (HMD) removes the player real world around them. If others wish to play, they need to use another HMD, or wait their turn passively in line watching on a 2D display. We theorize that the best way to expand the VR gaming experience for others to easily participate is with devices that most people already have access to: smartphones and tablets. Through extensive research and testing, we have developed a shared gaming experience between the Samsung HTC Vive and Apple iPads. Our aim is to see if building a network between VR devices and smart devices can be a viable way to expand the virtual experience.

Simulating the Islet: Exploring Diabetes Predisposition with Computer Modeling

William L. Fischer, Mathematics (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Richard Benninger, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:
In the past 35 years, the number of diabetic patients in the United States has increased almost six fold. Unfortunately, it's not a simple condition with a single cause. Instead, diabetes refers to a family of metabolic conditions that prevent the body from correctly regulating glucose levels. Without proper treatment, this can be debilitating or deadly. Understanding diabetes, however, is as difficult as it is essential. Glucose metabolism is regulated by a vast network of anatomical systems, so there are countless abnormalities that might predispose someone to the disease. For example, in the pancreatic Islets of Langerhans, when glucose is detected by clusters of interconnected Beta-cells, a cascading signal pathway triggers the coordinated secretion of insulin. Mutations in genes that encode the many proteins involved in this signal pathway can impact the insulin response. Mutations for multiple proteins in one patient could have a cumulative effect, which could significantly increase the patient's risk of diabetes. This project used computer modeling to simulate Beta-cell insulin responses to glucose stimulation under various combinations of possible defects. The model uses numerical approximation methods to solve a series of differential equations representing a simplified signaling pathway in the Beta-cell network. The study focuses on finding peaks in insulin secretion impact when multiple defects occur simultaneously. This approach can help us determine if specific combinations of mutations may be overly detrimental to Islet function, or contribute more to the progression of the disease, which in turn could inform strategies to treat islet dysfunction and diabetes.

Elucidating the Impact of Acid Mine Drainage on the Taxonomic Structure and Functional Potential of Bacterial Communities within the Chattanooga Fen

Kelsey Foster, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Timberley M. Roane, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Fens, marshy wetlands with an accumulation of partially decomposed organic matter, are estimated to store up to a third of the Earth's soil organic carbon. The Chattanooga Fen, located in southwestern Colorado, is anthropogenically and endogenously impacted by toxic metals. The anthropogenic source of metals is Acid Mine Drainage (AMD), an acidic, metal-rich effluent formed by oxidized metals from the nearby Gold Finch Mine. The endogenous metal impact is a result of acid rock drainage (ARD) formed from natural oxidation of sulfur-bearing minerals. While the entirety of the Fen is impacted by ARD, the terrain bisects the Fen into AMD-affected and AMD-unaffected portions. This study aimed to elucidate the impact of AMD in shaping the taxonomic diversity and carbon usage of microbial communities within this uncharacterized Fen. Sediment cores were collected in July and September 2016 along an AMD-gradient and from naturally metal-impacted sediments unimpacted by AMD. Illumina sequencing of extracted 16S rDNA provided the taxonomic structure of the bacterial communities. Carbon source usage was evaluated via Biolog EcoPlates. Data suggests that differences in taxonomy and carbon source utilization can be explained by the presence of AMD. Sediments unaffected by AMD had a higher relative abundance of Acidobacteria, while Deltaproteobacteria dominated AMD-affected sediments. The microorganisms within the affected sediments utilized a higher proportion of carboxylic acids, while the unaffected samples displayed a larger usage of carbohydrates. The understanding of how metals impact the diversity and function of microorganisms within the Chattanooga Fen will be essential in influencing future management decisions.

Development of a Near-Infrared Optical Coherence Tomographic Microscope for Use in the Imaging of Neural Tissues

Thomas Fox, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Andrew Challinor, Bioengineering
DC - College Engineering and Applied Sciences

Mentor: Dr. Emily Gibson, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:
Optical Coherence Tomography (OCT) uses a series of two-dimensional tomographic images to produce a three-dimensional image of an object. OCT is based on the Michelson Interferometer, which uses the principles of optical superposition to resolve microscopic distances. This technology has found limited applications within the realm of neural imaging and surgical navigation. A near-infrared (850 nanometers) fiber-optic OCT microscope was developed to investigate its ability to produce resolvable images of neural tissues. Given by the properties of the LED diode, the microscope is capable of a depth resolution of 6.2 micrometers and a depth of field of 14 micrometers. Additionally, a virtual instrument was developed in LabVIEW to control the microscope electronically.

Synthesis of functionalized oligonucleotides of RNA using 2-methylbenzothiophenyl groups at the C2'-O-position of uridine and adenosine

Andrew J Francis, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Kokouvi Y. Dzowo, Modern Human Anatomy, School of Medicine
AMC - Graduate School

Mentor: Dr. Marino J. E. Resendiz, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Given the significant role that RNA plays in many cellular processes, methodologies to functionalize this biopolymer have shown potential uses in medical therapies. Our goal is to functionalize oligonucleotides of RNA at the C2'-O- position using photoactive groups ($\lambda max > 290$ nm) and utilize this reactivity to alter their structure reversibly. Adenosine and Uridine were functionalized with 2-methyl-benzothiophenyl units for our initial studies. The first step in the synthesis of the probe was to produce 2-hydroxymethyl benzothiophene, obtained by reacting benzothiophene with paraformaldehyde after deprotonation with n-butyl lithium. This alcohol was brominated by reacting with carbon tetrabromide in the presence of tri-phenyl phosphine to yield the corresponding 2-bromomethylbenzothiophene group (70%). Functionalization at the C2'-O- was achieved the via selective protection of the C3'- and C5'- position using 1,1,3,3-tetraisopropyl-1,3-dichlorodisoloxane and allowing its exclusive functionalization at the C2'-O- position (75%). Desilylation was achieved using hydrogen fluoride and resulted in the C2'-O-functionalized nucleoside in quantitative yields. Current focus is being placed on the synthesis of the corresponding phosphoramidites for their incorporation into oligonucleotides of RNA. In addition to this effort, electronic structure calculations that compares modified RNA duplexes to its canonical analogue using density function theory was also used to compare the stabilizing effect of RNA duplex modified with four 2-thiophenyl methyl functional groups on each strand. This simulation displayed a greater stabilization effect on the modified RNA duplexes compared to its canonical analogue. This type of modeling will guide our efforts in developing synthetic methodology.

Denver's Liberal Turn: Politics and Protest in the Mile-High City since 1960

Kayla Gabehart (moderator), History, College of Liberal Arts and Sciences
DC - Graduate School

Sam Herbst, History
DC - College of Liberal Arts and Sciences

Christin Avent, History
DC - College of Liberal Arts and Sciences

Marina Mecham, History
DC - College of Liberal Arts and Sciences

Mentor: Dr. Chris Agee, History, DC - College of Liberal Arts and Sciences

Abstract:
This panel will explore the rise of liberals and transformations in liberalism in post-1960 Denver. In particular, the panel will examine how liberal politics in the Mile-High City reshaped the relationship between citizens and the government. Sam Herbst's "Professionally Corrupt: Criminal Incest in the Denver Police Department, 1959-1962" discusses the emergence of clean-government liberals in the 1960s. Herbst shows how attempts to rid the police department of corruption ultimately expanded the street-level power of the police. Christin Avent's "Conflicting Solidarity: How Denver's First Mexican-American Mayor Buried a Chicano Identity and Gentrified North Denver" explores Chicano efforts to mobilize political power through the control of spaces like the La Raza Park pool. Those spaces were critical to the rise of Frederico Peña, who used a multi-racial liberal coalition to win the mayor's race in 1983. As mayor, however, Peña sought to build a new liberal coalition oriented around downtown interests. Towards that end, Peña eliminated Chicano organizing spaces like La Raza Park pool. In "Murder on the Picket Line: Operation Rescue and the Legal Battle Against Abortion in the Denver-Metropolitan Area, 1989-1993," Marina Mecham examines the regional importance of Denver liberalism. During the 1980s, Colorado provided abortion services to women from bordering states that lacked abortion rights. Anti-choice activists from those bordering states thus turned their sites on Colorado. Ultimately, Denver's women's rights activists repelled this anti-choice campaign and ensured that Denver would remain a health service provider for women from throughout the Interior West.

Liberty and Corruption a Duality of Us

Alex Galindo, Painting and Drawing, Visual Arts
DC - College of Arts and Media

Mentor: Ms. Melissa, Furness, Visual Arts, DC - College of Arts and Media

Abstract:
This is a creative depiction of the duality of leadership the exists in America. With modified American Icons becoming the platform for a display of divided paradigms. It explores the different viewpoints of the figures who stood as great figures of liberty and humanity, vs the corrupt clowns and that have found their way to power.

Social Justice Organizing in Diverse Communities

Nancy Garcia, Ethnic Studies
DC - College of Liberal Arts and Sciences

Alejandra Armenta, Ethnic Studies
DC - College of Liberal Arts and Sciences

Hue Phung, Ethnic Studies
DC - College of Liberal Arts and Sciences

Alexandra Yeager, Ethnic Studies
DC - College of Liberal Arts and Sciences

Mentor: Dr. Donna Martinez, Ethnic Studies, DC - College of Liberal Arts and Sciences

Abstract:
Ethnic Studies Puksta Fellows panelists addressed housing, health, educational, and access disparities for immigrant families and historically underrepresented communities in Denver through their internships and research in a variety of non-profits. Their roles as community organizers empowered immigrant parents who struggled with housing rights in Denver neighborhoods, patients in the healthcare system, bilingual and lower income families seeking access to veterinary care for their family pets, and first generation underrepresented college students. This work revealed the critical need for culturally responsive advocates in working for social justice in diverse communities.
Garcia: Organizing Immigrant Families for Housing Rights
Armenta: Navigating Health Care Access for Immigrant Families
Phung: Mentoring Asian American Students
Yeager: Barriers Immigrant Families Face in Veterinary Health Care

Investigating Roles for FTO and Gsk-3 in Stem Cell Pluripotency

Sanju Garimella, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Christopher Phiel, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Glycogen synthase kinase-3 (GSK-3) is a protein kinase involved in many intracellular regulatory events. A novel role for GSK-3 was recently discovered by our lab – the regulation of mRNA methylation, referred to as m6A (methylation of adenosine bases at the C6 position). The m6A modification of mRNA is believed to control the stability of mRNA, and thus the persistence of gene expression. We have found evidence that GSK-3 controls m6A levels by regulating the enzyme that demethylates mRNA, FTO. In this study, a FTO lentivirus was made and wild type mouse embryonic stem cells (WT mESC's) were infected to create a stable cell line with FTO over-expression. A stable cell line has also been created using WT S33A cells, a cell line with a point mutation on serine 33 to adenine in the beta-catenin pathway. Progress on these studies will be presented in the report.

Adaptive Partitioning QM/MM Study of Proton Transport through EcCLC

Christina M. Garza, Public Health
DC - College of Liberal Arts and Sciences

Adam W. Duster, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Members of the CLC family include both Cl– channels and Cl–/H+ antiporters and are key to several processes including extreme acid response, lysosome acidification, and muscle and neuron excitation. Malfunctioning CLC proteins are responsible for a number of rare, incurable human diseases. Detailed mechanism of transport of protons through the EcCLC Cl–/H+ antiporter has largely remained unclear despite clues from both experimental and computational approaches. A major barrier to computational models has been the difficulty simulating the involved bond-breaking and bond-forming events necessary to pass protons from one molecule to the next. To explicitly model proton transfer through EcCLC, we employed our adaptive partitioning (AP) quantum mechanics/molecular mechanics (QM/MM) method, which is uniquely capable of simulating such events. Our data largely agrees with the existing mechanism, and demonstrates for the first time a direct interaction between the transferring proton and the chloride bound in the central binding site during dynamics simulations. This information provides insight into the coupling of the proton and chloride pathways, which is a critical component in the understanding of EcCLC's transport mechanism. Acknowledgments: This project is supported by the NSF (CHE-1564349), XSEDE (CHE-140070), NERSC (m2495), the Camille and Henry Dreyfus Foundation (TH-14-028), and the Undergraduate Research Opportunity Program of the University of Colorado Denver. We thank Prof. E. Tajkhorshid for the geometries from MM simulations.

EMC Field Probe Measurements Excited with Modulated Signals

Ryan Gillespie, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark Golkowski, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
For years, electromagnetic compatibility (EMC) testing has been used to measure field strength emitted from electronic devices whether the signals were accidental or intended. These testing structure allows devices to operate within FCC regulations which ultimately allows for several devices to coexist in an environment without interfering with one another. To measure these fields, the device is often put in an anechoic chamber and a field probe is used to conduct the measurements. Manufacturers of the field probes often calibrate and engineer their design based on continuous waveform (CW) tones. In this work, a field probe was used to measure different types of signals from CW to LTE. The goal was to see how accurate the readings are when modulated signals are introduced.

Assessment of Upper-Division Student Responses to True/False Questions Addressing Evolution and Genomics

Chelsey Lee Grassie, Science Education, School of Education and Human Development
DC - Graduate School

Mentor: Dr. Robert M. Talbot, Science Education, DC - School of Education and Human Development

Abstract:
Innovations in microbiology depend on evolutionary theory and genomics to advance practical uses of microbes such as for probiotics, and battle nearly untreatable diseases including seasonal influenza and antibiotic resistant Staph infections. While ample research indicates that students struggle with both evolution and genetics concepts, upper-division students are rarely the subject of study. Thus, the goal of this project is to assess how upper-division students respond to 22 questions regarding evolution and genomics, including concepts of: (1) general evolution theory, (2) mutation, (3) natural selection, (4) genetic drift, (5) genetic polymorphism, and (6) fitness. One-hundred and sixty-seven students averaging 93 college credits (senior status) responded to true/false statements addressing the six concepts listed above. Undergraduates from this Midwestern research university included microbiology majors (30.2%) and non-microbiology majors (69.8%), with pre-pharmacy students comprising the majority of respondents. Questions were developed by an expert in the field of microbiology and genomics, and descriptive statistics were assessed. Preliminary results on 42 responses indicate that students largely can address concepts of general evolution theory (87.5% class average), mutation (77.8%), and natural selection (77.8%). However, they struggle with concepts of genetic drift (56.5% class average), genetic polymorphism (57.1%), and fitness (59.5%). The average individual score was 71.0%, and scores were normally distributed (skewness: -0.19). Future work will analyze the remaining 125 responses and assess student responses by individual questions.

Dopamine Release in the Medial Dorsal Striatum During Voluntary Exercise

Natalie M. Haddad, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Benjamin Greenwood, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Despite the clear health benefits of physical activity, the participation in exercise by the general public is in constant decline. Identifying factors contributing to motivation to participate in exercise could have dramatic effects on quality of life. The neurotransmitter dopamine has been shown to play a crucial role in movement, reinforcement, and goal-directed behavior. There are two well-characterized patterns of dopamine release: tonic and phasic. Tonic is characterized by spontaneously occurring baseline release, and phasic by high-frequency, burst-firing which can drastically increase dopamine efflux. Indeed, phasic DA increases signaling through low-affinity dopamine 1 receptors thought to be particularly important for reinforcement and the promotion of movement. There is a general assumption that physical activity increases dopamine concentrations in target brain areas that promote reinforcement and movement, however the effect of voluntary exercise on phasic dopamine release has not been investigated. We characterized phasic dopamine release events in rats during voluntary wheel running using fast-scan cyclic voltammetry. Phasic dopamine release was measured in the dorsal striatum before, during, and after an acute voluntary wheel running bout, in rats with a history of between 1 and 3 weeks of prior nightly exercise. Data indicates that phasic DA release in the DMS increases during a running bout. As exercise behavior becomes habitual, the DA concentration decreases but the frequency of release events remains elevated. These data represent the first characterization of phasic dopamine release events during spontaneous, voluntary exercise, and could provide novel insight into the role of dopamine in guiding motivated behavior

Borderlands between Egypt and Nubia: Effects of Conflict on Health

Sewasew Haileselassie, Anthropology, College of Liberal Arts and Sciences
DC - Graduate School

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

Abstract:
Bioarchaeological study of Egypt and Nubia has an extended history that focuses on health and activity patterns of populations. This study uses data from published research in combination with new data to investigate the presence of a borderland effect in the Nile River Valley. Both historically and prehistorically, Egypt and Nubia extensively interacted through trade, political negotiations as well as through cultural intermixing. The two empires often interacted in border conflicts, sometimes completely ruling over one another. Such interactions resulted in border areas with culturally and ethnically intermixed population. One of these populations available for bioarchaeological study is El-Hesa. El-Hesa, situated at the first cataract of the Nile, has persisted in between the two empires for much of recent history. Cemeteries from El-Hesa were excavated between 1908-1911, providing skeletal elements from the late Roman to early Christian period. The skeletal collection at The American Museum of Natural History (AMNH) consisting of mostly adult individuals provides a case study to explore the effect of political change on the health of individuals through observation of trauma, skeletal markers of dietary stress such as cribra orbitalia and activity stress markers such as degenerative joint disease. This study compares data from El-Hesa with data for populations in Egypt proper and Nubia proper for the period as well as with populations temporally preceding and following. The goal here is to explore the effect living in border areas has on the health and quality of life of populations using the El-Hesa collection as a case study.

Using FRET and Lipid Coated Gold Nanoparticles to Monitor Synaptotagmin 7 C2A Facilitated Liposome Apposition

Desmond J Hamilton, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jeff D. Knight, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Synaptotagmin (Syt) proteins are composed of tandem C2A and C2B domains that mediate exocytosis by binding to anionic membranes when cytosolic Ca2+ concentrations increase in neuronal and endocrinal cells. Syt1- and Syt7-C2A domains have distinct differences in anionic lipid binding affinities, yet the biological consequences of this remain unanswered. For example, Syt7 C2A's capacity to trigger membrane apposition and liposome clustering was previously unknown. Here, we show that Syt7 C2A can initiate membrane apposition and liposome clustering with the localized surface plasmon resonance (LSPR) of lipid-coated gold nanoparticles (LCAuNP), förster resonance energy transfer (FRET) assays, and dynamic light scattering. Markedly, changes in the LSPR of LCAuNPs were observed with only 9.3 nM Syt7 C2A. Furthermore, of the three sizes investigated, 40, 55, and 77-nm diameter LCAuNPs, the 77-nm had the fastest rate constant for Syt7 C2A mediated clustering. Protein-membrane and inter-liposome FRET assays were used to demonstrate distinct Ca2+ and Syt7 C2A concentration dependent events: Syt7 C2A binding, then liposome apposition, followed by aggregation. A liposome competition FRET assay showed that Syt7 C2A remains bound to anionic membranes in the presence of 100 μM Ca2+, indicating high membrane binding affinity. LCAuNPs were added to the inter-liposome FRET assay inducing a 2-fold increase in FRET due to nanoparticle enhanced energy transfer (NEET). As a whole, LCAuNP biosensors act as highly sensitive detectors that can report on protein-mediated apposition events prior to large-scale aggregation. Finally, energy transfer through LCAuNPs with NEET may allow for deeper investigations into the dynamics of bio-molecular systems.

