Margaret A. Cargill Natural Sciences & Health Building Dedication - Fall 2018

Berea College Undergraduate Research Abstract Journal 2018

INTRODUCTION

Editors: Jennifer Bentz (Junior Biology Major); Ronald B. Rosen (Professor of Biology)

This is the thirteenth (2018) issue of the "Berea College Undergraduate Research Abstract Journal." Fifty-four abstracts representing majors from ten different Berea academic departments this year including Agriculture and Natural Resources{1}, Biology {15}, Chemistry {20}, Child and Family Studies {1},Computer Science {1}, Education Studies {1}, Health and Human Performance {4}, Mathematics {3}, Physics {6}, and Psychology {2}. Eighteen (33.3%) of these abstracts represent research conducted on-campus with 15 Berea College Faculty mentors. It should be noted that on-campus research in Biology, Chemistry and Physics was somewhat lower this last summer given the preparation for our move into the new MAC Building (see cover). The common theme to the research presented in these abstracts is that the original proposal was peer-reviewed and/or work was subsequently presented by undergraduates at on and/or off-campus meetings. Several projects were funded by academic programs; most (16 projects) on-campus research was made possible with funds provided by Berea College's Undergraduate Research and Creative Projects Program (URCPP). Off-campus projects were funded by academic institutions throughout the country often with assistance from Berea College's Office of Internships and Career Development. Many of these projects were presented on-campus during the 18th Berea Undergraduate Research Symposium (BURS) on October 19-20th 2018. A number of these projects were subsequently presented at the 104th Annual Meeting of the Kentucky Academy of Science at Western Kentucky University (34 presentations and 10 awards). If known, presentations, awards received and funding sources are noted below each abstract. Images of student participants are included if available.

ACKNOWLEDGEMENTS

This publication would not have been possible without the support of many people. We would like to thank Chad Berry, Academic Vice President and Dean of the Faculty, for providing funds to print hard copies of these abstracts, Esther Livingston for arranging funding from the Berea College Office of Internships and Career Development (27 total) and Sarah Broomfield for coordinating the URCPP (16 total) initiative on our campus. Gratitude is extended to Berea College faculty for their mentorship, and of course to students whose exemplary work is reflected in this journal. Finally, we would like to thank all the off-campus mentors at the following institutions/organizations for supporting Berea students during the summer of 2018 (number of Berea students in brackets): Best Friends Animal Society {1}, Cheetah Conservation Fund, Namibia {1}, Clemson University {1}, Harvard University {1}, Illinois Natural History Survey {1}, Kindred Spirit Elephant Sanctuary {1}, North Carolina State University {1}, Northern Kentucky University {1}, Ohio State University {1}, Stanford University {1}, Uniformed Services University of Health Sciences, Bethesda {1}, U.S. Department of Veterans Affairs, Seattle {1}, University of Chicago {2}, University of Colorado, Anschutz Campus {2}, University of Kentucky {6}, University of Missouri {1}, University of Notre Dame {1}, University of Tennessee {2} and Vanderbilt University {10}.

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Nutritional Management and Reproductive Performance of 2nd Year Beef Cattle Raised in a Sustainable Production System at Berea College. Carley Smith[1], Jacob Ford[1], Robert Harned[1], Marlon Knights[2], and Quinn S. Baptiste[1]. [1]Agriculture and Natural Resources Department, Berea College, Berea, Kentucky, 40404. [2]West Virginia University, Morgantown, West Virginia, 26506.

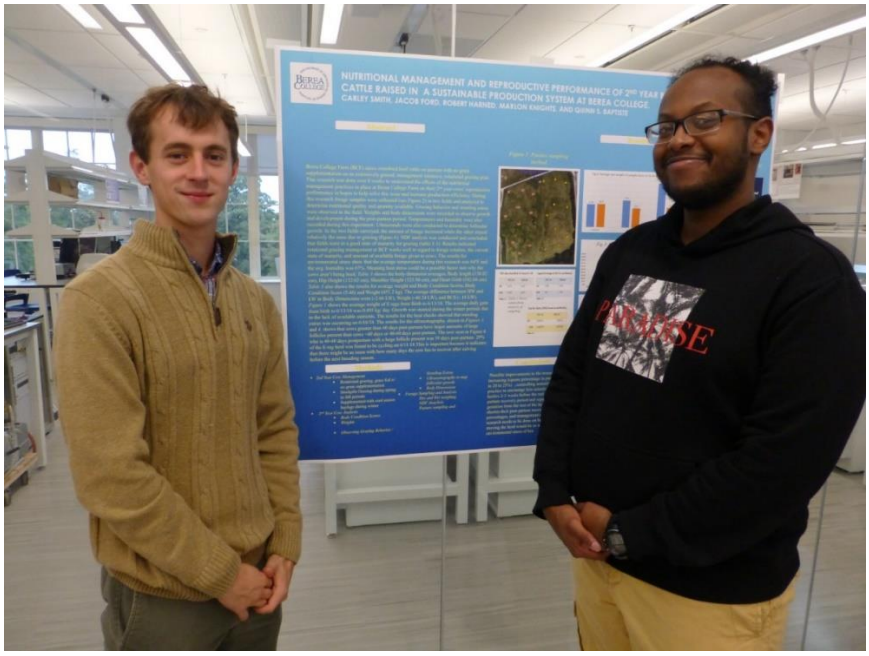
Abstract

This project evaluated the nutritional management and reproductive performance of beef cattle reared in sustainable production systems at Berea College. The project used the 2 year old cows at the Berea College Farm. Along with the assistance of farm staff, the URCPP students reviewed records of the recent performance of the beef cattle herd. Subsequently the students developed a research plan for investigating the nutritional management and reproductive performance of the herd during summer of 2018. Students communicated their research plans and preliminary results to the Berea College Farm staff and to Berea College Undergraduate audience via seminars and informal dialogue. They acquired valuable production information relevant to the interest area of this study, and subsequently modified their arrangements for conducting research. Through the use of a series of research mentor prompted and student designed questions and activities the specific nature and broader aspects of the research was clarified to the students. The students determined the producers' awareness of the impact of nutritional management on reproductive performance and discussed the variations in approaches to nutritional management of replacement beef heifers. The students have been presented the opportunity to further disseminate the final results of this research to the researchers, extension services, producers and as wide a range of an audience as possible. Specifically, in this, the third year of this multiyear project, the research efforts determined that the feeding of supplemental grain was not a component of the nutritional management for replacement heifers at Berea College Farm. This variation of nutritional management approaches affected heifer growth and development, particularly during the winter period, when apparently lower rates of growth occurred in heifers that are strictly grass fed. Despite the latter variation, the results indicate that onset of reproductive maturity and potentially reproductive performance of heifers raised in sustainable production systems at Berea College Farm were similar to what was obtained at community producer operations. The occurrence of rapid rates of growth in heifers during the spring period in grass fed heifers is believed to compensate for lower rates of gain that occurred during winter. Rapid growth contributed to the absence of differences in reproductive performance between grain supplemented and strictly grass fed heifers. These rapid rates of growth observed in grass fed yearling heifers are perceivably attributable to the rotational grazing management strategy that is used for feeding of the strictly grass fed heifers during the spring period. In contrast, when these yearling heifers give birth and become 2 year old cows the nutritional management strategy apparently does not adequately support their post-partum recovery. During the period from calving in the spring to being bred for the second time in the summer, the two year old cows show low growth and poor reproductive performance. The, low growth and poor reproductive performance will most likely lead to a low number of pregnancies in the 2 year old cows. Consequently, a high number of the 2 year old cows may be culled, which will be consistent with what has occurred during the last few years. This may represent economic

losses that may not be sustainable in the long term. The apparent changes in forage composition, nutrient content (carbohydrate and protein) and digestibility during the spring period and within a grazing rotation which are perceivably critical to the success of nutritional management strategies for developing yearling replacement heifers are not as effective for 2 year old cows. Hence, initial results are promising but indicate the need for continued investigations into the sustainable management approaches used at Berea College Farm for developing replacement heifers for long term production as cows. The students received very good research experiences which fulfilled URCPP goals and this was accomplished within budgeted allocations. On behalf of my students, I express deepest appreciation for the support granted to this project.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP



Recombinant Expression of Collagen IV from *Ministeria vibrans*: The Ancestral Collagen of the Animal Kingdom. Favour Akabogu[1], Ly Hoang[2], Aaron Fidler[3], Sergei Chetyrkin[3], Julie Hudson[3], and Billy Hudson[3]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Arkansas School for Mathematics, Sciences and the Arts, Hot Springs, Arizona, 71901. [3]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

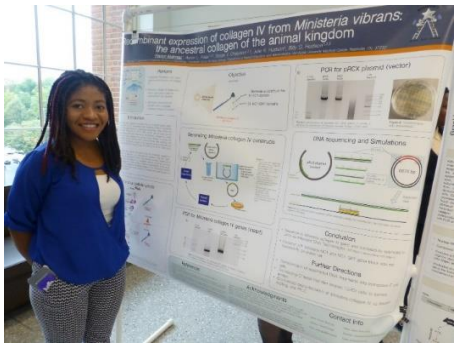
The transition from unicellular protists to multicellular animals coincided with the appearance of a specialized extracellular matrix (ECM), the basement membrane (BM). BMs are dynamic structures that modulate cell differentiation and behavior during development, and help shape tissue architecture. Collagen IV, a major component of BMs, forms large networks that provide tensile strength to tissues and function as smart scaffolds organizing diverse macromolecules in the BM. Importantly, collagen IV is conserved across all animals and likely played a role in the transition to animals. However, the mechanism in which collagen IV enabled this transition is unknown. The protist, *Ministeria vibrans*, has recently emerged as the first unicellular organism to contain collagen IV based on genomic and transcriptomic evidence. Here, we sought to build a construct with *Ministeria* collagen IV for recombinant expression in Chinese hamster ovary (CHO) cells. We have successfully cloned the *Ministeria* collagen IV gene, however, generation of a construct for transfection into CHO cells has not been successfully completed. Future work will include biochemical characterization of *Ministeria* collagen IV expressed by CHO cells utilizing fast protein liquid chromatography (FPLC) and Western blotting to determine how *Ministeria* collagen IV behaves in a unicellular organism. Together, these will provide insight into the ancestral function of collagen IV, and how collagen IV played a role in the evolutionary transition to multicellular animals.

KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

American Society of Nephrology (ASN) Kidney Week 2018, October 24-27, 2018, San Diego, California (Poster Presentation)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University



Elevated Resistance to AITC in Wild Bacterial Endophytes of *Arabidopsis thaliana*.

Yohannes Amsalu, Matalynn Shealy, Esther Abiara, and Brian Traw. Biology Department, Berea College, Berea, Kentucky, 40404.

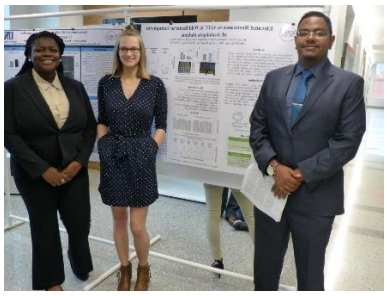
Abstract

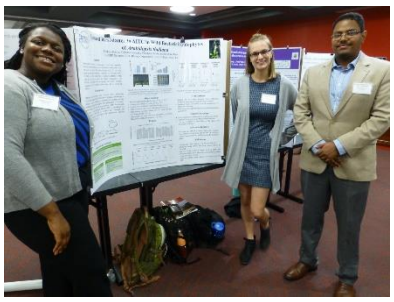
Isothiocyanates and their glucosinolate precursors are chemicals produced by *Arabidopsis thaliana* and other plants in mustards and other plants in the order Caparelles. While these compounds are known to reduce bacterial growth, whether they may structure bacterial associations with the plants has not been addressed previously. In this study, we first ask whether bacteria induce glucosinolate production. We then ask whether allylglucosinolate or allylisothiocyanate influence bacterial growth in media and whether bacteria collected from the leaves of *A. thaliana* in nature differ in resistance to these compounds. We found that infection of plants with *Pseudomonas syringae* pv. *tomato* DC3000 increased plant concentrations of glucosinolate relative to control plants. Sinigrin did not reduce bacterial titer, indicating that parent glucosinolates are not toxic to bacteria. We then tested the effect of allyl isothiocyanate (formed from the hydrolysis of sinigrin) on six bacterial strains, five of which were collected from wild *Arabidopsis* plants. The effect of allyl isothiocyanate (AITC) was highly variable but was most toxic to the lab strain, *Pst* DC3000. The wild strain *P. syringae* MEB081 tolerated concentrations of AITC that were nearly double the lethal dose for *Pst* DC3000. Two additional bacteria species, *Mesorhizobium loti* and *E. coli* were also highly resistant to AITC. Additionally, we found that plants infected with bacteria produce more glucosinolates than healthy plants. In order to investigate the role of glucosinolates during infection, plants deficient in myrosinase, the enzyme that hydrolyzes glucosinolates to isothiocyanates, were challenged with *Pst* DC3000. There was no difference in bacterial titers between wild type plants and plants with reduced myrosinase expression in vivo, but when assayed in vitro, bacterial titers increased when grown in plant tissue with reduced myrosinase expression. These results suggest a role of isothiocyanates in the defense of plants from bacterial pathogens and the potential of coevolution between plants and these enemies.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Ecology Section)

Funded by Berea College URCPP





Epidermal Growth Factor Receptor (EGFR) Controls Kidney Fibrosis by Regulating Nuclear Localization of Fused in Sarcoma (FUS). Jennifer Bentz[1], Manuel Chiusa[2], and Ambra Pozzi[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

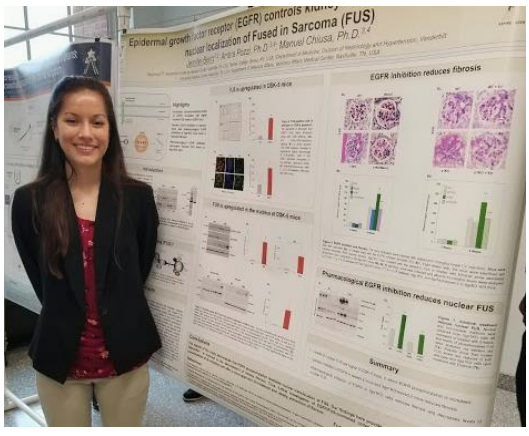
Abstract

Kidney fibrosis is a life-threatening consequence of kidney disease. The collagen receptor integrin α1β1 (Itgα1β1) plays an anti-fibrotic role by negatively regulating the activation of the epidermal growth factor receptor (EGFR). In previous work, we showed that Itgα1-null cells have increased levels of activated EGFR, produce more collagen, and have higher nuclear levels of Fused in Sarcoma (FUS) than wild-type cells. Our goal was to determine whether nuclear FUS correlates to fibrosis. Indeed, nuclear FUS levels are upregulated in kidneys of mice and humans with kidney fibrosis. Moreover, increased levels of nuclear FUS correlate with increased collagen production in Itgα1KO cells. We additionally found that activated EGFR forms a complex with FUS and controls its nuclear translocation. Here, we further determine a link between fibrosis, EGFR, and nuclear FUS in kidney cells using two additional models: DSK-5 mice and waved-2 mice, in which EGFR is either constitutively active or permanently impaired, respectively. We show that glomeruli of DSK-5 mice have higher nuclear FUS levels compared to glomeruli of wild-type mice. Furthermore, we provide evidence that both waved-2 mice and Itgα1KO mice treated with EGFR inhibitors show decreased fibrosis, and pharmacological inhibition of EGFR in Itgα1KO cells reduces levels of nuclear FUS. Thus, EGFR-mediated FUS nuclear translocation represents a previously undescribed mechanism whereby EGFR controls collagen production and fibrosis. Exploring EGFR/FUS-controlled collagen production in fibrotic diseases and the consequences of its inhibition will offer a novel approach for the treatment and, ideally, prevention of fibrosis.

KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University



Identifying Fecal and Urinary Biomarkers of Obesity in Mouse Model Using Proton Nuclear Magnetic Resonance Metabolomics and High-Performance Liquid Chromatography. Yacine Choutri[1], Ellison M. Poncho[2], Paul Voziyan[2], and Donald F. Stec[3]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University School of Medicine, Nashville, Tennessee, 37232. [3]Vanderbilt University Institute of Chemical Biology, Nashville, Tennessee, 37232.