Teaching Happy: a Look at Variance in Positive Psychology University Courses and Massive Open Online Courses (MOOCS)

Michael D. Harris, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Krista W. Ranby, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
An emerging science of well-being and happiness now allows citizens to seek reliable information about what happier people do (correlational findings) and even what activities tend to make individuals happier (causal findings). While advice about happiness has historically only been available in speculative or anecdotal forms, research-based information about positive emotions and "the good life" is now available to a wide audience. Two sources students can draw on for education in the research literature on well-being and happiness are positive psychology courses in traditional university settings and positive psychology MOOCS (massive online open courses). The number of these courses available has increased dramatically in the last ten years. However, to the author's knowledge, no research has yet examined the homogeneity of topics being taught in this newfound science at both local and international levels. The research conducted contains 1.) an examination of the frequency of topics taught in positive psychology courses across the U.S. and 2.) a content comparison between the average positive psychology college course and the positive psychology MOOCS currently available.

Determining the Enzymatic Degradation of RNA Containing 8-oxo-7,8 dihydroguanine

Cassandra C. Herbert, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Marino J. E. Resendiz, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
The focus of this study relies on the use of ribonucleases to assess local and global changes in RNA structure due to the oxidative lesion, 8-oxo-7,8 dihydroguanine (8-oxoG). Strands of RNA containing 8-oxoG were comparatively analyzed to determine changes in enzymatic degradation. Analysis of enzymatic degradation was accomplished via electrophoretic analysis (PAGE). The ribonucleases used in this study are RNase T1 and RNase A. Due to the conformational change at 8-oxo-G sites and the H-bonding pattern that is equivalent to those expected from pyrimidine containing nucleobases, data confirms that 8-oxoG is a substrate for RNase A and not a substrate for RNase T1

An Aquaponics Life Cycle Assessment: Evaluating an Innovative Method for Growing Local Produce and Protein

Rebecca E. Hollmann, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentors: Dr. Greg Cronin, Integrative Biology, DC - College of Liberal Arts and Sciences and John Brett, Anthropology, College of Liberal Arts and Sciences

Abstract:
In most states, only one to two percent of the food consumed comes from a source within one hundred miles. The transition of food production to an industrialized global system has increased the use of artificial fertilizers, pesticides, and fossil-fuels, which negatively affects the environment, human health, and local economies. Actively promoting, optimizing, and investing in local food systems can reduce society's reliance on industrial food production. This study is a life cycle assessment (LCA) of a local food production system known as aquaponics. Aquaponic farming is a system designed to produce protein and vegetables using minimal resources and producing negligible waste. This research evaluated the global warming potential, energy use, and water dependency of a local aquaponics system. These values were then compared with literature studies of traditional agriculture, hydroponics, and aquaculture. The LCA found that aquaponics yielded 22.02 kg WM/m2 of lettuce production, 560% higher than traditional soil crop yield of 3.90 kg WM/m2, but lower than the hydroponic yield. Aquaponics had a lower water dependency than traditional agriculture, 0.06 m3/kg to 0.25 m3/kg respectively, but a higher water dependency than hydroponics at 0.02 m3/kg. Aquaponics had a global warming potential of 8.50 kg CO2 equivalency per kilogram of fish production, which was slightly higher compared to other aquaculture systems. All other aquaculture systems had a higher energy use and water dependency compared to aquaponics. Understanding the costs and benefits of aquaponics may lead to better system management and long-term decisions on the sustainability of the system.

Properties of Electromagnetic Waves from the Near-Earth Space Environment

Poorya Hosseini, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark Golkowski, Electrical Engineering, DC - College of Engineering and Applied Sciences

Abstract:
The research I am pursuing for my PhD thesis involves studying the theoretical and numerical aspects of two types of electromagnetic waves in the near-Earth Space environment. These waves are called extremely low frequency/very low frequency (ELF/VLF) chorus and hiss and they are known to play an important role in the distribution of energetic electrons in the Earth's radiation belts. It is well known that the near-Earth space environment is extremely variable and hosts a large number of physical processes which pose a significant hazard to satellites and astronauts. Although these waves can be observed in situ on spacecraft, ground-based observing stations can provide orders of magnitude higher data volumes and decades long data coverage essential for certain long-term and statistical studies of wave properties. My project involves the theoretical and numerical analysis of ground observations of hiss and chorus observations from different stations in Alaska. The main impact of my work will be to further understanding of chorus and hiss generation, propagation, and their impact on the Earth's radiation belts. This will allow for improved forecasting of space weather which affects a large class of technological systems.

"Bless 'Em:" The Forgotten WACs of Colorado's Camp Hale

Brittany A. Huner, History, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Rebecca A. Hunt, History, DC - College of Liberal Arts and Sciences

Abstract:
During World War II, Camp Hale in Pando, Colorado served as a training post for the United States Army. The camp is most known for the training of the 10th Mountain Division "Ski Troops." However, most of the literature on Camp Hale's role in World War II has neglected to discuss the other large group also housed at the camp. The Women's Army Corps (WACs) sent almost 200 women to Camp Hale to train and work alongside the Army men. In my paper, I analyze both the role of WACs at Camp Hale and their portrayal in contemporary scholarship. Using the Camp Hale Ski-Zette, the camp's newsletter, I examine the way the Camp Hale soldiers talked about the WACs at the programs beginning and when WACs were first stationed at the camp. My paper also examines the historiography of Camp Hale, primarily how the WACs have been left out of the story of Camp Hale. Only two recent authors have examined the WACs and I look at both of their efforts, which include a book and a 2004 online exhibit. Although the primary documents written by the soldiers at Camp Hale reveal that they considered the WACs to be an important part of the war effort, most recent scholarship has practically left the WACs out of the Camp Hale story. The two authors that address the role of the WACs represent how the field of women's military history still needs to expand in future scholarship.

Large-Scale Prediction of Prokaryotic Optimum Growth Temperature Based on Genomic and Proteomic Features

Mallika R. Iyer, Masters of Integrated Sciences, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Christopher S. Miller, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Prokaryotes consist of bacteria and archaea, and are known to grow in environments spanning a wide range of temperatures. For example, microbes inhabit waters below arctic ice and near-boiling hot springs. Many studies have been conducted to identify the genomic and proteomic features that allow prokaryotes to grow at such temperature extremes. For example, it has been found that the fraction of certain amino acids (IVYWREL) in cellular proteins, dipeptide frequencies, and the fraction of more thermostable GC base pairings in ribosomal RNA (as compared to less thermostable AT base pairings) are all correlated with prokaryotic optimum growth temperature (OGT). However, these studies were performed 5-10 years ago on small, phylogenetically biased datasets available at the time. Furthermore, none of these features by themselves are accurate predictors of OGT. With advancements in DNA sequencing technologies, genome databases have increased exponentially in size. This gives us the potential to validate these previously found correlations and expand upon their use as predictors of OGT. The ability to accurately predict OGT has implications for understanding how small shifts in environment temperature could affect microbial community structure. In this talk, I will present my work on describing correlations between genomic and proteomic features and OGT for thousands of prokaryotes. Although these features show a stronger correlation for high temperature prokaryotes than low temperature ones, our results suggest that using a combination of features has the potential to provide a more accurate predictor of OGT across a broad range of temperatures.

The Oxytocin Receptor Gene and Posttraumatic Growth Modulate the Effects of Stress on Prosocial Behavior

Robert Jirsaraie, Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. David S. Albeck, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Previous research that has analyzed the effects of stress on prosocial behavior (actions that are intended to benefit others) have reported mixed results. Some studies suggest that stress increases prosocial behaviors, while others suggest that stress decreases them. These inconsistencies may result from unexplored factors that modulate the relationship between stress and prosocial behavior. For instance, some studies did not measure the oxytocin receptor (OXTR) gene subtype, which is strongly associated with prosocial behaviors, while other studies have not considered the positive outcomes of stressful experiences, such as post-traumatic growth. This study is designed to account for all these variables by investigating how environmental stress, post-traumatic growth, and the OXTR gene subtype interact to influence prosocial behaviors, such as cooperation and charitability. The collected data is currently being analyzed, and will be ready for presentation by the time of the symposium. The purpose of this study is to identify factors that modulate the effects of stress, and determine the specific conditions when stress enhances and inhibits prosocial behaviors.

Religious Art and Iconography: The Efficacy and Confines of Christian Appropriation of Pagan Images and Symbolism in Medieval and Renaissance Art

Emily L Joern, Art History
DC - College of Arts and Media

Mentor: Dr. Yang Wang, Art History , DC - College of Arts and Media

Abstract:
The use of pagan iconography, symbolism, and concepts in early Christian art on through the Renaissance has long been dissected in the art historical field by scholars such as Don Cameron Allen and Robin Margaret Jensen, both identifying an intimate connection. Jensen thoroughly analyzes pagan icons and symbols used by Christians in art while Allen argues that just as pagans initially persecuted Christians, as the pagans quietly dissolved, Christianity took a strong stance against earlier religions. Credible scholars such as Allen and Jensen who analyze this relationship between the religions' art and ideology have not adequately addressed the values and limitations of such creative appropriation. My paper addresses the ways in which this adaptive behavior was both beneficial in ways while also having confines. Specifically in my project, I will be looking at emblems such as the cross and the fish and these signs' various denotations and connotations in Christianity juxtaposed with their origin in pagan religions. I will identify images of deities from the pagan pantheon and juxtapose them with the various representations that they inspired of Christ such as the good shepherd and Christ as the Son of God. I argue that Christian dogma would not have been able to flourish without the aid of allegorical and iconographic artwork, especially that artwork produced during the Renaissance. In conclusion, this project, by closely examining Christian appropriation of pagan images and beliefs, sheds new light on the neglected issue of both the values and limitations of artistic appropriation.

Supermodel (You Better GesamtkunstWERK!): RuPaul's Drag Race Seen Through Richard Wagner's "Total Work of Art"

Elena K. Jones, Art History
DC - College of Arts and Media

Mentor: Dr. Yang Wang, Art History, DC - College of Arts and Media

Abstract:
More than ever before, gender norms and identities are being challenged in the mainstream American media. RuPaul Charles is host of RuPaul's Drag Race on Logo TV and VH1; he is arguably the most famous drag queen in the world. The program showcases talented drag queens from around the country in a reality TV show setting. The queens are challenged to sing, dance, act, make couture clothing, and perform comedy to win the title of "America's Next Drag Superstar." The multidimensional pageantry of Drag Race can be compared to Richard Wagner's notion of Gesamtkunstwerk, introduced in 1849, which describes opera as "a total work of art." I argue that RuPaul's show attempts to reincarnate Gesamtkunstwerk through drag queens as a way to normalize and legitimize drag performances. Wagner used highly innovative devices in his productions to enrapture the audience without interruptions, similar to the editing and framing used in television. Through the televised commercialization of drag, Drag Race encourages queens to become "total works of art" in order to reach their full potential as performance artists while simultaneously providing inspiration for anyone who is not accepted in society. Drag Race has explicitly contributed to the successful careers of those who compete on the reality TV show; the drag queens travel the globe and perform as well as produce music, write books, create drag merchandise, and more. By featuring drag queens' multifaceted talent in dizzying, sensory-loaded settings, RuPaul's Drag Race reactivates the celebrated art form of the Gesamtkunstwerk and implicitly suggests drag's relevance in mainstream, cisgender society.

"Don't Put a Carrot on a Stick in Front of Me:" Incentive Pay and the Deskilling of Teachers' Work in a Neoliberal Era

Sarah R. Jordan, Sociology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Jennifer A. Reich, Sociology, DC - College of Liberal Arts and Sciences

Abstract:
Increasingly, public school teachers are subjected to evaluation that is often used to structure their compensation. These programs claim to increase teacher quality and retention. Denver Public Schools (DPS) has led the nation in adopting an aggressive "pay for performance" system. Ten years in, Denver shows high teacher turnover with only roughly half of teachers continuing in the district past their first three years. Yet little is understood of how teachers who remain in schools under these merit-based pay systems experience changes to their worker identity and manage decisions about long-term career investment. Drawing on qualitative data collected from in-depth, semi-structured interviews with veteran public school elementary teachers, this study examines the experiences of public school elementary educators who worked in DPS before and after the implementation of pay-for-performance compensation and identifies some of the unintended consequences of a merit pay model that requires ongoing evaluation by superiors. Specifically, I examine how challenges to teacher worker identities as veterans and experts under an incentive pay policy contribute to an ongoing deskilling and devaluation of teachers' work.

Historical Occurrence of Intersex in Fishes

Harmanpreet K. Kang, Biology
DC - College of Liberal Arts and Sciences

Marian Evans, Psychology
DC - College of Liberal Arts and Sciences

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

Brigitte Nguyen, Public Health
DC - College of Liberal Arts and Sciences

Mentor: Dr. Alan M. Vajda, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
The primary objective of this project is to utilize museum collections to determine whether the recently observed high incidence of intersex in largemouth bass (Micropterus salmoides) and smallmouth bass (Micropterus dolomieu) precedes the widespread use of synthetic estrogenic contaminants. We have secured access to several museum collections of these species sampled approximately 25, 50, and 100 years ago. The collected tissues were dehydrated in a graded series of alcohol, embedded in paraffin wax and sectioned with a microtome. Slides were stained with hematoxylin and eosin, and coverslipped before microscopic evaluation. Investigation of archived museum samples to address long-term trends in the effects of environmental contaminants on reproduction is an innovative approach to address an emerging eco-human health issue, and has broad transferability for the evaluation of contaminant trends in diverse populations, globally.

Self-illuminating Nanoparticles for optical imaging

Rupinder Kaur, Chemistry, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jung-Jae Lee, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Molecular imaging is a fast growing field utilizing molecular probes that emit signals from the site of probes' localization and activation. Molecular imaging is amenable to the early identification of disease, facile monitoring of treatment, and acceleration of drug discovery. Fluorescent probes and labels have been of great importance in optical imaging but shown an obvious limitation of restricted tissue penetration for in vivo optical imaging. However, dyes emitting near-infrared (NIR) radiation with wavelengths in the region of 650-900 nm have a distinct sensitivity advantage due to diminished Raman scattering and low background of autofluorescence. Luminescent sensors provide an advantage of deeper tissue penetration with a high optimal target background ratio. We have recently discovered a unique set of NIR dyes that emit both chemiluminescent and fluorescent, and we have fabricated nanoparticles for dual modality optical imaging. The chemiluminescence is thermally-activated (that is, no chemical or electrical stimulus is needed) which means that the nanoparticles can be stored at low temperature (< 4 oC) and they only become chemiluminescent when warmed to body temperature. Preliminary results in mice show that chemiluminescence imaging permits identification of target sites that are more than two centimeters below the animal surface, which is about five times deeper than currently achieved using planar fluorescence imaging. A new imaging paradigm with self-illuminating nanoparticles including chemiluminescent and fluorescent will be demonstrated with experiments using relatively deep-tissue orthotopic and spontaneous tumor models in rodents.

Rock Art Stability in Grenada

Cayla D. Kennedy, Geography (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr Casey D Allen, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

Abstract:
During Dr. Casey Allen's Maymester 2015 field study program "Sustainability in the Caribbean", certain heritage sites, locally named "Carib Stones," were documented thoroughly and assessed for their geologic stability using the Rock Art Stability Index (RASI), a non-invasive rapid assessment that evaluates over three dozen rock decay variables. Prior to assessment, a group of well-meaning volunteers cleaned and potentially damaged one of the 1000-year-old petroglyph (rock art) sites. Two sites (Mount Rich and Duquesne Bay) had been assessed in previous years using RASI. While on-island in 2015, two additional sites (Victoria and Waltham) were discovered and preliminarily assessed for stability, but their precarious locations necessitated further study. Reassessments of the Victoria and Waltham sites in 2016 showed both sites in stable condition, but the setting around each of the sites caused some concern for the future of the Carib Stones. At the Victoria site, the boulder with petroglyphs is situated just below the major ring road, in a storm drain on the beach, and has previously been used as a trash dumping site. The Waltham site contains two boulders with numerous fading petroglyphs, and both sites are located on private property, near to the ocean and an ephemeral stream, and within reach of pets, people, and livestock. For each of these, the concerns listed may cause an acceleration in decay that may not occur if the petroglyphs were protected. This research highlights such concerns and lays the baseline for future geologic assessments for the Victoria and Waltham sites.

Superconducting Quantum Interference Devices on Tip

Steven Kenney, Physics
DC - College of Liberal Arts and Sciences

Jessica Nelson, Physics
DC - College of Liberal Arts and Sciences

Annastasia West, Physics
DC - College of Liberal Arts and Sciences

Jonathan Yang, Mechanical Engineering
DC - College Engineering and Applied Sciences

Mentor: Dr. Martin E. Huber, Physics, DC - College of Liberal Arts and Sciences

Abstract:
An effective method to understanding fundamental physics is magnetic field imaging at the nanoscale. However, to measure a field at this scale, one needs a highly sensitive sensor, namely the superconducting quantum interference device (SQUID) on tip (SOT), which operates with nanoscale resolution and maintains the capacity to operate within a similar distance from the system of interest. Resulting from this combination is the capacity to measure magnetic fields of a single electron. We are assembling a vacuum-sealed probe which, when cooled to temperatures near absolute zero, will allow us to study and optimize properties of the SOT. Additionally, we are setting up a Data Acquisition (DAQ) system to efficiently run our instruments as well as reading data. Our short-term goals are to finalize the assembly of the probe, instrument the superconducting amplifier, and confirm the functionality of the SOTs that were sent to us by our collaborators in Israel. Long-term research will mostly involve studying high-frequency properties of the SOT and using this information to optimize SOT sensitivity.

Defying Gravity, Defying Expectation: A Progressive Ballet Piece

Katherine C. Ketcham, Biology
DC - College of Liberal Arts and Sciences

Mentor: Mrs. Trishia Vasquez, Pre Health Professions, DC - College of Liberal Arts and Sciences

Abstract:
As a premedical student I am ever curious about the human body. To test its limits and to get a better consciousness of its harmony, balance and expression I delved into ballet. Ballet is the constant tension to appear ethereal despite its emotional and physical challenges making it the optimal dance for my analysis. After volunteering with the Colorado Ballet and the Denver Ballet Theatre Academy and attending a ballet course at Metropolitan State University of Denver I felt the style was severely limited by its characterization as perfect disciplined movements with set ethnic, socioeconomic statuses and genders. To begin remedying this I took the basis of the Vaganova method and choreographed a piece that defies those stereotypes while still accentuating its grace and emotion. The Vaganova method is a traditional Russian technique that focuses on lengthening through each body segment. The choreography has this elongation as its basis but adds other expectations in the construct of the creative and progressive piece.

Role of 2-Arachidonoylglycerol on Aggressive Behavior and Medial Prefrontal Cortex Function in Male or Female Rats

Tassawwar A. Khan, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Sondra T. Bland, Psychology , DC - College of Liberal Arts and Sciences

Abstract:
Normal social experiences early in life are critical for the development of healthy social function. Rats that experience social isolation during adolescence are observed to have aggressive behaviors, providing an animal model of early social adversity. In this experiment, the drug MJN110 was used to determine whether increasing the endocannabinoid 2-AG would reduce the aggressive behavior of isolated rats. The mPFC (medial prefrontal cortex) was studied as it regulates social behaviors. MJN110 is a MAGL (Monoacylglycerol Lipase) inhibitor, which inhibits the breakdown of 2AG. Male and female rats were assigned to group housing or isolation for 4 weeks, then received either vehicle or one of two different doses of MJN110. Then, half of the rats had a single 10-minute trial of social interaction with a novel stimulus rat while the other remained in their cages. MJN110 the aggressive behaviors of the socially isolated rats but had no effect on non-aggressive social interaction. Next, analysis of the mPFC took place with observations of glial and neuronal cell expressions for p-MTOR (phosphorylated mammalian target of rapamycin) pathway, which is a marker for neuronal plasticity. However, the results indicated that there was no relation between MJN110 administration and its subsequent behavioral changes with neuronal and glial cell expression in the mPFC, as no effect of MJN110 was observed on p-mTOR in the mPFC.

Investigating Perceptions of the Relative Importance of Multiple Intelligences in Chemistry

Alexandra Khong, Biology
DC - College of Liberal Arts and Sciences

Asha Sasmbells, Biology
DC - College of Liberal Arts and Sciences

Hajerah Mateen, Public Health, Biology Chemistry
DC - College of Liberal Arts and Sciences

Mentor: Dr. Karen, J., Knaus, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
It is important for educators and others to see the potential that cultural diversity has to improve education systems. According to Multiple Intelligence theory, each person has unique strengths in learning. In this study, a culturally diverse group of Undergraduate research students from various majors in the College of Liberal Arts and Sciences, designed a survey. The survey was intended to collect data about student and faculty perceptions of the relative importance of the various Multiple Intelligences in Chemistry. Preliminary results will be shared in this interactive presentation.

CRISPR vs. VODKA: Tagging GFP to an Endogenous Protein in Yeast Using CRISPR-Cas9. A system to quantitatively study genetic expression.

Abraheem F. Khouqeer, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Douglas Shepherd, Physics, DC - College of Liberal Arts and Sciences

Abstract:
Studies of in vivo gene expression have undergone fundamental changes with the rapid emergence of quantitative imaging methods. Using fluorescent molecules, components of the genetic expression mechanism, such as RNA and proteins, can be quantified using microscopy. In this study, a CRISPR-Cas9 system was developed to edit the HOG1 gene expressing an endogenous protein, mitogen-activated protein kinase (MAPK), in yeast. MAPK allows yeast to respond to osmotic stress, such as changes in salt concentration. Previous studies have examined the RNA expression of HOG1 in response to changes in salt concentration. In this study, we aim to construct a CRISPR-Cas9 methodology to study the protein expression of HOG1 itself. The CRISPR-Cas9 system is designed to introduce a green fluorescent protein (GFP) genetic sequence to the HOG1 gene, where the expressed MAPK is tagged with GFP. This allows for the study of the endogenous protein dynamics in response to changes in salt concentration.

Optimizing fast discharges for high speed time varying plasma antenna using particle in cell simulations

Rashad M. Kingsley Shadi, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark Golkowski, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
A recently proposed novel plasma antenna concept involves creating a dynamic conductor that can selectively pass current and change its state on time scales on the order of the current waveform propagation time. This concept can improve the efficiency of an electrically short wire antenna by mitigating the boundary condition at the end of the antenna which causes lower efficiency. Realization of this antenna requires fast switching of a current channel with nanosecond turn ON/OFF times and high power capacity. The switching is done with plasma that calls for ionization and quenching times on the order of nanoseconds. We investigate the discharge dynamics required for the proposed plasma antenna using the VSIM software package particle-in-cell code developed by Tech-X Corporation. It is found that for an argon plasma achieving a plasma density on the order of 10^18 [m3] in nanosecond time scales as well as quickly quenching that same plasma requires special conditions. The plasma must remain highly collisional but with sufficient mean free path for the fast evolution of the avalanching process. The presence of seeded metastable states also improves ionization time. Optimizing pressure, temperature and gas mixtures is required to achieve the required ON/OFF times for the plasma antenna.

Efficacy of undergraduate medical education in anatomical sciences for surgical residency preparation

Rachel Klaus, Modern Human Anatomy, School of Medicine
AMC - Graduate School

Mentor: Dr. Lisa Lee, Department of Cell and Developmental Biology, AMC - School of Medicine

Abstract:
Undergraduate medical education has transformed over the past decades into a more integrated, clinically oriented, and team-based curricula, guided by the core competencies. As a result, basic sciences contact hours have steady decreased. Implications of these changes on preparedness of interns for graduate medical education have been of concern to residency program directors. This study assesses preparedness of interns beginning surgical residency programs, in terms of basic sciences knowledge and other core competencies. 18-item survey was conducted to assess perceived importance of basic sciences to the discipline, areas of deficiency, and changes in preparedness and quality of interns over the years. Faculty and residents from over 30% of U.S. surgical residency programs participated. Residents consistently rated themselves as more prepared than faculty did on survey items assessing intern preparedness at the onset of their programs. Majority of faculty reported a decline in preparedness of incoming residents over the past decade; listing deficiencies in interpersonal skills, basic sciences knowledge, and independence. Residents identified basic sciences as the most valuable subject to acquire in medical school. Faculty identified competencies such as interpersonal skills, self-directed learning, critical thinking, and exposure to clinical practice as the most valuable skills to acquire during medical school. Both cohorts rated anatomy, physiology, and microbiology as the most important subjects for success in surgical residency. These findings suggest reevaluation of the changing medical curricula is necessary to ensure students acquire knowledge and skills necessary for success in graduate medical education.

Subspecific migration ecology and regional conservation priorities for the Dunlin (Calidris alpina) revealed by light-level geolocators

Benjamin Lagasse, Biology, College of Liberal Arts and Sciences
DC - Graduate School

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

Abstract:
The Dunlin (Calidris alpina) is a migratory shorebird that breeds throughout the circumpolar arctic and subarctic, and migrates along most flyways of the northern hemisphere. Subspecific structuring of this species occurs on the breeding grounds, with many subspecies co-occurring on nonbreeding grounds. However, the detailed migration ecology of subspecific breeding populations is largely unknown. With co-occurring subspecies ranging in population size from 900-1,330,000 this lack of knowledge has important conservation implications as the intertidal and freshwater wetland habitats Dunlin use during the nonbreeding period are, in part, declining at precipitous rates. Subsequently, the loss of any one wintering or migration site could have disproportionate effects on population stability at the subspecific level. To date, 158 light-level geolocators have been recovered from 11 breeding sites encompassing five subspecies. Summer of 2016 saw the deployment of 184 light-level geolocators on seven subspecies at 13 breeding sites. Here, I'll provide preliminary results and detail my plans to define 1) subspecific migratory timing during fall and spring migration, 2) spatial overlap of co-occurring subspecies during the nonbreeding period, and 3) areas of possible conservation concern within subspecific migratory networks. The information garnered from this study is intended to inform international landscape-scale conservation efforts for the Dunlin, and benefit other sympatric arctic-breeding shorebirds throughout the northern hemisphere, many of which are in decline.

Pulmonary Vascular Input Impedance as a Predictor of Disease Progression in Pediatric Pulmonary Hypertension

Aimee Lam, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Mentor: Dr. Kendall S. Hunter, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:
Pulmonary Hypertension (PH) is a disease of the lungs which yields increased blood pressure in the pulmonary circulation and stress on the right side of the heart. The pulmonary vascular input impedance (Z), developed at Children's Hospital Colorado, has been utilized to obtain more information regarding the disease, including pulmonary vascular stiffness (PVS) as well as providing more insight into frequency-dependent pulmonary vascular resistance (PVR). Because earlier studies included very small populations to conduct disease prognosis analyses, this study addresses this limitation by substantially increasing the population size – thus allowing us to assess the usability of impedance in the prediction of disease outcomes. Here, outcomes analysis is employed to evaluate the change of disease progression of pulmonary hypertension in pediatric patients. In addition, descriptive statistics are employed to describe whether PVR and Z easily differentiate between healthy and ill children, as well as to determine if a relationship exists between PVR and Z. In an era where many studies are not validated – and indeed, many are later disproven – this study is novel in that it provides an opportunity to expand the current database for consideration of a wider range of patients while validating the data. The prediction of disease will undoubtedly change between different population sizes, and so analyzing impedance as a predictor in this larger population will enable one to understand impedance and the capabilities it possesses.

Red-Green Versus Blue Tactical Light

Micaela B Lamari, Public Health
DC - College of Liberal Arts and Sciences

Mentor: Ms. Michelle G Pedler, Ophthalmology, AMC - School of Medicine

Abstract:
Combat medics rely on their ability to see to practice medicine on patients in the field. Especially in night environments, they need a reliable light source to assess the condition of their patient without drawing attention to the enemy. Currently, combat medics are using a blue light which does not allow them to see subtle changes in color between dark red and black. This can be detrimental to the patient if the medic cannot see whether the patient is bleeding, or if it's another source of fluid. We used the Farnsworth Munsell hue test (FM) to determine if normal subjects could differentiate subtle changes in color better using a red-green or a blue flashlight. We had the subjects use a white light first to determine baseline. Then we used a timed color determination visual test to determine how quickly normal subjects can identify color correctly and simulated surgeries with white, red-green and blue light sources. We found Total Error Score (TES) for white light was 49.714, 272.923 for red/green and 531.4 for blue. The subjective perception of simulated trauma wounds was not substantially different with red-green LED tactical light when compared with white LED light. However, simulated surgery under the blue LED was dramatically more difficult compared to simulated surgery with the red-green LED light. Red-green is a superior light source for military first responders. Especially, where light is required to allow accurate and efficient application of TCCC – Tactical Combat Casualty Care to injured personnel by combat medics.

Altering Perceptions of Homelessness in the Denver Metro Area

Bonnie Le, Biology
DC - College of Liberal Arts and Sciences

Sherleen Tran, Public Health
DC - College of Liberal Arts and Sciences

Alexsander Hay, Public Health
DC - College of Liberal Arts and Sciences

Daylee Randall, Psychology
DC - College of Liberal Arts and Sciences

Ethan Mounts, Anthropology
DC - College of Liberal Arts and Sciences

Hamzah Chahien, Biology
DC - College of Liberal Arts and Sciences

Calida Lieu, Public Health
DC - College of Liberal Arts and Sciences

Mentor: Mrs. Trishia Vasquez, Health Professions , DC - College of Liberal Arts and Sciences

Abstract:
Homelessness has a negative stigma attached to it here in the U.S. Roughly 85% of the general public believe that drug and alcohol abuse is the main cause of homelessness according to a general survey conducted by Gallup Inc. (Mae 2007). In reality, the leading causes of homelessness are a lack of affordable housing, unemployment, poverty, and mental illness (National Law Center of Homelessness and Poverty). Women and children, in particular, are forced into homelessness due to domestic violence. In the Denver Metro area, over 5,467 people were without a regular dwelling, and 39.2% of them were women and children (Metro Denver Homeless Initiative, 2016). The Champa House, a shelter in the Denver Metro area, provides single mothers the opportunity to begin a new and independent life. At Champa House, the women go through transitional phases that teach them how to lead sustainable lives for themselves and their children. Home in the Heart was developed in order to support these individuals. By hosting a game night on the Auraria Campus, we aim to raise donations for the women and children at the Champa House, which includes toiletries, household items, and toys for the children. At the same time, we hope to raise awareness about the causes of homelessness in order to help decrease the negative stigma that is associated with homelessness.

Student Interactions and Engagement in Learning Assistant and Non-Learning Assistant Introductory Biology Classrooms

Paul T. Le, Integrative and Systems Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Laurel M. Hartley, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
The Learning Assistant (LA) model has been adopted across the country to facilitate interactive engagement among students in undergraduate classes and promote student success and satisfaction. However, there has been limited analyses comparing engagement in LA and non-LA supported courses. I present social network analyses that characterizes student interactions in two introductory biology courses: one LA supported and one non-LA supported. I use these interactions as a proxy for interactive engagement and conceptualize the classroom community as a social network. Further, I use student demographics and interaction metrics to develop multi-level models to determine significant predictors of success the classroom. Data were collected in two 200-person General Biology courses during week 8. Students were given a paper survey in class that asked students to identify individuals they talk to about classroom material and to rate value of those interactions. Student response data were entered into a sociomatrix for analysis. I generated degree, betweenness, and centrality measures for each student using network data. I used Mann-Whitney U-tests to determine if there were significant differences in networks between the two courses. My analysis showed that there were significant differences between LA and non-LA supported courses with betweenness and centrality (i.e., LA-supported courses included students with higher betweenness and centrality). There were no significant differences with degree. Multilevel models show that degree and socioeconomic status are significant predictors of final grade. Students with higher degree scored higher final grades, and students with lower socioeconomic status scored lower final grades.

Exploring the Role of Magohb in Acute Myelogenous Leukemia

Yoo (Jasmine) Lee, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Patricia Ernst, Pediatrics, Hematology/Oncology/BMT Section, AMC - School of Medicine

Abstract:
Chromosomal translocations of the human MLL1 histone methytransferase gene produces oncogenes that result in poor-prognosis leukemia in both children and adults. The remaining MLL1 wild-type allele is usually retained in leukemia cells. Our laboratory found that deletion of the remaining normal Mll1 allele does not impair MLL-fusion protein-driven leukemogenesis, although this wild-type allele was previously considered a candidate drug target. Our findings also revealed an unexpected role for MLL1's closest paralog, MLL2. The deletion of mouse Mll2 reduces the survival of MLL-AF9-transformed cells and the knockout of Mll1 in this context further intensifies this effect thus reducing leukemogenesis in vivo. We then explored the role of the MLL2 target gene called Magohb by cloning it into a plasmid to create a gene over-expression vector to be transduced into the MLL-AF9 leukemia cells. Magohb is a component of the exon junction complex involved in RNA splicing. We found that Magohb expression is significantly down-regulated in Mll2-deficient leukemia cells, and even more down regulated in the Mll1;Mll2 double knockout cells. Cell viability experiments were also performed in Mll1;Mll2-deleted MLL-AF9 leukemia cells to determine whether re-expression of Magohb as well as other MLL2 target genes would rescue the cells. The expression of Magohb in the double knockout cells was not enough to completely restore cell viability, although it did exhibit partial rescue. Other target genes (Bcl-xL, Bcl-2, or IL3Ra) restored cell viability slightly better than Magohb, however no single gene could completely restore survival. These data suggest that Magohb, in conjunction with many other proteins regulated by MLL2, regulates survival of acute myelogenous leukemia cells.

CU Denver NIST PREP Fellowship: RADAR signal processing development for 5G MIMO technology standards

Selena K. Leitner, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark J. Golkowski, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
The National Institute of Standards and Technology (NIST) is a national laboratory specializing in measurement standards and a partner in the Professional Research Experience Program (PREP) here at CU Denver. The program places university students in NIST labs to gain hands-on research experience working with NIST researchers. Under the Radio Frequency Fields Group at NIST, a RADAR software for 5G Multi-Input Multi-Output (MIMO) technology is currently being developed. 5G is the next generation of telecommunications, utilizing smaller cells to improve capacity usage. MIMO allows for better data speed and signal integrity by utilizing multiple signal pathways. The MIMO setup for this experiment uses four transmitter antennas and a concave reflector to redirect the signal to the receivers. This system will be measured using a NIST-developed pixel probe, a precise metrology camera system, and robotic arm to collect detailed radiation patterns. Using previously developed algorithms from NIST, MATLAB is being utilized to construct a flexible but robust signal processing code to align the signals from the source to each transmitter antennas. In this process, calibration and background data must be removed while maintaining the flexibility to precisely control each signal. Using specifically developed gates and windows along with mirrored signals and Fourier analysis, the signals are manipulated and filtered to form the necessary feed. This code is vital to the development of an accurate testing method of the multipath analysis of the 5G MIMO experiment.

Rapamycin Modulates Exercise Induced Increases in mTOR without Affecting Fear Extinction Learning or Wheel Running Behavior

Brian A Lloyd, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Holly Hake, Psychology
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Margaret Tanner, Biology
DC - College of Liberal Arts and Sciences

Caroline Farmer, Biology
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Mykola Ostrovskyy, Biology
DC - College of Liberal Arts and Sciences

Tammy Nguyen, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Benjamin N. Greenwood, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Exercise is well known to produce beneficial effects in cognition and mental health including enhancing memory and providing resistance against stress-related anxiety disorders. In rats, these effects have shown to include enhancing fear extinction memory wherein exercising after exposure-based fear extinction training reduced fear and fear relapse. The mechanisms by which these beneficial effects occur is unknown. The mammalian target of rapamycin (mTOR) is a signaling protein involved in synaptic plasticity, cell growth, and cell survival. mTOR signaling has been shown to be increased in brain areas involved in learning and emotional behavior after exercise and is therefore a compelling candidate for providing the cognitive benefits of exercise. The goal of the present study was to test the hypothesis that mTOR signaling is required for the beneficial effect of exercise to enhance fear extinction memory. To test this hypothesis, the mTOR inhibitor, rapamycin was injected systemically to block mTOR signaling. Results show that rapamycin did not inhibit wheel running behavior and did not impair fear extinction learning. Assessment of whether rapamycin blocks the increased expression of a downstream protein, pS6, after exercise is ongoing. These results provide evidence that rapamycin is an mTOR inhibitor that could be used to study the cognitive effects of exercise given that it does not impair running behavior or extinction learning.

A Simple Isomerization Investigation as a Teaching Tool in Advanced Undergraduate Organic Chemistry Laboratories

Chelsi N Lopez, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Vanessa Fishback, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
A simple synthetic protocol was adapted for use in Honors Organic Chemistry Laboratories for undergraduates at the CU Denver as a teaching tool for common organic themes as well as more advanced characterization and analysis topics. The reaction performed by students is a first-hand example of nucleophilic attack both intermolecularly and intramolecularly, a vital mechanistic theme that appears often in undergraduate organic chemistry. By analyzing their final products, students obtain advanced spectroscopic experience, as the proton nuclear magnetic resonance (1H NMR) analysis comprises common topics such as electron deshielding, splitting patterns, coupling constants, as well as providing exposure to higher-level NMR analysis due to ring-chair conformations and diastereotopicity of the final products. The results also require an in-depth analysis by constructing representative resonance states and deducing their impact on the reactivity of specific functional groups. The results obtained from a preliminary cohort of 20 students assigned to various starting material provided linear data from which students could directly relate their developed hypothesis to the obtained results. A second cohort performed the experiment with only two types of starting material, comparing their results with the previous cohort and determining whether their results were analogous.