Abstract

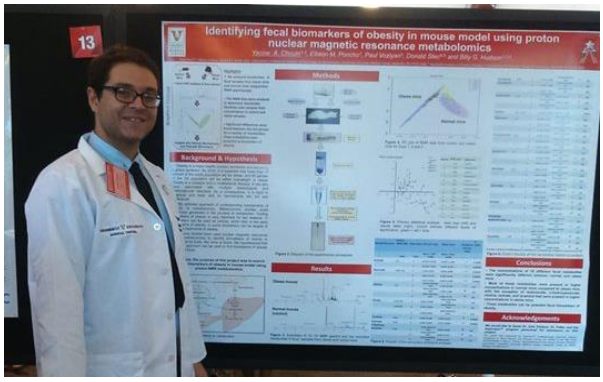
Obesity is a complex multifactorial disease and a major health concern. It is difficult to treat, and its mechanisms are not well understood. One approach to understand mechanisms of obesity is metabolomics, which studies small molecules generated during metabolism. These molecules can be biomarkers in the early diagnostics of obesity and/or targets of prospective therapies. We utilized nuclear magnetic resonance (NMR) technology to identify potential biomarkers of obesity in feces of mice receiving high-fat vs. normal diet. Feces collected from obese and normal mice were extracted with buffer, supplemented with the NMR standards and analyzed using a 600 MHz NMR spectrometer. The proton-NMR spectra were analyzed using a principle component analysis and metabolites were identified with Chenomx. The differences between obese and normal mice were determined by statistical analysis using a Bonferroni (cut-off p-value = 0.083) correction for multiple comparisons. We found 18 fecal metabolites with significantly different levels between obese and normal mice: 13 of these metabolites had lower levels, while 5 metabolites had higher levels in obese vs. normal mice. Six metabolites were present in both groups, while the rest were present in one group but not the other. We conclude that these metabolites have potential as biomarkers of obesity.
Research supported by: Berea/Aspirnaut™/Hal Moses Summer Research Internships; Vanderbilt University Medical Center; Vanderbilt Center for Matrix Biology; and Aspirnaut™.

KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Chemistry: Analytical/Physical Section: 1st place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University



Placental Transfer and Metabolism of FDA-approved Drugs Repurposed for Novel Tocolytic Use. Allison Harper[1], Shajila Siricilla[2], Raymond Johnson[2], Lauren Lambert[2], and Jennifer Herington[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

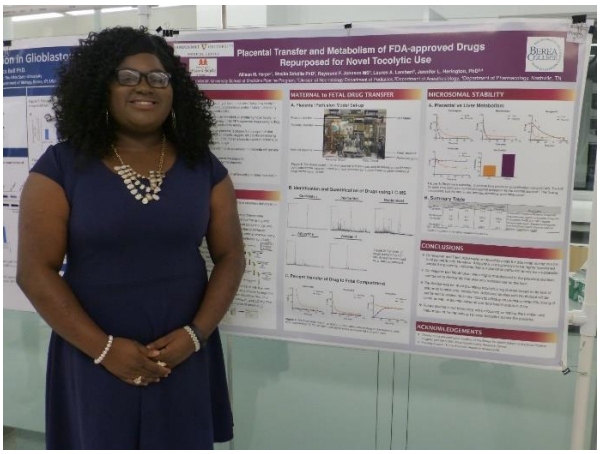
Abstract

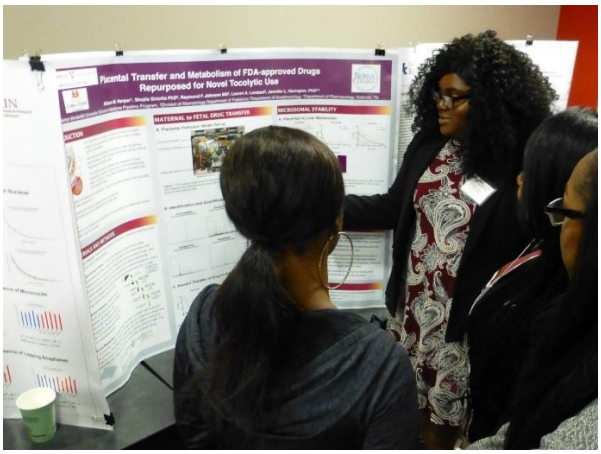
Preterm birth (PTB) rates continue to increase, with over 15 million PTB/yr worldwide, constituting ~10% of live births globally. There are currently no FDA-approved tocolytic drugs used to inhibit preterm uterine contractions. Our laboratory previously identified 20 promising novel tocolytics after screening 1,180 FDA-approved drugs using a drug discovery contractility assay. The objective of the study was to examine the transfer and metabolism of a novel tocolytics across the placenta to determine which drugs readily cross the placenta and expose the fetus to significant concentrations. To do so, we obtained placentas from term-pregnant patients receiving a cesarean delivery at Vanderbilt University Medical Center. Placental microsomes were isolated to examine the extent of metabolism and intrinsic clearance of drugs to be repurposed for tocolytic use. The closed model of ex vivo placental perfusion was used to assess an equilibration point between the maternal (donor) and fetal (receiver) perfusates following administration of drugs on the maternal side. We expect most drugs will cross the placenta, though at different transfer rates. Drugs which transfer slower indicate better half-life on the maternal side. We hope to perform these studies to identify an efficacious drug that will not transport nor metabolize across the placenta to have minimal side effects on the fetus.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physiology and Biochemistry Section: 2nd place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University





The Ethical Practices of Kindred Spirit Elephant Sanctuary in Thailand's Growing Tourism Industry. Sara Holly[1] and Talia Gale[2]**.** [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Kindred Spirit Elephant Sanctuary, Thailand.

Abstract

Kindred Spirit Elephant Sanctuary (KSES) is a small non-profit organization that works within the hill tribes of Northern Thailand. The organization is situated in the village of Ban Naklang, which is located in the Mae Chaem district approximately 180 km west of Chiang Mai city. Their mission is to bring working elephants back to their natural habitat with the support of the local Karen community. In their first year, the sanctuary was commended by the Thailand Green Excellence Award for their service in animal welfare. By spreading awareness of elephant welfare in Asia, KSES stands as an ethical model in the growing tourism industry. This is achieved through volunteer and intern programs, sponsorships, and donations.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development

Altered Immune Cell Profile Contributes to Increase Risk of Heart Disease in Aging Mice.

Aubrey Melton[1], Renee Donahue[2], Marlene Starr[3], and Ahmed Abdel-Latif[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky Saha Cardiovascular Research Center, Lexington, Kentucky, 40536. [3]University of Kentucky Nutritional Sciences and Pharmacology, Lexington, Kentucky, 40536.

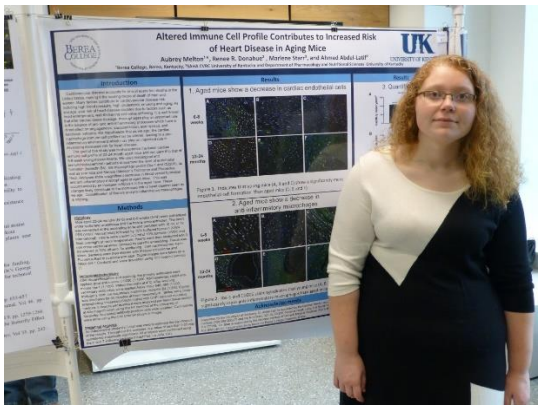
Abstract

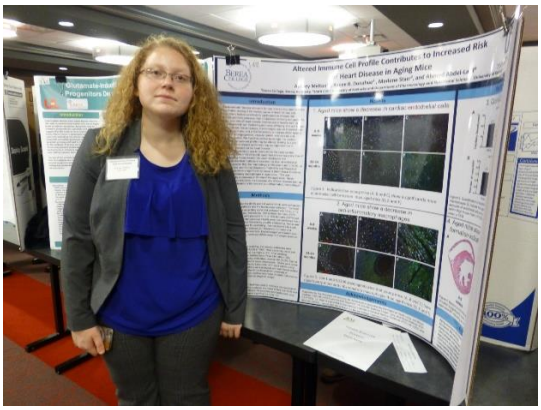
Cardiovascular disease accounts for one of every four deaths in the United States, making it the leading cause of death of men and women. Many factors contribute to cardiovascular disease risk including high blood pressure, high cholesterol, smoking and aging. As you age, your risk of heart disease doubles due to factors such as heart enlargement, wall thickening and valve stiffening. It is well known that after cardiac tissue damage, macrophages play an important role in the balance of pro- and anti-inflammatory processes which have a direct effect on angiogenesis, vascularization, scar spread, and functional outcome. We hypothesize that as we age, the cardiac macrophage immune cell profile may be altered, which can play an important role in developing increased risk for heart disease. Therefore, the goal of the present study was to characterize the basal cardiac immune cell profile of 23-24 month aged mice and compare it to that of 6-8 week young mouse hearts. We used immunohistochemical methods to examine the level of endothelial formation (Isolectin B4), the macrophage profile (Iba-1 and CD206), and scar size and fibrosis (Masson's Trichrome and Picrosirius Red). Analyses show a significant increase in blood vessel formation and anti-inflammatory macrophage numbers and a visual decrease in fibrosis in young mice compared to the aged mice. This may contribute to the increased risk of heart disease seen as we age. Quantification of fibrosis and pro-inflammatory macrophages is ongoing.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Health Science Section)