Exploring the Interconnectedness of Gender Based Violence in Society

Vikasini Mahalingam, Anthropology
DC - College of Liberal Arts and Sciences

Hannah Stobaugh, Elementary Education K-6
DC - School of Education and Human Development

Mentor: Ms. Sarah J Berg, Office of Equity, DC - School of Education and Human Development

Abstract:
Gender and gender roles, are a part of our everyday lives that often gets overlooked. Discrimination and violence often get explained away as just being a part of societal gender “norms.” In response to the breadth of experiences inherent to this issue, we decided to lead a group of 12 CU Denver students to Chicago in order to better understand the interconnected social and societal issues that play a part in gender based violence. The organizations we worked with aim to help victims in physical, financial, legal and/or emotional ways while trying to combat the root causes of violence in the community. Participants on this trip were exposed to people and their allies that have experienced violence in their lives and learn how they have learned to live through them. As a group we also explored the difference between service and voluntourism. Issues that were discussed include how to work with a community instead of for a community and how can we be allies to those experiencing gender based violence in our own Denver community. As a group we also learned ways to look at the assets of communities we are a part of or working with. We engaged in asset mapping different Chicago neighborhoods and relating the assets found there to the different needs of those areas. Through the week we were in Chicago, the 12 participants identified the assets of others in the group and discussed how to utilize those assets in their everyday lives and other service passions.

Ecological Niche Modeling Reveals Divergence Between Tetraploid and Hexaploid Populations of Eutrema edwardsii (Brassicaceae)

Jared E. Mastin, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Suzanne Meinig, Biology
DC - College of Liberal Arts and Sciences

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

Abstract:
Ecological niche modeling has revealed variation for niche differentiation between polyploid cytotypes. Within polyploid complexes, both niche expansion and niche contraction have been observed for higher ploidies. Eutrema edwardsii (Brassicaceae) is a near circumpolar allopolyploid species that comprises tetraploid, hexaploid, and octoploid populations, which occupy arctic-alpine wetlands across much of the Northern Hemisphere. Here we test the hypothesis that higher ploidy confers a broader niche that would allow polyploids to colonize habitats outside the niche of their progenitors. To test this, we employed ecological niche modeling to discover differentiation among polyploid populations of E. edwardsii. Cytotype was determined by flow cytometry using leaf tissue that was harvested from herbarium accessions (COLO, ALA, CAN) by comparison with a known diploid, Eutrema penlandii. Principle components analysis reduced the number of explanatory variables to those describing the majority of variation. These variables were used for Maxent modeling to estimate the niche for each cytotype. Niche models reveal a wide range of lowland and coastal habitats for tetraploids, while hexaploids occupy a narrow range of alpine areas. This is supported by niche breadth, which was 0.519 and 0.159 for tetraploids and hexaploids, respectively. Niche overlap (D = 0.354) supports niche divergence between ploidies. Niche identity (0.639/0.389) indicates that niches are distinct. Our results support the hypothesis of niche differentiation between tetraploid and hexaploid E. edwardsii. PCA analysis showed greater temperature seasonality and higher precipitation for hexaploids. Our results suggest polyploidy, in E. edwardsii, facilitated the colonization of habitat outside the niche of their progenitors.

Whistler Mode Wave Propagation in the Earth's Magnetosphere

Ashanthi Maxworth, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark Golkowski, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
Whistler mode waves are a type of low frequency (1 kHz – 30 kHz) signals created due to various natural and manmade sources. These intense waves play a dominant role in the Earth's magnetosphere. Earth's magnetic field is the dominant force in the magnetosphere hence the name. Magnetosphere is at a plasma state. Plasma is the fourth state of matter, where the particles are at an ionized state. Earth is surrounded by a collection of high energetic particles known as the radiation belts. In these radiation belts, the high energy electrons are trapped in a circular motion around the Earth's magnetic field lines, similar to the gyration of the Earth around the Sun. Interaction of space electronics such as satellites, with these high energetic electrons trapped in the radiation belts, can cause damage to the circuitry hence reduce their lifetime. Whistler mode waves can modify the gyration of these high energetic electrons and release them from their trapped motion. Hence whistler mode waves play an important role in space weather. Therefore it is important to study the propagation path of these waves. Raytracing is the process of determining the power flow path of waves. It is a numerical technique which takes the background plasma and the Earth's magnetic field into account. In this work we present our raytracing results considering the actual temperature of the magnetosphere. We also show a comparison between our simulations with the measurements from spacecrafts launched by the National Aeronautics and Space Administration (NASA).

Promoting Inclusion in STEM Fields through REU Programs: an evaluation of common program assessment techniques

Andrew L. McDevitt, Integrative and Systems Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Laurel Hartley, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
REU programs have improved their program assessment over the past five years by tracking learning outcomes, participant satisfaction, and matriculation/employment in STEM fields, however, our understanding of best practices and program impact are still limited. To identify future research priorities, we evaluated program assessment data collected from the Harvard Forest Summer Program in Ecology (HF-SRPE) and used cultural-historical activity theory to highlight the gaps in our understanding of the role REU programs have on promoting inclusion in the STEM fields. Demographic information contextualizes the student populations a program is serving and highlights HF-SRPE's ability to recruit women and minority students. However, focusing on demographics alone does not address how students are selected or supported within the research community. URSSA helps link demographic information with student gains, but the deployment of non-core survey questions is inconsistent across programs. The 40 core questions reveal that HF-SRPE cohorts respond at or above national averages yet provides limited insight into best practices that promote these gains. Since URSSA does not account for student's prior knowledge and skills nor contextualizes the learning environment of the program, comparisons between programs and the impact on student retention within STEM fields are ambiguous. HF-SRPE's alumni surveys indicate that >80% of respondents remain within ecological disciplines and >50% pursue or receive graduate degrees, but these outcomes are difficult to attribute directly to the REU program. To strengthen the inferences made from survey results, we advocate using a common theoretical framework that adequately contextualizes variation among students and across programs.

Community Health Needs Assessment of Denver's Refugee Population

Damarcus McGill, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Savita Malik, Health and Behavioral Sciences, DC - College of Liberal Arts and Sciences

Abstract:
According to Denver's Office of Immigrant and Refugee Affairs, 1,797 refugees were resettled in Colorado during 2012 and this figure has looked similar in subsequent years. Most of these refugees are resettled in the Denver-metro area. Persecution and torture based on religious, political or other beliefs and identities as well as the resettlement process itself can cause negative health outcomes. These outcomes include post-traumatic stress disorder and chronic diseases from food insecurity. After the resettlement process, navigating the American healthcare system and adjusting to society can worsen existing health issues or contribute to the development of new illnesses. A health needs assessment can be conducted to examine these issues and then be used to make recommendations that improve health outcomes.

Spatial Patterns of Habitat Use by Incubating Mountain Plovers in a Mixed Habitat and Ownership Landscape

Tyler J Michels, Biology, College of Liberal Arts and Sciences
DC - Graduate School

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

Abstract:
The mountain plover (Charadrius montanus) is a migratory shorebird that breeds in rangelands of the western Great Plains. Populations have declined sharply since the 1960s and the species is of conservation concern in most states and provinces where it occurs. Nesting behavior involves an unusual split-clutch mating system; females typically lay 3 eggs in a nest tended entirely by the male, before laying another 3 eggs in a different nest for the female. Mated birds do not provision each other during the incubation and brood-rearing periods (~29 and ~35 days, respectively). Because of this, nesting habitat must also provide efficient foraging for incubating adults. Nesting has been documented on fallowed cultivated fields since the early 1990s, but specific information about behavior and habitat use during incubation of cropland nests is lacking. To determine how incubating plovers use habitat in a mixed habitat and ownership landscape, we deployed and recovered 11 miniature global positioning system (GPS) data loggers on plovers incubating nests on agricultural fields, prescribed burns, and active prairie dog colonies in Weld County, Colorado. We programmed the data loggers to collect approximately 120+ locations randomized across ~6+ days. We estimated home-range size using 90% kernel density contours and report a median of 96.4 ha (range 7.36-1356). These data will help understand how landscape level habitat fragmentation brought about by changes in farming economics, energy development, and/or climate may impact mountain plover breeding biology.

Development of a Metacognitive Assessment Tool to Inspire Improvement in Students' Interdisciplinary Research Papers

Andrew Millar, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Karen J. Knaus, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
The development of a rubric intended to help students improve their research papers in an interdisciplinary chemistry course is described. In the course, students write a research paper where they have to propose a logical molecular mechanism for a natural medicine compound. The rubric proved useful in helping students improve their metacognitive thinking skills. More specifically, the rubric was used to collect students' ratings about how well they were able to integrate chemistry content knowledge into their research papers. Instrument reliability was established with a good to high level of interrater agreement among student ratings in all chemistry content areas. Instrument validity was established by examining the extent to which student ratings agreed with expert ratings using ANOVA tests. In general, as the quality of student papers improved, the level of interrater agreement increased in all content areas. In addition, interrater agreement was higher in content areas where students had more experience (e.g., general/organic chemistry); furthermore, prior knowledge seems to play a role in students' perceptions of their own as well as other students' ability to integrate chemistry content knowledge into their papers. Feel free to learn more at this interactive presentation.

Proton Uptake and Transfer by the M2 Channel in Influenza A Virus

Danielle E. Miller, Chemistry
DC - College of Liberal Arts and Sciences

Adam Duster, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
The influenza A virus is highly contagious and lethal [1]. A critical step for viral infection involves proton transfer through M2 channels in the viral membrane [2]. Blockage of the M2 channel prevents the influx of protons, interrupting the viral replication cycle and providing a way to fight against influenza A. Here we carry out combined quantum-mechanical/molecular-mechanical (QM/MM) simulations of proton transport by the M2 channel embedded in a lipid bilayer and solvated in water. The QM/MM method combines the accuracy of quantum mechanics and the efficiency of classical molecular mechanics, reducing the costs of calculations. Data from this project will provide missing details about the mechanisms of proton transport by M2 channels, which will be valuable to drug development in the future.
Acknowledgments This work is supported by NSF (CHE-1564349), Dreyfus Foundation (TH-14-028), and NVIDIA Corporation, and uses computational resources of XSEDE (140070) and NERSC (m2495).

Beyond the Ballot: An Examination of the Role of Social Media in the Political Participation of Millennials

Kiki Miller, Communication, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Larry Erbert, Communication, DC - College of Liberal Arts and Sciences

Abstract:
Millennials currently make up the largest and most diverse generation in the history of the United States and they also outnumber baby boomers when it comes to registered voters. In 2008 and 2012 increased engagement with politics online translated to increased civic engagement among youth voters during the presidential election. Youth voters not only turned out to the polls in record numbers, but they also engaged in other forms of civic engagement including protests, boycotting, and buycotting. Not only has the internet and social media had a major impact on the political socialization of millennials, it has also led to the most liberal generation in history who organizes themselves online around social and political issues to motivate real-life activism. They have been able to harness and revive Jürgen Habermas's concepts of deliberative democracy and the public sphere through online discussion and translate it to civic engagement and political participation. Social media has only been around long enough to study two presidential elections and generalizations based on that data may not be fair. This study will examine the role of social media in the 2016 presidential election through ethnography, in-person interviews, and survey data to determine the link between social media and the political participation and political socialization of millennials. It will add to this limited amount of research and literature could help contribute to the understanding of what role social media plays in politics, civic engagement, and the political socialization process of millennials (COMIRB Protocol Number 16-1894).

Identifying local and regional fire patterns and quantifying fire severity across the Biodiverse Klamath Mountains

Shelley Morton, Environmental Sciences, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Christy Briles, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

Abstract:
The Klamath Mountains are a biodiversity hotspot where the influence of future climate change and fire activity is a significant concern. Historical range of variability has been difficult to examine in this region due to the generally low temporal resolution of historical documents and coarser proxy records like those from tree rings. Paleoenvironmental records from lake sediments, specifically pollen and macro charcoal accumulations, have the capacity to temporally expand knowledge of the relationships between fire activity, climate change, and the environment. Reconstruction of these histories allows for a quantification of fire frequency, biomass burned and fire severity. Initial findings show that fire activity was infrequent and more variable at wetter western sites at higher elevations, while it was more frequent and consistent at drier eastern, lower elevation, locations. Additionally, looking at the Klamath region's paleofire records as a whole reveals regional fire regimes and vegetation patterns in these mid-to-high elevation forests during significant periods of climate change. The Klamath Mountains experienced higher fire activity during warm, dry periods (Medieval Climate Anomaly and early Holocene), and fewer fires during the Little Ice Age than today. Combining these local and regional data sets allows for the creation of a temporal and spatial depiction of how fire regimes, and more specifically fire severity, has changed. This information has the potential to influence future strategies to achieve ecological and forest management goals in northern California and southern Oregon.

BLOCKING CELL DEATH IN DONOR KIDNEYS DURING PRETRANSPLANT ORGAN PRESERVATION

Michelle K. Nelsen, Immunology
AMC - School of Medicine

Mentor: Dr. Trevor Nydam, M.D., Surgery, AMC - School of Medicine

Abstract:
More than 10% of adult Americans (>20 million people) may have chronic kidney disease. When the disease progresses to kidney failure, a patient requires dialysis or a kidney transplant to survive. Due to the national shortage of available transplantable kidneys, an increasing number of "marginal" donor grafts are transplanted that often exhibit delayed graft function (DGF) and poor outcomes. Pretransplant hypothermic machine perfusion is an intervention that reduces the risk of DGF and improves one-year graft survival. However, this preservation technique has changed little in the past decade. Based on our data from small animal models, we hypothesize that adding new interventions during pretransplant machine preservation will protect "marginal" human kidneys during cold storage. To test this concept, we will treat non transplantable donated human kidneys with an agent that preserves natural inhibitors of programmed cell death. Then we will evaluate the kidneys for indicators of DGF using measurements from renal histology, flow rate, vascular resistance, protein expression, and metabolomic profiling. We expect that this innovative study will demonstrate that pretransplant organ preservation provides an opportunity to introduce new immunotherapies that can improve organ function. This study will also provide the proof-of-principle that ex vivo machine perfusion can serve as a critical preclinical tool and drug-testing platform that aids the drug development pipeline.

The Changing Image of Fashion:
The Impact of Japanese Fashion from the 1980s to the Present

Khoa Nguyen, Art History
DC - College of Arts and Media

Mentor: Dr. Yang Wang, College of Arts and Media, DC - College of Arts and Media

Abstract:
The world of high fashion saw a major turning point in the Mid 1980s when a group of Japanese designers presented their collections in France. In contrast to the form-fitting and body-conscious styles preferred by French designers, Japanese designers Rei Kawakubo, Yohji Yamamoto, and Issey Miyake introduced baggy silhouettes, monochromatic palettes, and loose shapes. These designs profoundly impacted European fashion. While scholarship on fashion history continues to hold this era of Japanese influence in high regard, contemporary scholarship on the continued influence of this period on post-2000 fashion is missing even though western designers and mainstream fashion are still being influenced by this historical period. My paper addresses the impact this wave of Japanese designers had on the industry from 1980 to present. I will do this by discussing past and recent designer collections in relation to the changes we have seen in the fashion industry from runway to the mainstream. Images of pivotal runway collections that have drastically changed the image of fashion will be my main sources, along with designer interviews and critic reviews. This project aims to fill the gap between Japanese designer collections, and the changing silhouette of style from the 1980s to the present. It will also shed new light on work being created for the runway by designers in the past five years.

To What Extent Do Intercolonial Pavement Ants' Interactions Change at Different Increments of Time of Isolation?

Brigitte Nguyen, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Michael Greene, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Pavement ants are common urban ants that form conspicuous wars between neighboring colonies. In these wars, ants from two colonies fight in a ritualized manner by biting body parts and engaging in a "push-of-war". We use the pavement ant as a model to study the collective-organization of aggression between competing societies. Ant colonies are collectively organized in distributed systems, in which, ants regulate behavior without the use of a hierarchical authority. Instead ants make behavioral decisions using information from detective cues. These chemical cues help identify colony membership and lead to collective-decisions by the colony. Interaction patterns inform ant decisions. Interactions among nestmates and non-nestmates occur when ants touch antennae to another's body. Pavement ants are more likely to fight a non-nestmate ant if they have had a recent history of interaction with nestmate ants. Interaction rates of pavement ants collected from ant colonies on the Auraria campus will be measured and observed. Ants will be separated into 10 groups of 10 ants and then isolated individually, in clear plastic vials, for different increments of time, ranging from 10 minutes to 80 minutes, with a control group of no isolation. Ants will then be placed in an arena for 10 minutes. The interactions will be tracked and analyzed via computer program called Ant Tracks. This program allows for the labeling of individual ants and the tracking of ant interaction. This poster will present preliminary data. The project began in March 2017 and awarded by UROP in April 2017.

Analyzing Faculty/Course Questionnaire (FCQ) Scores Using Advanced Data Analytics

Aaron Nielsen, Applied Mathematics, College of Liberal Arts and Sciences
DC - Graduate School

Haoyue Zhang, Economics
DC - College of Liberal Arts and Sciences

Lilong Wang, Economics
DC - College of Liberal Arts and Sciences

Mentor: Mr. Aaron D. Nielsen, Mathematical and Statistical Sciences, DC - College of Liberal Arts and Sciences

Abstract:
In this talk, we will be using a variety of statistical methods to analyze faculty/course questionnaire (FCQ) results. In particular, we will be presenting a thorough exploratory data analysis of FCQ scores in the Mathematics department over the past two years. We will also be investigating potential factors that affect overall course score ratings using weighted least squares regression. Finally, we will use clustering analysis in an attempt to find common factors that lead to higher FCQ scores. We will conclude with some insights from the statistical analysis for instructors to utilize in their future classes.

SNP-Based Pathway Enrichment Analysis of Genetic Datasets to Determine a Link Between Bipolar Disorder and Allergies

Sierra S. Niemiec, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Stephanie A. Santorico, Mathematical and Statistical Sciences, DC - College of Liberal Arts and Sciences

Abstract:
Bipolar disorder (BD) is a brain disorder characterized by extreme shifts in mood, cognition, energy, and ability to function in society. BD can affect school and work performance, damage relationships, and lead to suicide. Based on a paper by Kleinman and colleagues (2003), annual costs for the care and treatment of BD-affected individuals were estimated at $45.2 billion. Despite the high costs, the distinct underpinnings of this illness are not yet fully understood. Studies by Baumeister, Russell, Pariante and Mondelli (2014) found suggestive evidence of abnormal inflammatory biomarker levels in severe mental illness. This suggests an association between inflammation and psychiatric disease. Allergies can be a source of great inflammation within the body and rank as one of the most common chronic conditions in the world. It may be that at least one subtype of BD is biologically associated with the inflammation caused by allergies. Such a link could provide insight into new BD treatment, aiding a population in dire and desperate need. This project aims to elucidate potential links between BD and allergies. A pathway enrichment analysis was used that examines point mutations in genes to see if particular pathways linked with bipolar are also linked with allergies. A genome-wide association study of BD was obtained from the database of Genotypes and Phenotypes (dbGaP) and used for statistical analysis.