Funded by Berea College Office of Internships and Career Development





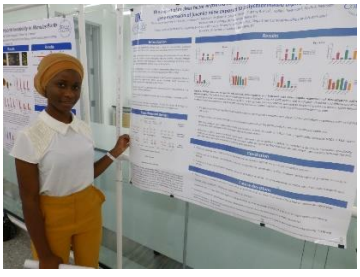
The Impact of Nuclear Factor Erythroid Related Factor 2 Genotype on the Hepatic Gene Expression of Juvenile Mice Exposed to Polychlorinated Biphenyl 126. Nishimwe Montessorie[1], Cecile Hermanns[2], Marissa McDowell[3], Sara Tenlep[3], Brittany Rice[3], Hollie Swanson[3], and Kevin J. Pearson[3]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Saint Louis University, Saint Louis, Missouri, 63108. [3]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

Emerging research demonstrates the role of environmental toxicants, such as polychlorinated biphenyls (PCBs), in the development and progression of disease. The detoxification of such toxicants are critical in maintaining and restoring health. PCBs are metabolized in the liver in two phases, Phase I and II. The toxicity of PCBs are reduced in Phase I through a series of reactions that involved oxidation, reduction, and hydrolysis. Phase I byproducts are converted into water-soluble compounds for excretion during Phase II. Research demonstrates the implications of nuclear erythroid related factor 2 (Nrf2) gene in Phase II detoxification of PCBs and in response to oxidative stress. The purpose of this study was to better understand the role of the Nrf2 gene and pathway in response to PCB exposure. We hypothesized that the ability of PCB126 to induce genes involved in Phase II detoxification will be compromised in mice that lack expression of Nrf2. To test this hypothesis, we bred male and female heterozygous Nrf2 mice (n = 22 of each sex) to establish a colony of Nrf2 wild type, heterozygous, and knockout mice. Genotypes of the offspring were determined and pups were weaned on postnatal day 21. At six weeks of age, offspring (n = 5 per sex and genotype) were exposed to 1 µmol/kg of PCB126 or vehicle. Twenty-four hours after exposure, the offspring were euthanized and their livers were harvested. RNA was then isolated from the livers and the mRNA levels of genes associated with detoxification pathway were measured. Genotype of the offspring influenced the gene expression of aryl hydrocarbon receptor (Ahr), the receptor that initiates PCB detoxification. This degree of significant differential expression was contingent upon sex of offspring, where males had significantly increased Ahr gene expression ($p = 0.010$) and females had marginally significantly increased expression ($p = 0.056$). Significant elevations in the RNA expression of Cyp1a1, a Phase I detoxification associated gene, were observed in offspring because of PCB126 treatment ($p < 0.001$). Cyp1b1 gene expression was upregulated in female offspring exposed PCB126 ($p < 0.001$), in comparison to those exposed to vehicle. Both Nrf2 wild type and heterozygous offspring exposed to PCB126 had a significant increase in Phase II detoxification gene NQO1 mRNA levels ($p < 0.001$) when compared to vehicle-exposed Nrf2 wild type and heterozygous offspring, while mice lacking Nrf2 did not have increased NQO1 expression in response to PCB treatment. These preliminary results are promising and give rise to a host of future directions that will further the understanding of the role of Nrf2 in Ahr modulation along with the expression of detoxification pathway related genes in mice with respect to NQO1 expression. Funding: This work was supported by the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health (NIH) [grant number P42 ES007380]. The content is solely the responsibility of the authors and does not necessarily represent the official views of NIH.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development



Best Friends Animal Society- Kitten Nursery. Brittany Ortiz[1] and Shemia Splonskowski[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Best Friends Animal Society, Salt Lake City, Utah, 84106.

Abstract

Best Friends Animal Society is a nonprofit that does outreach nationwide with shelters, rescue groups and members to promote pet adoption as well as no-kill animal rescue and spay and neuter practices. I practiced techniques that allowed me to take care of kittens from newborn to about eight weeks old. I learned how to avoid contamination, feed kittens, give vaccinations/medications, and syringe feed. At the end of this experience an intern project was due. I focused on where the nursery gets its kittens and what happens to them after they leave the nursery.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

Funded by Berea College Office of Internships and Career Development

Impact of Season, Game Fencing, Moon Phase, and Vegetation on Activity Overlap of Ungulate Species in the Greater Waterberg Landscape, Namibia. Emma Reasoner[1] and Laurie Marker[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Cheetah Conservation Fund, Namibia.

Abstract

The African grassland supports a variety of ungulate species which share a similar ecological niche. Species that are of similar body size and utilize a similar foraging strategy may use temporal avoidance to differentiate their niche and avoid interspecies competition. This study analyzed camera trap data obtained by the Cheetah Conservation Fund's Go Green project. The commercial farmland surrounding Namibia's Greater Waterberg National Park was mapped in a grid of 4 X 4 km squares. A motion sense game camera was deployed in the center of each grid square for one year. Using time of photo capture, the 24 hour activity of thirteen ungulate species was plotted by kernel density estimation. These curves were overlapped with those of other species to obtain a coefficient of overlap, indicating the extent to which the species are active at the same time. These values were then compared between the wet and dry season, game and cattle fenced areas, the four moon phases, and vegetation density. The objective of this study is to determine how the interactions of ungulate species' in the Greater Waterberg landscape are influenced by these factors, revealing more about the balance of ungulate biodiversity in the sub Saharan ecosystem.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Ecology Section: 2nd place Undergraduate Research Competition)

Funded by Department of Religion, Berea College

Endosperm-Based Hybrid Inviability in *Mimulus* Plants. Caitlyn Roberts[1], Robert Franks[2], and Miguel Flores-Vergara[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]North Carolina State University, Raleigh, North Carolina, 27695.

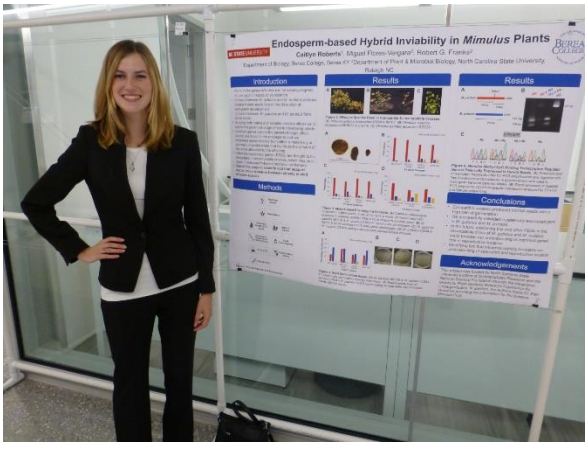
Abstract

Plants in the genus *Mimulus* exhibit varying degrees of post-zygotic reproductive isolation. Such reproductive barriers may be both a result of speciation and potentially a driving force of speciation events. Incompatible crosses between *M. guttatus* and *M. nudatus* produce inviable hybrid seeds because of the disruption of endosperm development. However, crosses between *M. guttatus* and *M. pardalis* form viable seeds. Studying both viable and inviable crosses allows us to test for the parent-of-origin effect in developing seeds. Imprinted genes, in which the parent-of-origin effect occurs, are found in the endosperm and are expressed predominantly from either a maternally or paternally inherited allele that facilitates the amount of resources allocated to the offspring. Paternally expressed genes (PEGs) are thought to be deregulated in incompatible crosses, which may be a cause of endosperm-based reproductive barriers. By examining potential imprinted genes in these crosses, we aimed to gain a better understanding of the mechanisms behind hybrid seed sterility. The overall goal of this project was to identify loci that support reproductive isolation between closely related *Mimulus* species. We successfully validated a PEG gene in *M. guttatus* and *M. pardalis*. In the future, examining this PEG in the incompatible cross of *M. guttatus* and *M. nudatus* could broaden our understanding of imprinted genes' role in reproductive isolation. We also phenotyped seeds and completed a germination assay to analyze the germination success of hybrid seeds compared to parental self-crosses. Examining these factors will illuminate how seed development and speciation are influenced by genomic imprinting.

17th NC State University Annual Summer Undergraduate Research and Creativity Symposium, July 31, 2018, North Carolina State University, Raleigh, North Carolina

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by NC State Integrative Molecular Plant Systems REU and the National Science Foundation



Disruption of Cell Adhesion and Loss of Arp2/3 Complex Function in Macrophages are Not Sufficient to Induce NF-kB Activity. Imelda Saintilma[1] and Jeremy Rotty[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Uniformed Services University of the Health Sciences, Bethesda, Maryland, 20814.

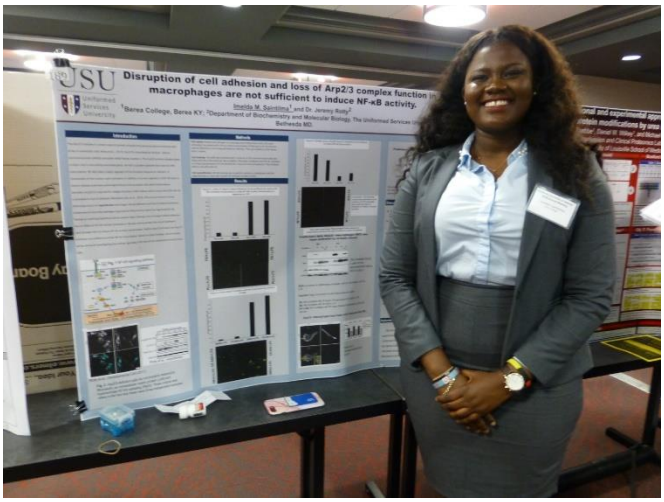
Abstract

The Arp2/3 complex is a seven-subunit protein complex that is essential for the regulation of the actin cytoskeleton in eukaryotic cells. Arp2/3 is stimulated by Wiskott - Aldrich syndrome protein (WASP) and other WASP family members. The Arp2/3 protein complex plays a major role in cell motility and endocytosis. NF-κB a protein complex that controls DNA transcription. NF-kB is also a major regulator of the immune response to infection. It translocates to the nucleus upon activation. In addition, incorrect regulation of NF-κB leads to various disease and other pathological issues such as cancer and other inflammatory disorders. Integrin-based adhesion and Arp2/3 based actin polymerization both contribute to regulating NF-κB signaling. Based on these findings, we hypothesize that integrin-based adhesion and Arp2/3 based protrusion collaborate to tune macrophages response to inflammatory stimuli by regulating NF-κB. Testing our working hypothesis led to several major findings: loss of integrin-based adhesion has no effect on NF-κB nuclear localization. We also demonstrated that Arp2/3 knockout macrophages (Arpc2-/-) upon inhibition alone did not induce NF-κB nuclear translocation. Neither loss of adhesion nor Arp2/3 inhibition is sufficient to aberrantly induce NF-Kb activity. Future studies will be aimed at investigating the cellular signaling of NF-kB and the adaptation of Arp2/3 null cells.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physiology and Biochemistry Section)

Funded by Berea College Office of Internships and Career Development



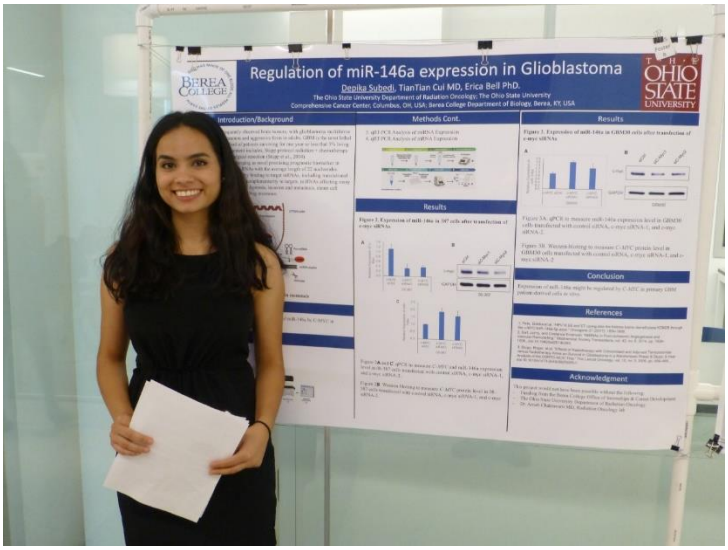
Regulation of miR-146a Expression in Glioblastoma. Depika Subedi[1], TianTian Cui[2], and Erica Bell[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Ohio State University, Columbus, Ohio, 43210.

Abstract

Gliomas are the most frequently observed brain tumors, with glioblastoma multiforme (GBM) being the most common and aggressive form in adults GBM is the most lethal brain tumors with only a third of patients surviving for one year or less than 5% living beyond 5 years. Current treatment includes Stupp protocol radiation + chemotherapy (temozolomide) following surgical resection. microRNAs (miRNAs) are emerging as a novel promising prognostic biomarker in GBM. miRNAs are non-coding RNAs with the average length of 22 nucleotides. miRNAs unhibit gene expression by binding to target mRNAs, including translational silencing or degradation based on complementarity to targets. miRNAs affecting many cellular processes: Proliferation, Apotosis, invasion and metastasis, stem cell differentiation, Angiogenesis, and Drug Resistance. Role of miR-146a in glioblastoma includes: primarily involved in the regulation of inflammation, other processes that function in the immune system, Tumor suppressive function in different cancer type, and one of the top miRNAs that correlate with OS in GBM in our continuous UVA. The goal of this study is to identify miRNA prognostic biomarker for GBM and/or identify molecular mechanisms of miRNAs that play a critical role in GBM biology and therapeutic sensitivity.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development



Cysteine Thiol Directed Chemical Modification of a KCNE1 Protein N-Terminus. Sharman Sugumaran[1] and Keenan Taylor[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

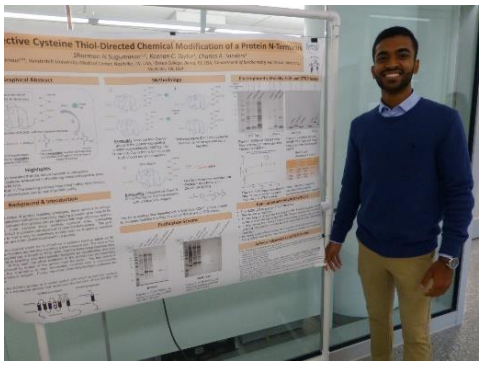
The chemical tagging of a protein at or near its N- or C- terminus has remained a challenge when multiple reactive cysteines are present. The development of such a technique would be widely useful in a variety of applications. As a model system, we selected KCNE1, a single span membrane protein that functions in conjunction with KCNQ1 to form a functional potassium channel. The KCNE1 and KCNQ1 complex regulates ion flow during the cardiac action potential. Mutations in the KCNE1 gene causes long QT syndrome (LQTS), which results in cardiac arrhythmia. We added a cysteine residue within the N-terminal hexa-Histidine tag thereby providing a thiol (-SH) reactive site. However, the problem arises when the protein has other cysteine residues with similar affinity towards thiol-reactive reagents. The goal of this project then, is to explore potential ways to specifically modify a Cys-SH group located at the protein N-terminus without modifying other reactive Cys-SH groups. While bound to Ni-NTA, the native Cys-SH was modified with a blocking reagent while we hypothesized that the N-terminal Cys residue would be sterically occluded. An Ellman's Reagent (DTNB) assay was conducted to determine the number of reactive cysteines in the protein as well as an electrophoretic mobility shift assay (EMSA). Interestingly, comparing the data from both assays with that of a wild-type variant reveals an unreactive native cysteine. Unfortunately, the cysteine embedded in the His-tag remained reactive, even when bounded to the Ni-NTA. The results from this study leaves much to ponder about the reactive properties of cysteine residues.

KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Cellular and Molecular Biology Section)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University



Developing a Prototype Platform for Efficient Mass Digitization for Pinned Lepidoptera Specimens. Zellarose Walden[1] and Thomas McElrath[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Illinois Natural History Survey, Champaign, Illinois, 61820.

Abstract

Entering specimen information is a time consuming process for curators. Digitizing specimens is an efficient method of cataloging, and databasing specimen information, but requires a platform that a computer program can recognize, and assign the information to the appropriate type, such as locality. Part of the research conducted at the Illinois Natural History Survey's insect collection was developing the prototype platform for pinned specimens, and the other consisted of testing manual data entry, and comparing it to the prototype digitization method. The purpose of this prototype is creating a tool for current and future curators to mass database pinned Lepidoptera specimens. Over the course of the experiment the collection of the genus *Colias* was used to test the prototype. We concluded that the prototype was more effective than manual data entry.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

Funded by Berea College Office of Internships and Career Development

A Functional Module for a Response to Low Nutrients in *Arabidopsis*. Muntathar Jamal Alshimary[1], DeQuantarius Speed[2], and Jean Greenberg[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Chicago, Chicago, Illinois, 60637.