Use of the Oxford Nanopore MinION for Genome Sequencing of Microbial Communities

Maria Nikulkova , Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Christopher Miller , Integrative Biology , DC - College of Liberal Arts and Sciences

Abstract:
Metagenomics, uses DNA sequencing to study the genetic material collected from microbes living in their natural habitats. These microbes inhabit our everyday lives and make up an essential part of living systems on Earth. By being able to sequence DNA from the microbes found in our environment, we can further understand our living world. With current DNA sequencing technology, short genomic reads from 150-1500 base pairs long can be read, out of microbial genomes that are typically millions of base pairs long. Trying to find overlapping segments among these short reads makes it difficult to reassemble the genome found in an environment sample. The new Oxford Nanopore MinION sequencing machine shows a novel approach to sequencing DNA that can produce reads as long as 150,000 base pairs. This ability to directly read long stretches of genomic DNA means overlapping reads can be found more easily, allowing for the simpler assembly of microbial genomes from complex mixtures of genomes found in natural environments. We are applying this sequencing capability to microbial DNA extracted directly from temperate freshwater wetland soils, which are a large source of microbially produced atmospheric methane. Our aim is to improve genome assembly for the complex community of microbes that live in these habitats.

Stitching Forward: Feminism, Craftivism, and Contemporary Art

Katelyn E. Odenheimer, Art History
DC - College of Arts and Media

Mentor: Dr. Yang Wang, Art History, DC - College of Arts and Media

Abstract:
In 1918, the architect Le Corbusier and artist Amédée Ozenfant famously wrote, “there is a hierarchy in the arts: decorative arts at the bottom, and the human form at the top. Because we are men.” The attitude held by these famous men of arts demonstrates Western culture’s general patriarchal disregard for decorative handicrafts associated with the domestic realm. Throughout the twentieth century, feminist activists have attempted to destabilize this patriarchal hierarchy by elevating handicraft to the realm of fine art. Despite more than a century of supposed progress, contemporary feminist artists continue to assert the importance of craft by using it as an outlet for activism. This paper examines the art of Zoë Buckman, Elaine Reichek, and Ghada Amer through the lens of Craftivism in order to shed light on how these artists explore intersectionality. I argue that these age-old practices of craft are ultimately redefining what constitutes as fine art and by re-appropriating text and images. These artists are redefining the conversations in our social political climate while providing a movement forward for women worldwide.

Analysis of Colorado Death Penalty Sentencing

Chinyere Okpara, Applied Mathematics, College of Liberal Arts and Applied Sciences
DC - Graduate School

Mentor: Dr. Audrey Hendricks, Mathematical and Statistical Sciences, DC - College of Liberal Arts and Sciences

Abstract:
In the state of Colorado, recent studies have suggested that there was arbitrary sentencing of the death penalty between 1999 to 2010. These studies showed that the race of the defendant and the location of the trial were strong indicators in predicting the prosecution's decision to pursue a death penalty case. With the consideration of both race and location, the primary purpose of this study is to perform a more exhaustive analysis of the decision to pursue the death penalty with the inclusion of aggravating factors (i.e. guidelines created to prevent discretionary sentencing of the death penalty). Here we analyze the death sentencing decision on both the case and county-level. From these analyses, race again was found to be a significant predictor although the number of applicable aggravating factors had a greater impact on the probability of pursuing the death penalty. Moreover, after controlling for the types of crime and the number of applicable aggravating factors, we found that cases tried in a more republican county with a higher minority population are more likely to be pursued as a death penalty case.

Cognitive Deficits in a Mouse Model for Schizophrenia

Amber G Olson, Psychology
DC - College of Liberal Arts and Sciences

Mentors: Dr Diego Restrepo, Cell and Developmental Biology, AMC - School of Medicine, Dr. Shane Rolen, Cell and Developmental Biology, AMC - School of Medicine

Abstract:
Schizophrenia is a neuropsychiatric disorder where symptoms are debilitating and split into three types: positive, negative, and cognitive. Historically, research has focused on the positive and negative symptoms, with little focus on the cognitive deficits that include working memory, executive function, and impaired ability to maintain focus. Recently missense mutations of the CaMKIIα gene have been identified in human schizophrenic patients (Purcell et. al., Nature 506, 185-190). CaMKIIα is involved in long term potentiation and therefore these mutations may underlie learning deficits in these patients. Our research focuses on whether decreased expression of CaMKIIα elicits deficiencies in associative learning and whether cognitive deficits are accompanied by changes in neural oscillatory activity in the CA3 region of the hippocampus. We used an olfactory associated learning task (oALT) go/no go water rewarded task to compare behavioral performance between mice heterozygous for CaMKIIα (Hets) and wild type controls (WT). We also performed extracellular local field potential (LFP) recording in the CA3 region of the hippocampus, to record the theta/gamma phase amplitude coupling LFP oscillations that are thought to play a role in hippocampal learning. In preliminary studies we found that the Het under performed the WT in the oLAT, and also we found differences in the theta/gamma phase LFP amplitude for Hets compared to the WT. We are following up on these findings to determine whether deficiency in associative learning in the Hets is correlated with differences in phase amplitude coupling in CA3 in the hippocampus.

Working Memory Deficits in aCaMKII-alpha Model for Schizophrenia

Amber G Olson, Psychology
DC - College of Liberal Arts and Sciences

Mentors: Dr Diego Restrepo, Cell and Developmental Biology, AMC - School of Medicine, Dr. Shane Rolen, Cell and Developmental Biology, AMC - School of Medicine

Abstract:
Schizophrenia is a neuropsychiatric disorder estimated to affect about 1.1% of the world's population. Symptoms are debilitating and spilt into three types: positive, negative, and cognitive. Historically research has focused on the positive and negative symptoms with little focus on the cognitive deficits, which include working memory, executive function, and impaired ability to maintain focus. Recently missense mutations of the CaMKIIα gene have been identified in human schizophrenic patients (Purcell et. al., 2014), and CaMKIIα is heavily involved in memory and learning. This proposal focuses on whether decreased expression of CaMKIIα contributes to working memory deficits seen in SZ patients. We will use an olfactory driven working memory task to compare behavioral performance between mice with this CaMKIIα mutation. Additionally, this task will be delay non-match task to study deficits in the medal pre-frontal cortex, an area of the brain known to be involved with WM and important in SZ.

A Sustainable Solution for Lighting and Ventilation of Portable Restrooms Using Renewable Energy Resources

Jackson T. Osborn, Electrical Engineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Carolina Guerrero-Rocha, Electrical Engineering
DC - College Engineering and Applied Sciences

Mentor: Dr. Jae-Do Park, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
There is a need for an alternative, sustainable solution for developing areas that lack adequate waste and electrical infrastructure to provide lighting and ventilation for use of a portable restroom day or night. This project seeks to investigate the application of microbial fuel cells as a power source for energy harvesting, in addition to a solar panel and a micro-wind turbine that charge a lithium polymer battery pack. The main goal is to develop a self-sustaining system that requires little to no maintenance that is able to harvest energy from multiple sources. The battery would provide power for the loads (light, fan and single-board computer). The single-board computer will provide the necessary PWM (pulse-width modulation) required for the DC-DC converters and will also serve as the data acquisition system to monitor the outputs of the various sources. A microbial fuel cell relies on electrogenic bacteria that metabolize carbon sources from which they extract electrons. The electrons are accepted by the anode and thus produce electricity. An existing fuel cell has provided the basis for this project. This fuel cell can produce up to 300 mV. Our fuel cells will be a similar design that is scaled up in size. The objective of this project is to provide a working prototype that demonstrates the ability to power LED lighting and a fan for ventilation. This project could provide useful insight into development of systems that could operate on a larger scale.

Illustrated Book for Vocal Empowerment

Melisande I. Osnes, Visual Arts (UROP Recipient)
DC - College of Arts and Media

Mentor: Mr. Quintin Gonzalez, Visual Arts, DC - College of Arts and Media

Abstract:
In May of 2016 I traveled to Shirtati Tanzania to work with an organization called Maji Safi. There I worked with the female hygiene program to facilitate the young women in the program in illustrating a book on their coordinator, Linda Arrot's voice. This book, written by Linda and illustrated by the young women, serves as a tool for their vocal empowerment program. I took the line drawings the young women did and colored and compiled them together to create a cohesive aesthetic. For example I designed a fabric pattern using the designs drawn by the young women for Linda's dress so that, even though she was drawn differently by every girl, it was clear who she was throughout the book. This book was distributed to every young woman in the program. Allowing them to feel ownership of a finished product while also helping them understand what vocal empowerment entails.

Art in Activism: The Power of Music and Theater to Galvanize Social Movements

Mary P. Ozanic, Master of Social Sciences, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Omar Swartz, Social Sciences, DC - College of Liberal Arts and Sciences

Abstract:
This research will examine music in the form of the protest song and the use of activist community theater as fundamental elements of communication in order to galvanize social movements. Protest songs are associated with movements for social change and are hence part of a broader category of topical music. Social movements with an associated body of songs and theater include the movements for abolition, women's suffrage, labor unions, human rights, civil rights, feminism, the sexual revolution, gay rights, animal rights, environmentalism, anti-war and the 1960's counterculture. The presentation will include a compilation of audio and video clips depicting the history of art in activism, along with a discussion of the evolution of activist street theater. There will be an interactive creative forum in which spectators will be invited to help pen the words to an original musical score that can be used as a means to promote the power of the vote and our right to choose.

Sex Differences in Neuroprotection

Angela Pagano, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Lindsey Hamilton, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Sex Differences in Neuroprotection looks at how neuroprotection works and what can go wrong with it. Stemming from the idea that neurodegenerative disorders and neuroprotection have a different interaction in men and women; it is thought that interaction is what causes neurodegenerative disorders. Looking at how Estradiol and Androgens interact with brain support cells to create neuroprotection is a hot topic in research. It is also being researched what takes away neuroprotection to cause damage to stay and diseases to occur. Both sets of research will be used to explore how neuroprotection can fail and why it does. Neuroprotection is highly based on differences of sexes and so is neurodegenerative disorders. To understand neuroprotection, one must understand how hormones affect the brain and it's processes. While both males and females have neuroprotective properties, more research has been done on estrogen. This is also why the biggest neurodegenerative disorder (Alzheimer's Disease) is mostly in women.

Correlation of Type II Diabetes Mellitus Glomerulopathy with Pancreatic Morphometry

Lucine A Papazian, Modern Human Anatomy, School of Medicine
AMC - Graduate School

Mentor: Dr. Lisa Lee, Cell and Developmental Biology, AMC - School of Medicine

Abstract:
Insulin producing beta cells in pancreatic islets play a critical role in the expression and manifestation of type II diabetes. Longstanding hyperglycemia, associated with the diabetic condition, impairs beta cell insulin production and systemic insulin sensitivity. Systemic glycation ensues when insulin production and insulin action are impaired during periods of prolonged hyperglycemia. Microvasculature glycation is central in the pathogenesis of the related diabetic disorder, Diabetic Nephropathy (DN). While DN progression is a documented and staged disorder, there is no standard classification for pancreatic morphometric alterations. Pancreatic functional deficits and morphological alterations have been reported, however correlation with DN pathogenesis and stages of pancreatic histological alterations remains unestablished. The objective of this study was to investigate the morphometric changes in pancreatic tissue in relation to the established DN progression, and to establish a set of pancreatic histological criteria associated with diabetes progression. In this study, 91 matched pancreatic and kidney tissue slides were obtained from the existing autopsy repository at the University of Colorado Hospital. Pancreatic adipose infiltrates and islet morphology was analyzed and quantified. Matched kidney tissues were then histologically assessed and grouped, DN class I-IV. Quantified pancreatic metrics were compared across the four DN groups; results show a marked increase in pancreatic adipose infiltration and decrease in islet density corresponding with DN class I onset, and a significant reduction in total pancreatic islet composition throughout DN. For the first time, coinciding diabetic complications between the organ systems has been evaluated, and pancreatic morphometry has been correlated with DN progression.

Occupancy and Nest/Den-Site Selection between Co-occurring Mountain Plover, Burrowing Owl, and Swift Fox

Ryan A. Parker, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Michael B. Wunder, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Research has independently linked Mountain Plover (Charadrius montanus), Burrowing Owl (Athene cunicularia), and Swift Fox (Vulpes velox) to Black-tailed Prairie Dog (Cynomys ludovicianus) colonies in shortgrass prairie ecosystems throughout the Western Plains. Patterns emerge from preliminary trend data for plovers, owls, and foxes collected on prairie dog colonies by the US Forest Service on the Thunder Basin National Grassland (TBNG) in eastern Wyoming. This suggests that an ecological relationship may exist between these species. This research will draw from current literature on these species and their required habitat to address a potential trophic-level relationship. We will use occupancy and species distribution-based modeling and mapping to investigate whether dynamics between predatory swift fox and burrowing owl influence the breeding biology of a shared prey resource, mountain plover, using a subset of black-tailed prairie dog colonies on the TBNG. The main objectives are to 1) model the rate of occupancy of mountain plover, burrowing owl, and swift fox as a function of observation (time, observer) and site level (weather, vegetation, species co-occurrence) covariates on prairie dog colonies, and 2) map the spatial distribution of, and association between, plover, owl, and fox nest/den site selection as a function of site level covariates and location. This project will provide a multi-species management tool for land management agencies and contribute to broad-scale research initiatives throughout the distribution of the shortgrass prairie ecosystem.

Blood Flow Measurement as a Tool for Measuring Inflammation of Pancreatic Islets in Type 1 Diabetes.

Samantha E. Passman, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Mentor: Dr. Richard K.P. Benninger, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:
Type 1 diabetes is an autoimmune disorder in which the immune cells misrecognize and destroy the insulin producing beta cells in the Islets of Langerhans located in the pancreas and affects approximately 1.25 million people in the United States. Infiltration of the islet by T-cells or insulitis, causes inflammation in the islets. The purpose of this research was to use non-invasive contrast enhanced ultrasound technology to measure insulitis by measuring changes in pancreatic blood flow to determine if there are regional differences in insulitis as revealed by differences in islet blood flow across the pancreas. To measure regional differences in insulitis, Non-Obese Diabetic (NOD) mice which mimic the Type 1 diabetes disease course in humans were injected with lipid microbubbles and burst using a high-mechanical-index pulse. The rate of recovery of the bubbles flowing into the pancreas after bursting was then measured using ultrasound. As diabetes progresses, there are changes in average rate of blood flow and vessel diameter which indicate inflammation changes within the islets, these values were measured across three sections of the pancreas. Overall, variability in rate of blood flow and vessel diameter across the pancreas with disease progression was not detected suggesting that there are no significant regional differences in pancreatic inflammation in NOD mice. In contrast to the changing islet density distribution across the pancreas due to its shape in humans, it appears that there are no regional differences in islet density and blood flow associated with insulitis in NOD mice.

Lynx Alternative Break To Nepal

Surakshya Pathak, Geography, Environmental Science
DC - College of Liberal Arts and Sciences

Shubheksha Shubheksha, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Ms. Megan J. Frewaldt, Student Life

Abstract:
CU Denver Community Engagement provides multiple platforms for students to get involved with different local communities and expand their knowledge on the importance of active citizenship. During January 2017, through the Lynx Alternative Breaks program, CU Denver students along with two student leaders and two staff advisors participated in a volunteer journey to Nepal. During the trip students took on the mission of advocating for Nepalese communities on the social, cultural, and environmental injustices they faced after the 7.8 magnitude earthquake that happened in April of 2015. The earthquake shattered many Nepalese people's hopes and dreams for their future and this trip was an opportunity for the students to acknowledge how unity and understanding strengthens a community in a crisis such as a natural disaster. This experience served as an opportunity for our students to join hand-in-hand with the Nepalese people to restore their communities after such disaster. The service projects ranged from aiding at a public, governmental school which was severely affected by the earthquake to building a community and health center in a rural village. Immersing in the community in this way helped CU Denver students to learn and reflect on the many privileges we experience within the U.S. The underlying smiles on people's' faces in Nepal, even after losing their homes and livelihood, was a testament to the resiliency of humanity, and inspired every member of our group to optimistically face adversity.

Opting Out of Preventative Medical Care: the association between becoming widowed and mammography utilization in the U.S.

Krysta A. Pelowich, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Patrick M. Krueger, Health and Behavioural Sciences, DC - College of Liberal Arts and Sciences

Abstract:
Marital transitions, specifically widowhood, are associated with various health and health behavior outcomes but have not been linked to health care utilization. Our study examines whether the death of a spouse causes a woman to change her mammography behavior. Mammography is an ideal outcome because it results in improved breast-cancer treatment outcomes at the population level, but women may avoid them due to high levels of false positives. We focus on contrasting theories that suggest how mammography behaviors may change after the death of a spouse. The fatalism perspective argues that the death of a spouse may lead women to become socially isolated and emotionally distressed, and that she may be more likely to forgo preventive health care. Alternately, the renewed commitment to life perspective suggests that women may respond to the death of a spouse by recommitting to her own health and pursuing healthier behaviors, including increased mammography utilization. We will also examine whether education modifies the association between the death of a spouse and women's mammography behavior. Our data come from the Health & Retirement Study, a longitudinal study of adults aged 51 and older in the United States. We use multilevel growth models to test our hypotheses.

BioBrewers Presents: The Boozerite wearable alcohol sensor

Frank G Pendrell, Landscape Architecture and Urban Design, College of Architecture and Planning
DC - Graduate School

Steve Lewis,

Alexander Swanson, Marketing

Mentor: Dr. Heather Underwood, Inworks, DC - College of Architecture and Planning

Abstract:
An interdisciplinary group of scientists, brewers, and marketers have designed a smart, wearable, alcohol sensor to keep you from embarrassing yourself this weekend! The Boozerite bracelet seeks to enable users to have better control and understanding of their alcohol consumption. By sensing the alcohol that naturally evaporated from our skin when we drink, this bracelet can accurately relay the intoxication level of the user, both visually and through an app. When linked to the associated smartphone app, the Boozerite can alert a friend or family member, call you a ride once you hit a certain poi

Missionaries: Agents of Socioeconomic Change in Papua New Guinea

Ariana Pepe, Anthropology
DC - College of Liberal Arts and Sciences

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

Abstract:
This paper focuses on how missionaries prompted change in Papua New Guinea in regard to their social structure and their economy. There is a strong indigenous presence within Papua New Guinea today, but a lot has changed within their societies due to contact with the western world many years ago. By setting up missions on the coasts and then using native missionaries from previously proselytized islands surrounding Papua New Guinea, missionaries were able to reach people beyond the coast and into deeper parts of the island that were very secluded from the outside world. Their goals were to reach as many people as possible. Yet, the missionaries not only brought over their faith, but they also shared and emphasized western values and traditions. These new ideas changed the way the people of Papua New Guinea viewed themselves and their society, prompting adaptation in order to fully embrace the Christian faith and western lifestyle. Not only did this affect their social lives and how people went about their day, but it also had deep changes to how the natives ran their societies and how they interacted with the rest of the world economically. My research looks at how the goals and fundamental ideologies of the missionaries set the stage for further socioeconomic evolution on the island.

Community Experiences of Changing Urban Landscapes

Cody Peterson, Applied Geography, College of Liberal Arts and Sciences
DC - Graduate School

Tirzha Zabarauskas, Applied Geography, College of Liberal Arts and Sciences
DC - Graduate School

Emily Anderson, Applied Geography, College of Liberal Arts and Sciences
DC - Graduate School

Bryan West, MS Environmental Science, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Bryan Wee, Geography and Environmental Sciences, DC - College of Liberal Arts and Sciences

Abstract:
In much of the social sciences and humanities, researchers are actively exploring alternative research methods and modes of communication that capture the complexities of human experience. These include participatory research designs as well as novel applications of digital media, such as story mapping, that visually represent human-environment interactions at various scales. A story map is an interactive mapping interface which links specific locations to participant-generated text, images, audio, and video — the map in effect tells a spatial story that reveals the more intimate, human dimensions of a place and the worldviews of people who live there. This project develops and applies story maps to explore the experiences of both youth and adults who inhabit the changing neighborhoods of north/east Denver. These communities are currently undergoing substantial social and material transformation, including mass infrastructure expansion, housing redevelopment, and gentrification/ demographic shift. The research stems in part from a recognition that the perspectives of non-voting youth are often ignored in public policies that reshape the city, even though such policies will ultimately affect their future opportunities. Specifically, participants in this project exemplify an emerging generation of young activists whose stories intelligently explore difficult questions of race, class, identity, pollution, and urban change. Thus, the story map not only represents the lived realities of individuals and communities, it stands as a testimony to the capacity of youth to participate in local political dialogue.

Denver Museum of Contemporary Arts - Sustainable Features

Wilbur Pillsbury, Civil Engineering
DC - College Engineering and Applied Sciences

Malay Patel, Civil Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Lance VanDemark, Civil Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mikolaj Salamon, Civil Engineering
DC - College Engineering and Applied Sciences

Emilia Cabeza de Baca, Architecture
DC - College of Architecture and Planning

Mentor: Dr. Caroline Clevenger, Civil Engineering, DC - College Engineering and Applied Sciences

Abstract:
The Contemporary Art Museum in Denver was designed with several sustainable elements in mind. The video submitted, overviews several of these design practices that have scored the museum a LEED Gold rating. From water efficient facilities to natural day lighting, the museum merges environmentally conscious goals with occupant comfort and contemporary intent.

Aluminum(I) Diketimine Complexes Activate C(sp3)–F and C(sp2)–F Bonds by Different Mechanisms

Chloe E. Pitsch, Chemistry
DC - College of Liberal Arts and Sciences

Mentor: Dr. Xiaotai Wang, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Activation and functionalization of carbon–fluorine (C–F) bonds can lead to fluorinated organic compounds with potential applications as drug molecules and functional materials. Experimentalists have recently accomplished activation of C(sp3)–F and C(sp2)–F bonds in fluoroalkanes and fluoroarenes, using inexpensive aluminum(I) diketimine complexes. Through the use of density functional theory (DFT) computational methods, we have found two different mechanisms for the cleavage of such C–F bonds by these aluminum(I) compounds. The C(sp2)–F bond is added to the Al(I) center by a concerted oxidative addition mechanism, while the C(sp3)–F bond is cleaved via a stepwise mechanism involving fluoride transfer and the formation and recombination of an ion pair.

Satisfaction, Health Concordance and Dietary Behaviors in Engaged Couples

Arynn J Prescott, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Krista W. Ranby, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Previous research has documented that within couples, spouses offer a significant source of social support and influence that affects their partner's health status and health behaviors over time. Evidence in psychology literature further suggests that social support constructs in the context of romantic relationships are very important in establishing, changing or maintaining certain health behaviors, which includes dietary choices. This one health measure, dietary behavior, impacts many other areas of an individual's overall health. Poor dietary choices are linked to obesity and other chronic health issues. The current study seeks to examine concordance in dietary behaviors in relation to relational satisfaction among newly engaged couples. A total of 305 engaged (pre-marital) couples, most of whom are cohabitating, completed a survey assessing various types of relationship, health and lifestyle behaviors. Demographic information, cohabitation length, concordance on dietary choices, shared meal habits, and several measures of relationship satisfaction in engaged couples were collected. Using that data in this proposed research study, it is predicted that higher rated levels of investment and satisfaction will positively correlate with highly similar dietary habits and higher influence on dietary and global health behaviors. This study is significant as it has the potential to inform psychological and public health protocols on couples-specific dietary interventions.

Benzodiazpines and Their Dual Administration with Ethanol Increase Accumbal Transient Dopamine Release Events

Dylan R Rakowski, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Katherine J. Pultorak, Biology
DC - College of Liberal Arts and Sciences

Scott A. Schelp,Biology , Psychology
DC - College of Liberal Arts and Sciences

Gregory Krzystyniak, Physics
DC - College of Liberal Arts and Sciences

Mentor: Dr. Erik B. Oleson, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Drugs of abuse are commonly thought to increase the concentration of dopamine in the nucleus accumbens (NAc), although their effects on phasic dopamine release events remains to be fully characterized. Here, we are assessing the action of dual-administration of ethanol and benzodiazepines on accumbal dopamine release events. Using fast-scan cyclic voltammetry (FSCV) performed in the freely-moving rat, we first assessed the effects of benzodiazepines (0.3-1mg/kg IV) on accumbal dopamine release. We found that two distinct benzodiazepines, diazepam and zolpidem, increase the frequency of dopamine release events, but decrease the concentration of dopamine per release event. This effect was consistently observed in both the core and shell subregions. Previous FSCV studies from the Robinson' lab demonstrated that ethanol increases both the frequency and amplitude of accumbal dopamine release events. We then assessed for changes in dopamine concentration after treating animals with a range of ethanol doses (0.125-2g/kg IV) followed by 1.0mg/kg IV diazepam.

Comida en Cuba: The Future of Sustainable Agriculture in Changing Political Climates

Claire Ransom, International Studies (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Sasha Breger Bush, Political Science, DC - College of Liberal Arts and Sciences

Abstract:
When the Soviet Union fell, it took Cuba down with it. The small island nation lost access to fuel and fertilizers, and thus very quickly to food. Forced to quickly innovate solutions, they established organoponicos, or small urban farms in the heart of the city. Today, nearly three decades later, urban agriculture serves a form of social justice in the city of Havana, providing healthy, local food to those who need it most. In comparison, in cities in the United States, food often travels thousands of miles and frequently comes from large-scale farms with heavy pesticide and fertilizer use. This system is neither beneficial for human and environmental health nor sustainable in the long term. While sustainable development has been a hot topic in research, tangible solutions like organoponicos are only just starting to be recognized on an international scale. However, as relations with the United States change, it is unclear how these systems will be affected. As such, this research will address the sustainability and potential future of Cuba's organic agricultural systems, particularly as international relations and politics shift.

Lynx AB Environmental Stewardship and Sustainability

Claire E Ransom, International Studies
DC - College of Liberal Arts and Sciences

Matthew McCoo, Biology, Public Health
DC - College of Liberal Arts and Sciences

Mentor: Dr. Hannah Anchordoquy, Biology, DC - College of Liberal Arts and Sciences

Abstract:
To celebrate the 100th anniversary of our beautiful national parks, we led an Alternative Break trip focused on environmental stewardship to Saguaro National Park through the office of Community Engagement. We worked on environmental justice by completing a week-long, service trip over spring break with twelve students from across campus. This trip consisted of various direct service projects to preserve the landscape such as trail work and maintenance, vegetation restoration, wildlife protection, and invasive species removal. Throughout the trip, we learned about how the environment has been threatened by human activity, ways to contribute back to the national park system and be active citizens in our own communities.

Src Tyrosine Kinase Activation in Xenopus laevis Fertilization

Hinal Rathi, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Leslie Simmons, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Bradley J. Stith, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Src tyrosine kinase (Src) is a non-receptor enzyme that places a phosphate group onto a tyrosine found on other proteins, and this can turn on or off the activity of the other protein. Src plays a role in cancer, Alzheimer's Disease, and fertilization. Understanding of how this kinase is regulated is important but still unclear. Dr. Stith's lab has found that a lipid named phosphatidic acid (PA) can bind to and activate Src. Src activation involves changing from an inactive tight conformation, where the domains of Src are bound up, to a "loose" configuration. This change is due to the breaking of two sets of weak bonds: one set of bonds that must be broken is between the SH2 domain of Src and the c terminal phosphorylated tyrosine 527, and the second set is between the SH3 domain and a proline-rich linker domain. Thus, dephosphorylation of tyrosine 527 can help Src unfold and this leads to activation. Finally, phosphorylation of tyrosine 418 occurs and this causes the movement of the activation loop out of the active site, the site is no longer blocked and Src can phosphorylate substrates. We have shown that Src is activated by recording a decrease in tyrosine527 phosphorylation that occurs simultaneously with an increase in tyrosine 418 phosphorylation. These results suggest that PA induces a cycling of Src activity. To continue this evaluation of how Src is activated, we will quantify other Src sites as to whether phosphate has been placed on certain amino acids located there (phosphorylation). Through Western Blotting with antibodies specific to phosphorylated sites, we were able to quantify phosphorylation at other regulatory sites (which are also present in humans). We also have preliminary data showing threonine 420 phosphorylation increases with PA addition and this may induce removal of the activation loop from the active site.

Vascular Ventricular Coupling Ratio Outcomes Study

Adam Rauff, Bioengineering (UROP Recipient)
DC - College Engineering and Applied Sciences

Mentor: Dr. Kendall, Hunter, Bioengineering, DC - College Engineering and Applied Sciences

Abstract:
The focus of the project is a disease of the heart and lungs called Pulmonary Hypertension (PH). More specifically, this research initiative targets PH amongst a pediatric population. Strictly speaking, PH is a microvascular disease that induces a high resistance to blood flow in the pulmonary circulation. The fine blood vessels in the pulmonary circulation narrow, and the increased long term blood pressure causes fibrosis in the arteries, which is characterized by thickening and stiffening of the vessels yielding increased blood pressure. The right side of the heart, which pushes blood to the lungs, cannot cope with this state, which eventually leads to death in the majority of cases. The disease most commonly originates in children as a result of genetic heritage or Drug-toxin induced, classified as idiopathic, or along with congenital heart defects, classified as associated. PH is a fatal disease that progressively deteriorates individuals' lives and remains with no cure. In order to diagnose the disease, a physician will utilize a variety of non-invasive measurements such as echocardiography, electrocardiograms, x-rays, and light exercise tests. The clinical tools mentioned above are instrumental in the diagnosis, however, cardiac catheterization, an invasive tool, remains the gold standard in the identification of PH. Catheterization may take place under systemic anesthesia, which poses an undesired risk, particularly in pediatric patients. Furthermore, the current standard of care involves a metric named pulmonary vascular resistance (PVR) that is derived from catheterization. This measurement approximates the resistance to flow in the main pulmonary artery. While PVR provides insightful information about the mechanical state of the heart, and subsequently the progression of the disease, it does not adequately capture the dynamic nature of heart acting as a mechanical pump. Vascular ventricular coupling ratio is a metric that has been around the cardiovascular research community for over 30 years, yet it has not been integrated into standard clinical care. VVCR originated as a measurement that takes volumetric and pressure measurement to compare the distensibility of the walls of the heart to the walls of the pulmonary vasculature. Other research groups have conducted experiments on canine where the main pulmonary artery was occluded, and a predictable VVCR was obtained. Thus, VVCR allows physicians to better evaluate the current state of the heart compared with a hypothetical scenario of heart failure, where the right ventricle can no longer push blood into the pulmonary vasculature due to increased resistance. In this project, we conduct an observational retrospective clinical study target at the exploration of a new metric called vascular ventricular coupling ratio (VVCR). The project will involve a statistical analysis of longitudinal data involving a variety of metrics derived from standard of care such as blood pressure, blood flow, resistance. These metrics will be compared with our calculated VVCR. Finally, we plan on evaluating what metrics can be used as the most useful predictors of hard outcomes such as death, hospitalization, or lung transplantation.

Characterization of Xenobiotic-mediated Activation of the Nrf2 Pathway in Down Syndrome

Abhishek Rauniyar, Biology
DC - College of Liberal Arts and Sciences

Stefanos Aivazides, Toxicology, School of Medicine
AMC - Graduate School

Mentor: Dr. James R Roede, Pharmaceutical Science, AMC - School of Pharmacy

Abstract:
Down syndrome (DS) is the most common genetic cause of intellectual disability in the US, and results from the presence of a third copy (whole or part) of chromosome 21. This triplication results in a variable phenotype that includes several comorbidities, such as early onset Alzheimer's disease, epilepsy, autism, diabetes, and leukemia. Oxidative stress has been proposed to be involved in the development of the aforementioned comorbidities. Additionally, elevated markers of oxidative stress are observed in biological samples from DS individuals. Cellular responses to oxidative and electrophilic insults are mediated via the transcription factor Nrf2 but there is no literature concerning the Nrf2 pathway activation and kinetics in this population. Therefore, this study aims to elucidate the dynamics and role of

LWPC Modeling of VLF Perturbations on Overlapping Propagation Paths from Lightning Induced Energetic Electron Precipitation

Chad Renick, Electrical Engineering
DC - College Engineering and Applied Sciences

Sandeep R. Sarker, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark, Golkowski, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
Lightning discharges are a source of high amplitude, broad frequency electromagnetic radiation. These electromagnetic waves can cause perturbations in electron densities in a region of the upper atmosphere called the ionosphere. The changes in electron density are caused by either ionization from quasi-electrostatic fields or from induced energetic electron precipitation from the magnetosphere. Because changes in electron density affect the conductivity of the ionosphere, lightning discharges can perturb the amplitude and phase of VLF communication signals propagating through the Earth-ionosphere waveguide. Most past work in this area has involved singular propagation paths between a transmitter and receiver. Modeling of such perturbation events often involves uncertainty since the perturbed ionospheric profile cannot be uniquely determined. In this work we focus on overlapping VLF propagation paths when signals from two different VLF transmitters share a common path to a receiver. This allows for the geographic area of the overlapping path to be simultaneously diagnosed with two signals with different mode content. Observations show that a lightning induced perturbation on the overlapping path can have a large effect on the amplitude or phase of one signal, while leaving the other wave relatively unaffected. The Long Wave Prediction Capability (LWPC) software is used to simulate this phenomenon by altering the effective conducting height of the ionosphere near the location of a known nighttime lightning strike. Good agreement is found between the simulation and the observations providing additional constraints on the perturbed ionosphere and a more accurate model of how lightning effects ionospheric electron densities.

LWPC Analysis of Lightning-induced Sferic's ELF Propagation Velocity

Sandeep R. Sarker, Electrical Engineering, College of Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Mark Golkowski, Electrical Engineering, DC - College Engineering and Applied Sciences

Abstract:
The Long Wave Propagation Capability (LWPC) software package is a comprehensive simulation tool with a longstanding track record of simulating the propagation of very low frequency (VLF: 3-3- kHz) electromagnetic waves in the Earth-ionosphere waveguide. The code is able to simulate waves launched at any geographic location and takes into account effects of parameters that vary spatially around the world, such as the Earth's magnetic field, the ground conductivity, and the zenith angle of the sun. In this work, we apply LWPC to the extremely low frequency (ELF : 0- 3kHz) band and focus on the group velocity of electromagnetic impulses generated by lightning discharges, known as "sferics". The group velocity shows variation as a function of the electron density profile of the lowest region of the ionosphere known as the D-region. The D-region's electron density profile can generally be fitted as an exponential function quantified by two key parameters, 1) the scaling factor for the reflection height of the Earth-ionosphere waveguide 2) the sharpness of the exponential profile. We analyze the change of the group velocity for profiles with reflection heights ranging from 70-90 km as well as sharpness magnitudes ranging from .4-6 . These parameters correspond to day and night conditions. The variation of the propagation velocity in an Earth-ionosphere waveguide containing a non-exponential electron density profile is also analyzed. Other factors that are analyzed in this work are the path lengths of the propagation, the conductivities of the ground, different directions of propagation, geographic locations of the transmitter and receiver, propagation across the day-night terminator, as well as the trend of propagation velocity change under the event of a sudden ionospheric disturbance (SID). A SID occurs when the sun emits a short wavelength X-ray carrying a high-level of energy towards the Earth. These X-rays carry enough energy to penetrate into the D-region and induce photo-ionization. This photo-ionization process lowers the reflection height and increases the sharpness of the profile. Two models for predicting the change of the electron density profile under a SID event have been developed. The first developed model simply changes linearly with the logarithm of the strength of the X-ray flux. This model is relatively accurate in predicting the change of the amplitude and phase, but does not capture the relaxation of the ionosphere after the SID event took place. The relaxation time depends on the number of electrons that were freed during the event and the duration of time needed for these electrons to reattach to the ions in the D-region. The second model captures the relaxation of the ionospheric profile after the event. The results show that ELF propagation velocity increases during a SID event.

Human-Human Interface: A Neuroscience Outreach Pilot

Jonté B. Roberts, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Erik B. Oleson, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
The Oleson lab performs several Neuroscience outreach events each year. Current stations offered are: visual plasticity, comparative neuroanatomy, sheep brain anatomy/dissection, careers in the biomedical sciences, drugs and the brain. Here, we are piloting out a potential outreach station on human-human interface. Essentially, I will try to control your body with my brain using similar technology to that used in robotic prosthetics. When your arm moves, an electrical impulse is sent from the primary motor cortex of the brain (M1) to your arm's muscles. We are able to detect such electrical impulses and send them to a robotic arm, or even another person, to make the arm move. In this case, we will take the impulses produced by a brain, amplify them using arduino technology, and then deliver them to the arm of an interested participant to cause it to move involuntarily. By placing two electrodes onto the ulnar nerve of participants and then adjusting the amplitude of nerve impulses originating from an experimenter, we will be able to control the participant's' arm movements. Our hypothesis is that we can efficiently apply this technology to student volunteers. If so, we will implement this technology into our outreach program.