Abstract

Plant survival and performance depend on the plant's ability to efficiently explore their environment to find water and nutrients. Zinc (Zn) and Iron (Fe) are essential micronutrients for plants. A recent report suggests that the protein AZI1 promotes root growth in low Zn media. AZI1 also has a role in salt stress tolerance and systemic immunity to pathogens. In these processes, AZI1 functions in a module with its paralog EARLI1 and the proteins MPK3/MPK6. MPK3/MPK6 are kinases that regulate AZI1's localization to multiple membranes, including plastid envelopes, an important site of defense metabolite production. I hypothesized that AZI1 acts together with EARLI1, MPK3 and MPK6 to modulate root growth in nutrient-limited conditions. To test this, I grew mutants lacking these proteins on –Zn, –Fe, and complete media and compared their root lengths over time. Unlike wild type, the mutants failed to show increased growth on Zn-limited media. Thus, AZI1, EARLI1, MPK3 and MPK6 may constitute a functional module in root growth in low Zn conditions. However, there is no evidence that they promote root growth on limited iron. AZI1's protein features suggest that it uses a non-typical signal anchor mechanism for plastid localization. I produced a fusion protein to test whether AZI1's plastid envelope location might involve AKR2, a chaperone in the signal-anchor pathway. This construct will enable future research concerning targeting mechanism of AZI1. Investigating AZI1's function and localization is important for understanding how plants respond to environmental stressors, which is a necessary step in ensuring global food security.

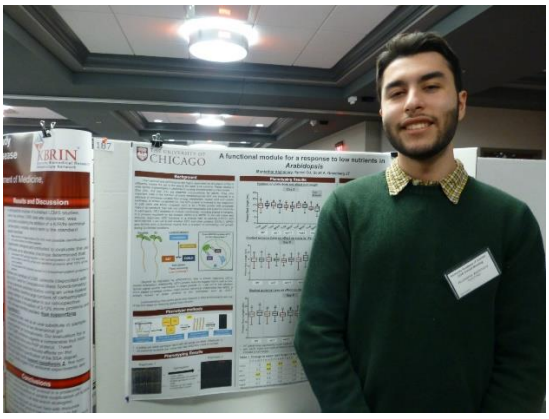
18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Research Experiences for Undergraduates Symposium, October 28-29, 2018, Alexandria, Virginia

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physiology and Biochemistry Section)

Southeastern Medical Scientist Symposium, November 10-11, 2018, Vanderbilt University, Nashville, Tennessee

Funded by University of Chicago (National Science Foundation)



Dose-Dependent Induction of Circulating SAA, and Pulmonary Inflammation After Ozone Exposure: Alzheimer' Disease Link. Helina Asrat[1] and Michelle Erickson[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]US Department of Veterans Affairs, Seattle, Washington, 98174.

Abstract

Ozone is a widespread chemical in air pollution, and contributes to adverse effects of air pollution on health. Emerging evidence has shown that ozone exposure is a risk-factor for mid-life cognitive decline and Alzheimer's dementia. However, the mechanisms that link ozone inhalation to CNS dysfunction are unclear. Recently, the liver-derived acute-phase protein serum amyloid A (SAA) has been implicated as a possible mediator of lung-to-brain communication following ozone-induced pulmonary damage: SAA is substantially increased in liver, blood, and brain following exposure to 3ppm ozone, and can cross the intact blood-brain barrier. The present study explores the dose-dependent responses of pulmonary inflammation and SAA induction following ozone exposure. Female Balb/c mice aged 12 weeks were exposed to 3ppm, 1ppm or air for 4 hours, and then studied 24-26 hours after the start of exposure. There was a significant increase of SAA in the blood and liver of mice at 3ppm ozone exposure but not 1ppm. Pulmonary neutrophils were significantly increased by 3ppm ozone, but not by 1ppm. In the encounter of inflammatory stimuli like ozone, leukocytes leave the spleen decreasing its normal weight. A significant reduction in spleen weight was observed following exposure to both 1ppm and 3ppm ozone concentrations. These findings encourage future behavioral studies with the aim to find a link between ozone induced SAA and dementia as well as depression. Another aim is to see if pulmonary inflammation is required for the increased SAA levels.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physiology and Biochemistry Section)

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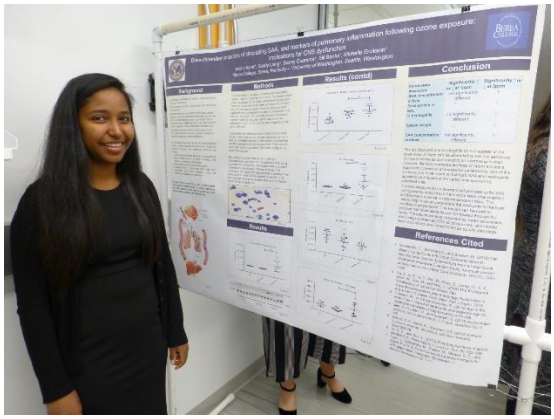
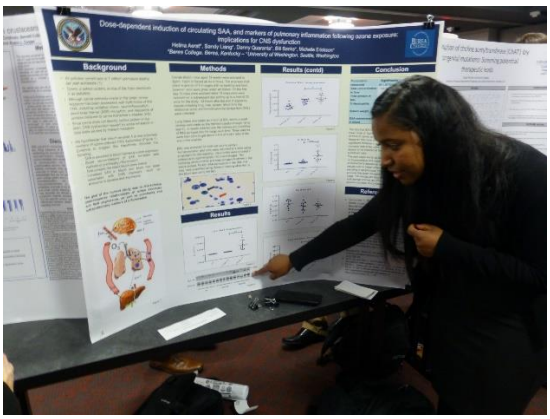




Solid Phase Organic Synthesis of an Antibody Conjugate Linker. Levi Blevins, Ominica Crockett, and Elizabeth Thomas. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

Antibody-Drug Conjugate Linker or ADCL is a new method for cancer treatment with a promising future. With ADCL, treatments can become more specific to certain cancer tissue. This results in ADCL methods not being as harsh as chemotherapy is on the body. With time and research, more diverse methods for the cleavage to deliver their cytotoxic payload to their intended target can be discovered. In exploring diversity, methods such as Solid Phase Organic Synthesis or SPOS is becoming a rapid player in the advancement of ADC. By using SPOS as a form of synthetic chemistry, it aims to accelerate its development due to assisted separation and prohibition of additional purification of both intermediate and target products. While also, providing excess reagents to force reactions to completion which typically resulted in the increase of product when compared to the contemporary form of synthesis linkers by several folds once cleaved and purified. Through this research, the main objective was to use SPOS to design and synthesize cleavable peptide biotin labeled linkers to conjugate to cancer-specific antibodies such as CD-5.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Chemistry: Organic/Inorganic Section)

Funded by Berea College URCPP

Trash to Shine. Courtany Brown, Adan Martinez, and Elizabeth Thomas. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

In this research converting trash into an energy source was explored. The purpose was to create ethanol from trash that is all around us - cigarette butts. Saponification, hydrolysis, and fermentation was used to create the energy source.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP

The Synthesis of Annulene-Oxacalixarene Hybrids. Emily Brown[1], Nicholas Spark[2], Owen Sharp[2], Eli Biedenbender[2], and KC Russell[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Northern Kentucky University, Highland Heights, Kentucky, 41099.