Spatial Analysis and Linear Regression of Infant Mortality Rate, Social Disadvantage, and Healthcare Access

Alex D Romero, Sociology, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Adam M. Lippert, Sociology, DC - College of Liberal Arts and Sciences

Abstract:
While the US infant mortality rate (IMR) has declined in recent decades, racial disparities remain. The IMR is considerably higher in counties with higher proportions of Black Americans than more racially homogenous counties. Research indicates that social disadvantage and health care access may contribute to these differences, though few studies have considered these factors simultaneously. The current study addresses this gap by merging social disadvantage data from the American Community Survey (ACS), healthcare access data from the Area Health Resource File (AHRF), and infant mortality data from the CDC. Spatial analysis and cartographic methods demonstrate the spatial distribution of infant mortality and its correspondence to racial composition across 178 US urban counties. Ordinary linear regression models reveal a positive association between the county-level proportion of Black Americans and infant mortality. This relationship is attenuated with the addition of a measure of social disadvantage, which itself is positively associated with infant mortality. The positive association seen is also decreased with the addition of a standardized measure of hospital beds and nonfederal office based pediatricians, which are positively and negatively associated with infant mortality respectively. However, once all variables above are considered together the associations seen from AHRF variables are attenuated by social disadvantage and are no longer significant. Therefore, overall findings suggest the concentrated disadvantage is a confounding variable for healthcare access and IMR outcomes at the county level. These findings highlight the importance of adjusting for the measures of both social disadvantage and healthcare access when analyzing infant mortality outcomes.

Enhancing Electricity Production by Bacteria in Wastewater

Jessica L. Romero, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Timberley Roane, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Microbial fuel cells (MFCs) rely on 'electrogenic' bacteria to produce electricity, offering an innovative form of sustainable energy with further investigation. With potentially dozens of electrogenic bacterial species inhabiting wastewater, growth conditions satisfying the metabolic needs of these organisms, thus enhancing electricity production, are still being determined. The objective of this study was to enhance the metabolic activity of electrogenic bacteria in MFC reactors to encourage extracellular electron release, resulting in the production of current and voltage to produce power. MFC designs tested included a 'box' reactor design with different anodes (titanium and iron oxide) and different chemical compositions of growth medium. Among the MFC designs tested, an iron oxide anode in conjunction with a vitamin and mineral-enriched medium was found to increase power production. Within 30 days of incubation under 1000 Ω resistance, this MFC design produced an average of 334 mV, a 7-fold increase over a design consisting of a titanium anode and a less enriched medium under the same timeframe and resistance. With the former design, analysis of the iron oxide anode fibers under fluorescent light microscopy showed evidence of a diverse anode biofilm. Bacterial 16S rDNA sequencing of the electrogenic community in free solutions and in anode biofilms collected at different time points during MFC maturation showed diverse bacterial communities. Continuing studies will further optimize MFC conditions to meet the metabolic needs of the mixed electrogenic bacterial communities.

Analysis of Ingroup Bias: Understanding How Individuals Maintain In-Group Advantages Under Cognitive Stress

Joseph F. Rosales, Psychology, Sociology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jim Grigsby, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
In-group bias is the tendency to benefit members of one's own groups over members of other groups. Also, stress is known to greatly influence an individual's implicit behaviors. In this study, we are investigating if individuals under stressful conditions are less likely to share resources with individuals from different ethnic backgrounds and more likely to share with similar individuals demonstrating in-group bias. To measure this, we first asked participants to complete a timed math task termed the Paced Serial Auditory Addition Task (PASAT) in which participants have to quickly add two single digits together. Most participants found this test somewhat difficult and mildly stressful. To measure in-group bias, we used a procedure from behavioral economic game theory, the dictator game, which is designed to assess how willing people are to act against their sole interest and share economic resources. In our findings, we found that individuals were more likely to share fewer resources with individuals from dissimilar ethnic backgrounds.

An Exploration of Responsible Employee Policies on College Campuses as Directed by Title IX: What do Victims, Faculty, and Administrators Really Think about the Policy?

Jessica M. Rosenthal, Criminal Justice, School of Public Affairs
DC - Graduate School

Mentor: Dr. Callie Rennison, Criminal Justice, DC - School of Public Affairs

Abstract:
Many institutions of higher education have responded to guidelines set forth under Title IX by creating mandatory reporting policies. These policies include the requirement that all responsible employees report any information they have about an instance of sexual misconduct to the Title IX coordinator, regardless of the victim's wishes. The question remains about how those affected, view these polices. This research addresses that question by exploring the views of victims, faculty members who have gone through the reporting process, faculty members who have gone through the training, and administrators who work with victims of sexual misconduct. The research also provides insight into how opinions about the responsible employee policy are influenced by services available to victims. Both overarching themes and themes specific to each group are presented. Policy implications are considered.

Expand the Mind, Expand the Culture: Linking Hallucinogenic Iconography Between Pre-Columbian Civilizations

Kara Rossi, Art History
DC - College of Arts and Media

Mentor: Dr. Yang Wang, Visual Arts, DC - College of Arts and Media

Abstract:
Anthropological research has established that hallucinogenic substances were commonly used in Pre-Columbian cultures for shamanic ceremonies and everyday consumption. Artworks and artifacts provide physical evidence for not only how the peoples of these cultures ingested these substances, but also depict the visions that people experienced while taking the substances. However, this existing body of research has yet to connect the practices of different Pre-Columbian cultures through these instruments and visual depictions of hallucinogenic use. Through formal analysis and iconographical study, methods rooted in art history, my paper will connect the imagery and instruments found between several different Pre-Columbian cultures. I will expand upon anthropological studies that discretely examine the role that psychotropic plants played in individual cultures by establishing connections between these cultures through specific objects, artifacts, and motifs. Through this research, I argue that not only did these Pre-Columbian cultures experience similar hallucinations, but may have also depicted their experiences in ways that would have been understood by other nearby cultures. The similarities found between the objects and practices of these cultures may suggest a form of trade or relationship between each other. By recognizing visual and material evidence that ink these cultures through art historical analysis, this study furthers our understanding of the impact hallucinogenic substances had on these cultures and points to possible connections between the cultures.

Correlations between Altruistic Behavior and Overall Quality of Life

Matias G. Saez, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. David S. Albeck, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
To analyze how altruistic and prosocial behavior relates to mental and physical health. Specifically, to look at factors such as life satisfaction, self-esteem, reported happiness levels, diet, and exercise to determine if there is a correlation between altruism and these factors. Additionally, another interest is how altruistic and prosocial behavior plays a role in relationship satisfaction amongst couples.

Crossmodal effects of irrelevant auditory stimuli on saccadic eye movement behavior

Cailey A Salagovic, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Carly J. Leonard, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Due to the tremendous amount of sensory input constantly entering the brain, attentional selection of the most important information is required. The thousands of individual eye movements made per day which directs the sensitive visual receptors of the fovea to select locations are an important selective behavior which can be measured with eye-tracking techniques. While it is well understood that visual cues and salient information affect attention, further research is required to understand the role of auditory stimuli in directing visual attention. Existing research suggests that the occurrence of a random sound, such as a beep, during a visual search task may speed target acquisition by triggering a brief pause in scanning eye movements, known as “oculomotor freezing”. This may be because extended visual sampling of a relatively broad area takes place during this freeze, allowing for a subsequent eye movement directly to the target. The proposed study will use eye-tracking to examine the mechanism of this crossmodal attentional behavior. Experiment 1 will replicate this concept using both a simple beep and a more complex beep to determine whether the complexity of a sound modulates this oculomotor freezing effect. Experiment 2 will compare two simple beeps which occur with differing frequencies to gauge whether the novelty of a sound modulates freezing. We hypothesize that complex sounds will cause greater freezing than simple sounds and novel sounds will cause greater freezing than frequently occurring sounds.

Mating-receptivity in Female Dipterans Is Mediated by Daily Fluctuations of Dopamine Levels

Erin J. Sanders, Chemistry
DC - College of Liberal Arts and Sciences

Mentor: Dr. John G. Swallow, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Stalk-eyed flies (Teleopsis dalmanni), like vertebrates, are subject to circadian rhythms. Circadian rhythms can cause physiological changes that lead to differences in behavioral responses throughout the day. These physiological changes include fluctuations in monoamine levels, such as dopamine and serotonin. Invertebrates, such as stalk-eyed flies, are a useful model for studying the function of conserved mechanisms, like monoamines, that are also seen in vertebrates. Stalk-eyed flies tend to roost with other flies from around six to ten pm. When studied, female flies were found to have a spike in dopamine levels during this time period. This spike was not seen at other times throughout the day. It was hypothesized that this spike in dopamine would lead to increased mating receptivity in females. To test this, a drug was used to knock down dopamine globally in female flies and mating receptivity was tested and measured against that of female control flies. The results supported this hypothesis and suggested that dopamine plays a significant role in mating receptivity in female stalk-eyed flies.

Induced Hyperthermia of Tumors using Near Infrared Radiation and Photothermal Nanoparticles

Hunter Sauerland, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jung Jae Lee, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Photo thermal molecules absorb energy from electromagnetic radiation into thermal energy. It is thought that this heat can be used in body tissues to combat cancer by inducing localized hyperthermia. Due to the ability of body tissues to absorb many wavelengths of light however, it can be unfeasible to induce hyperthermia at the site of a tumor without also destroying body tissues above and below the tumor. Near infrared radiation with a wavelength around 700 nm to 900 nm is known to have low absorption by body tissues and as such deep penetration. The compound cypate is known to absorb light at 780 nm. If cypate was placed at the site of the tumor then near infrared light would be able to cause localized hyperthermia at the site of the tumor without also destroying healthy tissue. Due to commercial unavailability, cypate was synthesized and purified in the lab. Cypate was then conjugated with chitosan to form nanoparticles. The thermal capabilities of cypate was then analyzed by exposing it to a laser emitting near infrared light. H-NMR testing shows that a pure sample of cypate was produced for use in testing. The laser testing concluded that cypate could induce localized hyperthermia great enough to kill a tumor.

A Comparison of Mercury Concentrations in Gentoo Penguins (Pygoscelis papua) across a Wide Latitudinal Range

David Schutt, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Mike Wunder, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Anthropogenic pollution has been detected in remote regions of the planet for several decades. Mercury in particular, a byproduct of fossil fuel combustion and various industrial processes, has been shown to have deleterious effects on wildlife and humans alike. As a potent neurotoxin causing a range of impairments such as reproductive insufficiencies, immune compromise, and endocrine disruption, mercury bioaccumulates through the food web and can ultimately be found in human populations that consume fish. Penguins, as mesopredators localized to the Antarctic and subAntarctic region, serve as suitable biomonitors of mercury loads reaching this isolated system from global burdens. For my study, I am investigating mercury concentrations in Gentoo penguins (Pygoscelis papua) along a latitudinal gradient from the Falkland Islands at approximately 51° S latitude to the farthest southern extent of the species' range on the Antarctic peninsula at approximately 66° S latitude. The aim of this study is to 1) Specify the spatial gradient of bioavailable mercury in this system and 2) To explore the mechanisms that generate disparities in mercury bioavailability between Antarctic and subAntarctic systems.

Being the Bridge: Making an Old School Document Internet Ready

Dorothy L. Shapland, Leadership for Educational Equity, School of Education and Human Development
DC - Graduate School

Mentor: Dr. Elizabeth Steed, Early Childhood Special Education,, DC - School of Education and Human Development

Abstract:
Taking a dense, text-heavy document, and breaking it into user-friendly, accessible and interactive components for use in an online environment, requires the people skills to navigate and finesse both the original document's authors and the tech team charged with taking the final product live. This presentation will discuss the iterative process used to revise and refine the ECTA Planning Guide to Statewide Implementation, Scale-up and Sustainability of Recommended Practices, and provide some insight into the soft skills necessary for intensive collaborative work.

Connecting Policies to Perceptions: How Do College Students at CU Denver Understand Sexual Consent?

Bonnie J. Siry, Master of Social Science, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Jennifer Reich, Sociology, DC - College of Liberal Arts and Sciences

Abstract:
Based on data collected through in-depth interviews of CU Denver students, this research seeks to understand the perceptions women students have of sexual consent. In trying to understand their perspectives, participants are asked about sexual consent, sexual assault, campus life, and campus sexual assault policies. Drawing on previous research on students' perceptions of consent as well as research on sexual assault policies, this research explores how the policies translate into the lives of students and how students understand their own experiences. The research focuses on three questions: How do college students at CU Denver understand sexual consent? What sources do they draw upon to understand this issue? How do students perceive and experience campus policies on sexual assault and sexual consent? Perspectives of CU Denver Students give insight specifically on sexual assault concerns on a commuter campus. Interviews with 18-24 year-olds lasting up to an hour were conducted, then transcribed and analyzed. Data collected in interviews demonstrated the variety in understandings of sexual consent. While there were plenty of differences in how consent was understood interview participants all found communication to be vital to have a consensual sexual interaction. Most of the perceptions women interviewed held came from family or friends sharing their experiences, which excludes information about our campus and our policies. This research leaves the question, how can we make the numerous resources on sexual assault and consent available on our campus more accessible to our student population.

Calcium-Inhibition of SLP-2 C2A

Timothy A. Spotts, Chemistry (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Jefferson Knight, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Cell-to-cell communication plays an important role in maintaining homeostasis in a multicellular organism. In humans, the circulatory system gives the body of means of transporting nutrients to various tissues. When the amount of blood glucose is high after eating a meal, the body must have a means of storing excess nutrients for later; when blood glucose levels are low, after intense exercise or fasting, the body must have a means of unlocking the stored nutrients for distribution. The pancreas is responsible for detecting changes in blood glucose levels and transmitting signals to promote a proper homeostatic response by a cell somewhere else in the body. These chemical signals are known as hormones. The Knight Lab studies proteins that are involved in the release of hormones via a mechanism known as exocytosis. These proteins contain the ability to bind to cell membranes to facilitate the release of hormones in the blood stream. This project shows the rare ability of calcium to prevent the binding of one such protein to the cell membrane.

Long Term Urban Wildlife Research Potential Through Course-based Undergraduate Research Experiences

Sarah St. Onge, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Jamie Stedman, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Laurel Hartley, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Urbanization is increasing rapidly worldwide, leading to highly fragmented habitats which have been shown to be the leading cause of local wildlife species endangerment. Therefore, it will be important to study urban ecosystems to investigate effects of urbanization on wildlife. Urban wildlife research has the potential to support land and wildlife management decisions, wildlife and habitat conservation, urban biodiversity, disease dynamics awareness, and help with human-wildlife conflicts. The goals of our project are to establish CU Denver as a partner in the nationwide Urban Wildlife Information Network (UWIN) and use long-term monitoring of urban wildlife as a context for a Course-based Undergraduate Research Experience (CURE) in General Biology courses. This study will first establish a wildlife monitoring protocol in the Denver metro area using motion-activated camera surveys along an urban to rural urbanization gradient that will serve as a "trial run" for CURE logistics, and provide preliminary data. Curriculum creation will include developing learning objectives and identifying core experiences for scientific literacy that are consistent with current national directives and that comply with important aspects of CUREs, including relevancy of the project that results in the discovery of new scientific knowledge, use of scientific practices, collaboration with peers, and iteration. By creating a CURE curriculum, this project will be the start of a long-term monitoring project that will be beneficial for students, universities, land managers, and UWIN. Here we present initial findings from our first camera deployment and the learning objectives for the planned CURE course.

The Methodology of Camera Placement in Urban Wildlife Monitoring Initiatives

Jamie L. Stedman, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Laurel Hartley, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Urban sprawl and the growth of the population have created several challenges that humans face when they come into contact with the animals living nearby. The occurrence of these challenges has displayed that there is a need to study and develop in a way that keeps these animal populations in mind, for both the ease of the humans and the animals. Uninformed human sprawl can lead to eradications of animal populations, infestations and damage of habitats. This is the intersection where urban wildlife monitoring comes in. Through the use of camera surveying, information can be gathered about these animals, which can be used in many ways to create a better-shared environment. The placement of these cameras for surveying can be an integral part of a study, therefore it is important to consider the mechanism for camera placement, including location size, distance between cameras, and the area a camera may be deployed. Through the use of different methods, a variety of information may be gathered. This variety of information may be useful in attaining a wide range of data for the Urban Wildlife Information Network (UWIN).

Let's Talk About Sex: Promoting Youth Empowerment Through Knowledge About Sexual Health and Identity

Hannah K Stobaugh, Elementary Education K-6
DC - School of Education and Human Development

William L. Card, Music Business
DC - College of Arts and Media

Maria E. Ortiz, Public Health
DC - College of Liberal Arts and Sciences

Vikasini Mahalingam, Anthropology
DC - College of Liberal Arts and Sciences

Jun Lee, Biology
DC - College of Liberal Arts and Sciences

Mentor: Ms. Sarah J Berg, Office of Equity, DC - School of Education and Human Development

Abstract:
Sex and gender identity isn't easy to talk about. Not with parents, teachers, friends, and unfortunately, in some cases not even intimate partners. Since sexual health is hard to talk about therefore it is not a priority in education and students are not receiving the information they need to be content with their sexual relationships. Spanning anatomy, body positivity, self care, consent, communication-related issues, and advocating for your needs in relationships, sexual health is much more than birth control and contraceptives. We decided to partner with two high schools in Denver Public Schools--East and Manual High School--to design a conference aimed at addressing the disparities in education around sexual health and identity. The conference entitled, I Am Enough: A Conference on Sexual Health and Identity, took place March, 10th 2017 with the two main themes being Sex and The Self and Sex in Society. The conference included presentations on: media and sexuality, being an active bystander, LGBT+ in the self and the community, birth control and contraceptives, as well as healthy body image and self care. With upwards of 80 students from DPS in attendance and overwhelmingly positive feedback from students and teachers, students will be able to now take and utilize resources in their community to advance the conversation of sexual health and identity.

Right to Clean Water: Public Health in Flint, MI

Adnan S. Syed, Public Health
DC - College of Liberal Arts and Sciences

Jazmin I. Beltran, Public Health
DC - College of Liberal Arts and Sciences

Mentor: Ms. Megan J. Frewaldt, Community Engagement

Abstract:
Switching the city's source of drinking water from the Detroit Water and Sewage Department to the Flint River, with supply pipes that experienced significant corrosion over time, initiated the distribution of lead contaminated water to the Flint community. According to the World Health Organization, children face the most risk with lead exposure, as it can impact their brain development, leading to mental impairments and behavioral disorders. This Alternative Spring Break focused on assisting with continuing water relief and recovery efforts, while also seeking to further understand the underlying factors of the Flint Water Crisis. The pre-trip meetings involved education on several factors, including the impacts of deindustrialization, spatial segregation and other social determinants on environmental justice and environmental health in the Flint community. During the actual trip, we partnered with Crossing Water, which is a grassroots organization dedicated to providing access to the most vulnerable populations of Flint to clean water, through cases of bottled water and water filters, and ancillary social services/resources. We also partnered with Habitat for Humanity to aid in affordable housing construction efforts. Participants were also given opportunities to engage in open dialogue with Flint residents about the water crisis, attend lectures surrounding current efforts and engage in other community immersion activities.