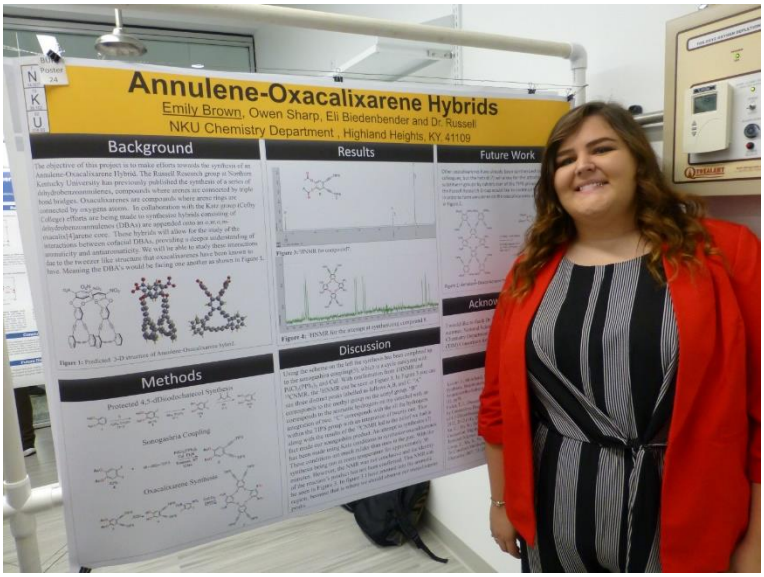
Abstract

The Russell Research group at Northern Kentucky University has previously published the synthesis of a series of dehydrobenzoannulenes, compounds where arenes are connected by triple bond bridges. Oxacalixarenes are compounds where arene rings are connected by oxygens atoms. In collaboration with the Katz group (Colby College) efforts are being made to synthesize hybrids consisting of dehydrobenzoannulenes (DBAs) are appended onto an o,m,o,m-oxacalix[4]arene core. These hybrids will allow for the study of the interactions between cofacial DBAs, providing a deeper understanding of aromaticity and antiaromaticity. This poster will present the current progress being made to synthesize these hybrid compounds.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Chemistry: Organic/Inorganic Section)

Funded by Theoretically Interesting Molecules (TIM) Consortium



Avidin Functionalized Coverslips for Model Membrane Imaging. Sergio Perez Cruz[1], Lindsey Miller[2], and Tessa Calhoun[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Tennessee, Knoxville, Tennessee, 37996.

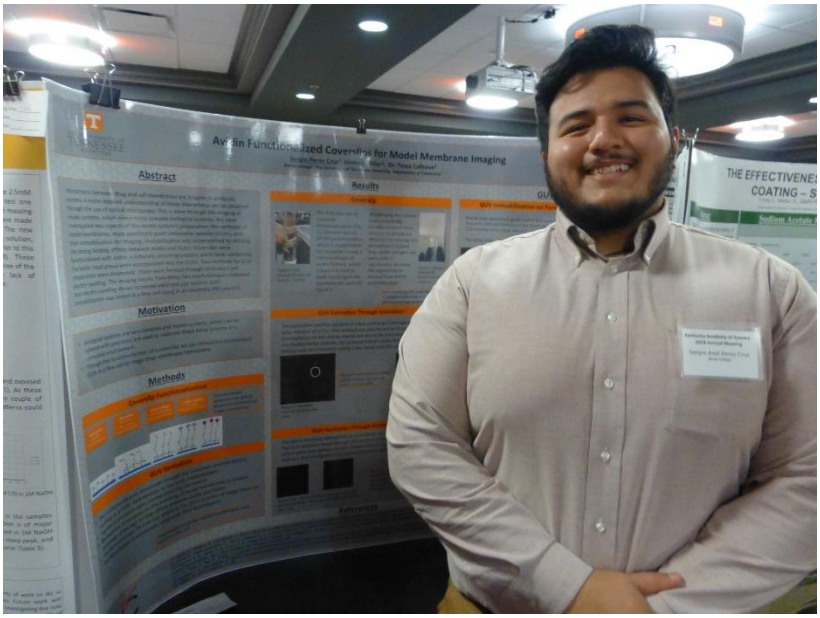
Abstract

Interactions between drug and cell membranes are integral to antibiotic success. A more detailed understanding of these interactions can be obtained through the use of optical microscopy. This is done through the imaging of model systems, which mimic more complex biological systems. We have investigated two aspects of this model system's preparation: the synthesis of model membranes, more specifically giant unilamellar vesicles (GUVs), and their immobilization for imaging. Immobilization was accomplished by utilizing the strong binding affinity between avidin and biotin. Coverslips were functionalized with avidin, a naturally occurring protein, while lipids containing the biotin head group were incorporated into the GUVs. Two methods for GUV preparation were attempted. These were formation through sonication and electro-swelling. The imaging results from these two methodologies indicated that electro-swelling shows increased yield and size control. Guv immobilization was tested in a flow cell using an isosmotic sucrose solution.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Chemistry: Analytical/Physical Section)

Funded by University of Tennessee (NSF-REU)



Characterization of the Molecular Diversity of Pulmonary Sensory Neurons. Issac Domenech[1], Mark Krasnow[2], and Yin Liu[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Stanford University School of Medicine, Stanford, California, 94305.

Abstract

The visceral sensory neurons, which sense our internal environment and communicate with the central nervous system, are crucial for maintaining physiological homeostasis of our bodies. Our research focuses on a subset of these neurons that specifically innervate the lungs, the pulmonary sensory neurons (PSNs). Over the past decades, PSNs have been extensively studied in their electrophysiological properties, which revealed their heterogeneity, however, the full molecular, morphological, and functional diversities of these neurons have only recently begun to be appreciated. Previous work in the lab using single-cell RNA sequencing (scRNA-Seq) has identified eight subtypes of PSNs based on their genome-wide transcriptional profiles. This study aims to validate and challenge the scRNA-Seq results by assessing mRNA and protein expression in situ using RNAscope and immunohistochemistry. The genes we selected for this study are specific to one subtype or a cluster of subtypes based on the scRNA-seq data. Our results showed that Slc18a3-expressing PSNs do not overlap with either Trpv1- or Piezo2-expressing PSNs, consistent with the scRNA-seq results. Neurons that express Calb1 and Atp1a3 are largely non-overlapping, however, we did find two cells that express both. This work adds to our confidence on the scRNA-Seq results which we can then utilize to further study each subtype on where it terminates in the lung, what stimuli it senses, and what physiological responses it mediates.

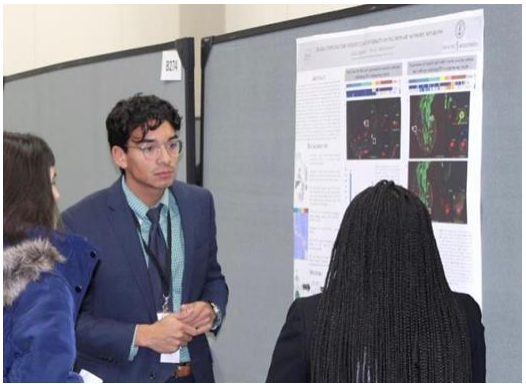
Stanford University 2018 Annual Research Symposium, August 22-23, 2018, Stanford University, Palo Alto, California (Oral Presentation and Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Physiology and Biochemistry Section: 1st place Undergraduate Research Competition)

Annual Biomedical Research Conference for Minority Students 2018, November 14-17, 2018, Indianapolis, Indiana, (Poster Presentation-Physiology Section: Outstanding Presentation Award)

Funded by Stanford University Genetics Department



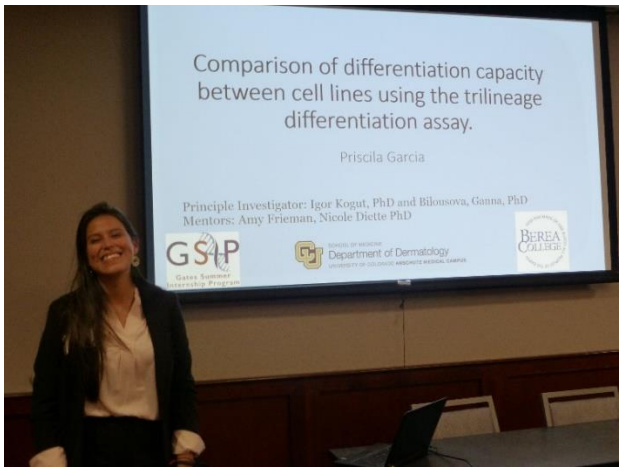
Comparison of Differentiation Capacity between Cell Lines Using the Trilineage Differentiation Assay. Priscila Garcia[1] and Denis Roop[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Univeristy of Colorado Anschutz Medical Campus, Aurora, Colorado, 80045.