Effects of physical activity on behavior in house crickets

Margaret K Tanner, Biology, College of Liberal Arts and Sciences
DC - Graduate School

Erin Sanders, Chemistry
DC - College of Liberal Arts and Sciences

Megan Miner, Biology, Psychology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Benjamin N. Greenwood, Psychology, DC - College of Liberal Arts and Sciences

Abstract:
Physical activity in mammals has been shown to modulate behaviors important for survival by acting on the monoaminergic system, such as dopamine and norepinephrine. Monoaminergic systems are present in invertebrate species; however, little is known about the effects of physical activity on monoamine-dependent survival behaviors in non-mammalian species. In the common house cricket (Acheta domesticus), the norepinephrine analog octopamine is involved in experience-dependent changes in aggressive behavior and bite-force. This study exposed male and female common house crickets to 10 minutes of physical activity that was preceded by and followed by a measurement of bite-force capacity. Initial results revealed that male crickets experience an increase in bite-force capacity following the first bout of physical activity, while females do not respond to exercise. Follow-up studies will verify these initial results and determine the effect of physical activity on monoaminergic systems of house crickets.

Development of a Computational Educational Laboratory Activity to Improve Students' Thinking Skills and Mental Models for Understanding Intermolecular Forces

Kirubel Tekletsadik, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Karen J. Knaus, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
This computational laboratory activity and research project involves the design and development of a learning module to improve students' thinking skills and mental models for understanding Intermolecular forces. This presentation describes the educational theory behind the design of the activity, a description of the student learning activities in the module, as well as typical results from student interaction with the educational activity in the first trial. The module was designed with various activities and calculations using the Spartan computational software. Results from the preliminary implementation helped with careful re-design of the assessment of learning outcomes tool as well as helped with formulating new ideas for improvement in teaching practice to support future implementations of the educational activity. In addition, students were also asked to apply their understanding of IMFs to biological molecules of medical interest (e.g., protein and DNA structures). Feel free to learn more at this interactive presentation.

Contemplating Nature: The Impact of Chinese Painting Theory and Culture on Bonsai Display

Phil K. Than, Art History
DC - College of Arts and Media

Mentor: Dr. Yang Wang, Art History, DC - College of Arts and Media

Abstract:
Along with Buddhist sutras, Chinese garden culture in the form of texts, gardens, and laborers also made its way to Japan through religious exchange between the two countries in the late seventh- through ninth-centuries. Before then, Chinese literature served as the main vehicle for the transmission of Chinese culture to Japan. One of the Chinese art forms to have reached Japan is the ancient art of penjing ("tray landscapes"). The Japanese took the art form and transformed it into their own--as they did with other aspects of Chinese literary culture--in a process of developing an identity distinct from the Chinese. Thus, penjing was developed into the Japanese art called bonsai ("potted trees") with its own array of specific rules and methods, not unlike the classifications and theories of Chinese painting codified in China centuries before. The interactions between China and Japan of Buddhist monks and scholars and landscape painting, penjing, and bonsai have closely informed the formal display of bonsai trees and related arts. By establishing the relationship between China and Japan through penjing and bonsai, and by examining Chinese texts on painting and considering their connection to existing bonsai philosophy, this paper bridges the two art forms in order to understand the art of contemplating bonsai.

Binding Sites of Granuphilin C2A with Negatively Charged Lipids

Sherleen Tran, Public Health (UROP Recipient)
DC - College of Liberal Arts and Sciences

Nara L. Chon, Chemistry, College of Liberal Arts and Sciences
DC - Graduate School

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Insulin secretory vesicles are docked to the plasma by Granuphilin C2A in preparation for exocytosis. However, the detailed mechanism of this binding process is unclear. [1] It was hypothesized that the positively-charged lysine cluster of the β-4 sheet of the C2A domain was the primary interacting binding site with the negatively charged head group of the lipid molecules.[2] Here we combined molecular dynamics and docking calculations to test this hypothesis. A granuphilin C2A model is constructed and solvated in water. To partly account for the protein flexibility, multiple representative protein geometries from the 200-ns equilibrated trajectory as well as the experimental structure were used for docking calculations. In silico mutation on selective lysine residues were performed to these geometries, which were used in docking calculations. The data confirmed that the β-4 sheet of the C2A domain plays a key role in the binding of the lipid with granuphilin C2A. Acknowledgements: This work was supported by Dreyfus Foundation (TH-14-028), and NVIDIA Corporation, and used computational resources of XSEDE (140070) and NERSC (m2495). [Ask Dr. Knight for NIH grant number]

Investigating Zar Function Through Engineered Mutants

Ashley M. Trumpie, Biology Psychology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Sarah Russo-Pearl, Biology
DC - College of Liberal Arts and Sciences

Jericho Oviedo, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Amanda Charlesworth, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Zygote arrest (Zar) proteins are critical for embryonic development. The Zar mechanism of action is not currently understood, but it is known that they bind to RNA and regulate protein synthesis. Two active mutants were developed as potential tools to investigate Zar function. One was a truncated Zar C-terminal (CCZar), the other had a deletion in the N-terminal(ΔN). Mutants retained the RNA-binding domain and lost the protein-synthesis domain. Control inactive mutants were created with a disrupted RNA-binding domain. Mutants were successfully made as verified by restriction digest analysis. DNA sequencing verified the expected mutations had been introduced. RNA encoding the Zar mutants was transcribed and microinjected into frog eggs and embryos. Western blot confirmed the expressed mutant proteins were the right size. Experiments showed when active ΔN-Zar mutant was expressed a two-hour delay to meiosis was observed in frog eggs. This was not seen with the inactive ΔN-Zar mutant. In frog embryos, the active ΔN-Zar mutant was correlated with apoptosis and/or neural tube deformation, which were not seen with the inactive ΔN Zar mutant. The frog eggs and embryos injected with active CCZar mutant did not exhibit significant differences from any controls. Western blots suggested CCZar was expressed at the right size, morphological observations were inconsistent between samples. Thus, this study created an effective tool (ΔN-Zar) that will be used in future to better discern the role of Zar in early development and embryogenesis. CCZar was not an effective tool, but may still be used as an inactive specificity control.

We Don't Talk About That: Exploring the Needs For Adult Survivors of Childhood Sexual Abuse

Grace H Undis, Community and Behavioral Health
AMC - Colorado School of Public Health

SydneyLawrence, Community and Behavioral Health
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Jenell Bowen, Community and Behavioral Health
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Maureen Dechico, Community and Behavioral Health
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Kristin Banks

Whit Oyler

Stacey Quesada

Sarah Ballard

Mentor: Dr. Yvonne Kellar-Guenther, Community and Behavioral Health, AMC - Colorado School of Public Health

Abstract:
Statistics show that 1 in every 4 women and 1 in every 6 men were sexually abused as children (WINGS, March 2016) yet this group remains largely hidden in public health research. We interviewed and gathered survey data from 67 adult survivors of childhood sexual abuse in order to understand: (1) what services they have accessed to aid in the recovery, (2) what gaps exist in services for these adult survivors, and (3) what these survivors recommend to make it easier for other adults who were sexually abused as child who have not yet identified as a survivor. Both quantitative (survey) and qualitative (interview) data has been collected and is currently being analyzed. We have conducted qualitative content analysis comparing the stories of those who have had some level of support in their healing journey to those who have not. The survey data will provide a description of both groups to lend insight into the similarities and differences we are seeing. Our hope is to increase awareness around the issue and to provide the public and health providers insight so that survivors can get the support they need to rebuild their lives.

The Effect of Restrictions on Provider Access in Health Plans on Total Health Care Expenditure

Eline M. van den Broek-Altenburg, Health Services Research, AMC - Colorado School of Public Health
AMC - Graduate School

Mentor: Dr. Adam J. Atherly, Health Systems, Management & Policy, AMC - Colorado School of Public Health

Abstract:
Coming from The Netherlands, where the Dutch implemented a new health insurance system in 2006, I am particularly interested in studying new insurance systems. Numerous recent policy proposals, both in the U.S. and other western countries, have been advanced to regulate network design without a clear understanding of the impact of restricted networks on health care spending. This is why, now in the U.S., I study the ACA health insurance exchanges. I am particularly interested in provider choice for patients and how limited provider choice influences people's choice of insurance plan and total healthcare expenditure. The objective of this paper is to estimate the effect of restricted network health plan designs on total health care spending. Restricted network plans have proven popular on the U.S. health insurance exchanges, which strictly contrast plans that offer out-of-network benefits and those who do not. I hypothesized that closed networks should impact overall and outpatient spending but not Rx spending unless the network restrictions reduced access to prescription drugs, which would suggest provider access problems. The study findings suggest that health plans without restrictions on provider access have significantly higher predicted total expenditures than restricted network plans. The price gap between restricted network plans and those that cover care outside is growing in many places. The results are relevant for policymakers in the various countries in which insurers have or have started to restrict their network of providers as it estimates the additional health care costs for enrollees of less restricted plans.

Trans-Corneal Glaucoma Drainage Device Using Shape-Switching Polymers

Ross H. Volpe, Mechanical Engineering, College Engineering and Applied Sciences
DC - Graduate School

Mentor: Dr. Christopher M. Yakacki, Mechanical Engineering, DC - College Engineering and Applied Sciences

Abstract:
While the pathophysiology of glaucoma is widely unknown, current treatment relies on lowering intraocular pressure (IOP) in order to delay vision loss. The standard in the surgical treatment of glaucoma is to drain aqueous humor to lower IOP. Trans-corneal drainage has recently become of interest, which offers a predictable IOP lowering performance while eliminating procedural outcomes that lead to many of the current complications (e.g. blebs). In this study, we propose a novel manufacturing process of a trans-corneal drainage device constructed from a nano-porous liquid crystal elastomer (LCE), which can be implanted and removed using the two-way actuation behavior of the material. Sub-micron channels are created in an LCE matrix using a sacrificial template of water soluble nanofibers. Tailorable sacrificial templates of nanofibers are formed via electrospinning of poly(vinylalcohol) (PVA). LCE monomers are polymerized around these sacrificial templates, and once these fibers are dissolved from a bulk LCE, the remaining channels allow for predictable flow. By changing the concentration of PVA used in electrospinning, fibers of various sizes are created. Higher concentrations of polymer solution yield larger fibers, and thus larger pores upon dissolving the fibers. The diameters of fibers and pores were confirmed with SEM and fluorescent microscopy. Infiltration of porous samples with a fluorescent marker showed the diameter of the pores and the interconnectivity of the network. Finally, the drainage efficacy is tested using a water column perfusion test. Using this data, a trans-corneal drainage device was designed to provide adequate drainage to patients experiencing dangerously elevated IOP.

Impacts of Mining on a Subalpine Lake in the Central Colorado Rocky Mountains

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DC - Graduate School

Mentor: Dr. Christy Briles, Geography and Environmental Science, DC - College of Liberal Arts and Sciences

Abstract:
This study analyzed freshwater diatoms, pollen, charcoal, and geochemistry to assess how the terrestrial and aquatic ecosystems responded after termination of mining activity in a subalpine lake ecosystem in the central Colorado Rocky Mountains. Mining activity increases mineral exposure that can continue to impact the surrounding ecosystems after mine closure due to remaining minerals and mine tailings. However, the long-term impacts and ecosystem recovery are not well understood. This study assesses the recovery of aquatic and terrestrial ecosystems at Lily Pond, a subalpine lake that formed at the end of the last ice age approximately 17,000 years ago. The Forest Hill Mine operated upstream of Lily Pond, and was in use from 1880-1920 with a short break from 1907-1916. The decade halt in mining provides another temporal period to examine ecosystem response. A 1.1-m sediment core from Lily Pond was used to compare pre- and post- mining conditions. Initial results show changes in the top portion of the sediment core. A shift from epiphytic and epipelic diatoms towards Fragilaria occurs, suggesting increased sedimentation and turbidity. Geochemistry data indicate an increase in metals and magnetic susceptibility also increases, suggesting allochthonous inputs possibly from the mine. Charcoal increases around this time while percentages of arboreal pollen decrease, indicating an increase in burning and decrease in arboreal vegetation. Results demonstrate that mining activity impacted the aquatic and terrestrial communities at Lily Pond by increasing heavy metals, changing the composition of the diatom community, and altering forest structure.

ARE YOU TALKING TO ME? CELLULAR COMMUNICATION SHAPES MUSCLE

Emily Ann Warp, Biology
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Brenna Clay, Cell Biology, Stem Cells, and Development, School of Medicine,
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Lauren Rutt, Biology
DC - College of Liberal Arts and Sciences

Mentors: Dr. Aaron N. Johnson, Integrative Biology, DC - College of Liberal Arts and Sciences

Abstract:
Animal development is an amazing process in which a single fertilized cell gives rise to all of the intricate parts of the body. Development requires extensive cell proliferation, but more importantly, the cells must communicate to generate the overall pattern of the organism. To dissect the vocabulary of cell-to-cell communication, we used the powerful genetic tools in the fruit fly to identify new components of cell communication pathways during development. Cell-to-cell communication initiates with a transmitting cell, which secretes a signal in the form of a protein. A signal-receiving cell then interacts with the signaling protein, which can cause changes in the form and function of the receiving cell. The protein DELTA is a well-characterized protein signal that interacts with the protein NOTCH in signal-receiving cells. Our study identified a new regulator of NOTCH activity during muscle development, which is an intracellular protein we named BYSTANDER. Muscles that lack BYSTANDER fail to acquire the correct form during development and the resulting embryos are largely paralyzed. DELTA and NOTCH regulate a myriad of biological processes outside of muscle development, including congenital diseases and cancer. This study has identified a new component of the cellular communication network that will be broadly applicable to understanding both development and disease.

Caffeine on Physical Reaction Time

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

Mentor: Dr Lindsey Hamilton, Psychology , DC - College of Liberal Arts and Sciences

Abstract:
Due to the commonality of caffeine consumption, this study aims to analyze the effects of caffeine on physical reaction time. It has been proven that caffeine can enhance cognitive awareness and function with sleep deprivation (Kamimori, 2015). It has also been proven that caffeine increases alertness (Smith, 2002). With this information and the data conducted in a previous study, this study specifically analyzed the response time to stimuli while not caffeinated compared to caffeinated. As mentioned this study was previously conducted last year, however, data suggested that future studies would need to be conducted to see the extent of how much caffeine reduce physical reaction time. For instance, a larger sample size and higher dosage primarily would need to be studied to be conclusive that caffeine has a positive effect on response time.

Exploring Inflammatory Signals in Precancerous Skin

Derek M. Wengryn, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Enrique C. Torchia, Dermatology, AMC - School of Medicine

Abstract:
To understand the inflammatory responses in precancerous skin, a mouse model was created to mimic hyperplastic skin lesions known as Actinic Keratosis (AK) that are precursors to skin carcinomas. The mice co-expressed mutants of the tumor suppressor p53 and the RAS oncogene. Expression of these mutants was also combined with the genetic deletion of the mitotic Kinase AURORA-A. This was used as an experimental tool to study how cell division was regulated in AK-like skin. Hyperplasia of the skin was achieved by the short-duration topical treatments of the tumor promoter TPA on the skin of the mice. It was hypothesized that genes inducing inflammatory responses would be upregulated in precancerous mice with these types of mutations. To characterize immune and inflammatory signatures, total RNA was isolated using commercial kits from skin samples of the mutant mice. The quality of the RNA was examined using MOPS gels and an Agilent Bioanalyzer. Samples with high-quality RNA were tested using the Nanostring technology platform using a panel of 561 immunology-related mouse genes. A total of 77 genes were found to be upregulated and 165 genes downregulated by AURORA-A co-deletion ($p<0.05$). These findings were then tested independently by quantitative polymerase chain reaction (qPCR). These data show the enhancement of immune responses in AK-like skin when mitosis is inhibited; they also represent the potential of combining anti-mitotic drugs with immunotherapies for preventing and treating skin cancer.

Making the Invisible Present: Examining Pregnancy-Related Depression Consultations During Well-Child Care

Shengh Xiong, Biology
DC - College of Liberal Arts and Sciences

Mentor: Dr. Ayelet Talmi, Psychiatry and Pediatrics, AMC - School of Medicine

Abstract:
Approximately 14% of women in the US experience pregnancy-related depression (PRD) shortly after childbirth. This study aims to understand how PRD symptoms are addressed at two-week well-child care (WCC) visits by evaluating consultation types and presenting problems identified at among women who had PRD (assessed using the Edinburgh Postnatal Depression Scale; EPDS) and those who did not. Electronic medical records of two-week old patients were reviewed for EPDS scores, consultation type, presenting problem, and clinical recommendations. Patients were seen by clinicians at the Child Health Clinic (CHC) at the Children's Hospital Colorado as part of the Project CLIMB (Consultation Liaison in Mental Health and Behavior). Data were grouped based on EPDS scores (≥10 as signs of PRD; <10 as not experiencing PRD) and language disparity (English, Spanish, and other), and statistically analyzed using SPSS. 6339 patients were identified in this cohort, with 566 patients consulted by CLIMB clinicians as consulting due to PRD. Those with elevated EPDS scores were more likely to be listed as having PRD as the presenting problem (63%) than those with non-elevated scores (37%). Unexpectedly, CLIMB clinicians were more likely to recommend clinic follow-up to those with non-elevated EPDS scores (64%) than those who had elevated scores (36%). English speaking families and Spanish-speaking families had higher odds (3.04 times and 2.43 times, respectively) of receiving CLIMB follow-up recommendations than families who speak other languages. Regardless of EPDS score or consultation types, CLIMB clinicians are sufficiently identifying PRD at the two-week WCC visits. Logistic regression analysis showed that both English and Spanish speaking families had higher odds of receiving a CLIMB follow-up recommendation than families who speak another language. Further research is needed to understand why follow-up with CLIMB clinicians was recommended for patients with non-elevated EPDS scores.

Computational Study of Chloride Transport through the E. coli Cl–/H+ antiporter

MacKenzie Zarecki, Biology (UROP Recipient)
DC - College of Liberal Arts and Sciences

Mentor: Dr. Hai Lin, Chemistry, DC - College of Liberal Arts and Sciences

Abstract:
Cl- transport proteins control the selective flow of Cl- ion in the regulation of pH, blood pressure, membrane excitability, etc. Malfunction of the ion channel leads to diseases such as myotonia congenita, Bartter syndrome, and epilepsy. We study the Cl- transport pathway in E. coli CLC Cl–/H+ antiporter 1 by various computational methods.2 Steered molecular dynamics simulation investigates the dragging force of Cl- through the pore. Umbrella sampling is used to estimate the free-energy barrier of Cl- Conduction. The calculated potential of mean force along the translocation path implies the readiness of passing Cl- down the channel, as the barriers are rather small (~2.0 kcal/mol). Acknowledgment: This work is supported by the NSF (CHE-1564349), Camille & Henry Dreyfus Foundation (TH-14-028), and NVIDIA Corporation. This work used XSEDE under grant CHE-140070, supported by NSF grant number ACI-1053575, and NERSC under grant m2495.