Abstract

The future of induced pluripotent stem cells could lead to "personalized medicine" in the medical field as well as a further research within developmental biology and disease research studies. Stem cells are pluripotent cells that are able to self-replicate and differentiate into any different types of cells. Using a technology that reverts mature somatic cells into embryonic stem cell-like cells, labs can create what are known as induced pluripotent stem cells, or iPSCs. Scientists were able to accomplish this through ectopic expression of Oct 3/4, Sox 2, C-Myc, and Klf4 genes. iPSCs can substitute the usage of embryo pluripotent cells (ESCs) thus avoid any ethical arguments that arise in the field of regenerative science. The most important quality of iPSCs is their pluripotency, meaning that they are able to differentiate into any type of cells in the body. A way to assess pluripotency is to use a trilineage differentiation assay. Trilineage differentiation refers to the three different types of germ layers: endoderm, mesoderm, and ectoderm. Pluripotent stem cells should be able to differentiate into all three germ layers if they are indeed pluripotent. Using iPSCs generated in the lab, we seek to differentiate multiple clones of the same line into the three germ layers in order to compare the differentiation capacity of each clone. We will confirm differentiation into the three germ layers via fluorescent immunocytochemistry, using antibodies against lineage-specific markers. We expect that each different clone of the same line will be able to differentiate into each germ layer with similar efficiency, indicating a consistent differentiation capacity among reprogrammed cell lines. If iPSCs are indeed pluripotent, their usage in the medical field and scientific research are very promising.

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Cellular and Molecular Biology Section)

Funded by Berea College Office of Internships and Career Development



Mechanism of Quinolone Resistance in *Escherichia coli* Type II Topoisomerases. Nyasha Gombami[1], Alexandria Oviatt[2], and Neil Osheroff[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

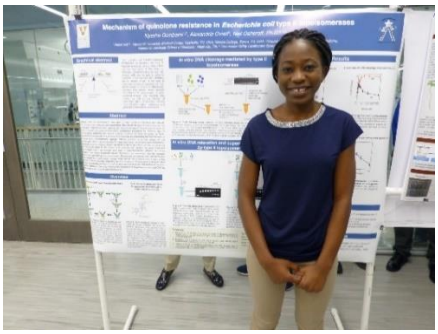
Quinolones, such as ciprofloxacin, are used to treat bacterial infections that include anthrax, urinary tract diseases and gonorrhea. The cellular targets of quinolones are the bacterial type II topoisomerase, gyrase and topoisomerase IV. Quinolones kill cells by stabilizing covalent enzyme-cleaved DNA complexes generated by bacterial type II topoisomerases, inhibiting the overall catalytic activity of these enzymes, or both. Gyrase and topoisomerase IV maintain DNA topology by generating transient breaks in the double helix. Furthermore, gyrase relaxes positive supercoils ahead of the replication fork, while topoisomerase IV separates sister chromatids after replication. Unfortunately, due to overuse, there has been a rise in quinolone resistance since the 1990s. Mutations occur in the amino acid residues that anchor the water-metal ion bridge through which quinolones and type II topoisomerases interact. To better understand how these mutations cause resistance, we examined how the catalytic cycles of wild-type and mutant quinolone-resistant *Escherichia coli* gyrase and topoisomerase IV are affected by ciprofloxacin. Assays were carried out to assess the impact of the quinolone on DNA cleavage, supercoiling, and relaxation. Ciprofloxacin enhanced DNA cleavage mediated by wild type *E.coli* gyrase, and inhibited the introduction of negative supercoils. Moreover, the drug inhibited the relaxation of positively supercoiled DNA by *E.coli* topoisomerase IV. Based on our findings, we propose that mutations may cause quinolone resistance in *E. coli* cells by stabilizing DNA cleaved complexes mediated by type II topoisomerases in addition to inhibiting the relaxation of positive supercoils.

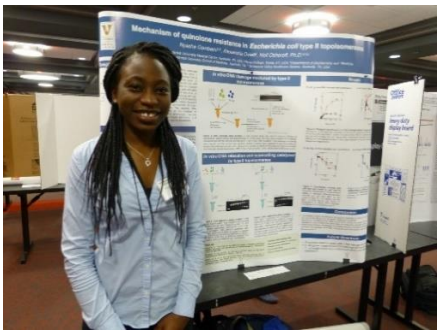
KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physiology and Biochemistry Section: 1st place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University





Targeted Integration of Fluorescent Reporters into iPSCs Using CRISPR/Cas9. Chann Makara Han[1], Dennis Roop[2], Igor Kogut[2], Ganna Bilousova[2], Partick Sean McGrath[2], and Kiel Carson Butterfield[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Colorado Anschutz Medical Campus, Aurora, Colorado, 80045.

Abstract

Animal models frequently have limitations when used to study human disease. In 1998, the first isolation of human embryonic stem cells (hESCs) ushered in a new era for modeling genetic diseases. However, there are still many barriers to using hESCs to study or treat human diseases including accessibility, immune rejection, and ethical concerns. The development of patient-specific induced pluripotent stem cells (iPSCs) and new technologies including CRISPR/Cas9 gene editing have helped to alleviate many of the barriers to stem cell disease modeling. iPSC-derived patient-specific models are a very powerful tool in the understanding of human disease development and translational research. One valuable way to model diseases is by directly visualizing cellular and physiological phenotypes during cells' renewal and differentiation via tagging with fluorescent reporters at specific loci. We developed a strategy to construct a series of constitutively expressed fluorescent proteins for knock-in into the AAVS1 safe-harbor locus, or other genes of interest, using CRISPR/Cas9. Additionally, we have further modified each fluorescent protein to include either nuclear- or membrane-localization signals. Building additional resources into iPSCs, such as fluorescent tags and reporters, will advance the model system as a research tool. The goal of the project is to construct a library of fluorescent cell lines spanning the spectrum from blue (405-excitation) to far-red (647-excitation) for downstream applications.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Cellular and Molecular Biology Section: 2nd place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development

Role of Shear Stress on Endothelial Insulin Sensitivity. Areli Medina Hernandez[1], Lauren Walsh[2], Thaysa Ghiarone[2], Luis Martinez-Lemus[2], and Jaume Padilla[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Missouri, Columbia, Missouri, 65211.

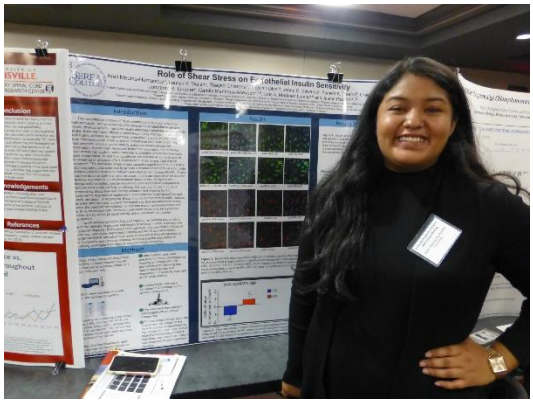
Abstract

The vasodilator actions of insulin contribute to glucose uptake by skeletal muscle, and previous studies have demonstrated that acute and chronic physical activity improves insulin-stimulated vasodilation and glucose uptake. Because this effect of exercise primarily manifests in vascular beds highly perfused during exercise, it has been postulated that increased blood flow-associated shear stress on endothelial cells is an underlying mechanism by which physical activity enhances insulin-stimulated vasodilation. Accordingly, herein we tested the hypothesis that increased shear stress can acutely render vascular endothelial cells to become more insulin-responsive. To test this hypothesis, we cultured endothelial cells in the presence or absence of a 1-h increase in shear stress from 3 to 20 dynes/cm2. The increased shear stress caused a significant ($P<0.05$) shift in insulin signaling characterized by greater activation of endothelial nitric oxide synthase (eNOS) relative to mitogen-activated protein kinase (MAPK). These experiments on endothelial cells were part of a larger study in which isolated arterioles exposed to 1-h of intraluminal shear stress (20 dynes/cm2) subsequently exhibited greater insulin-induced vasodilation compared to arterioles kept under no-flow conditions. We also found that in humans increased leg blood flow induced by unilateral limb heating for 1-h subsequently augmented insulin-stimulated popliteal artery blood flow and muscle perfusion. In aggregate, these findings across models (cells, isolated arterioles, and humans) support the hypothesis that elevated shear stress causes the vascular endothelium to become more insulin-responsive and thus are consistent with the notion that shear stress may be a principal mechanism by which physical activity enhances insulin-stimulated vasodilation.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Cellular and Molecular Biology Section)

Funded by Berea College Office of Internships and Career Development



Synthesizing Cleavable Antibody Drug Conjugates via Solid Phase Organic Synthesis.

Michael James, Levi Blevins, Ominica Crockett, and Elizabeth Thomas. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

There is a need for cancer treatment to become more effective and more specific for cancerous tissue, and antibody drug conjugates are a promising method for doing just that. While the concept behind them is promising, they lack diverse cleavage methods to deliver their cytotoxic payload to their intended target. Therefore, cathepsin B mediated cleavage was explored as a delivery mechanism for antibody drug conjugates because of the increased cathepsin B expression in cancerous cells (especially metastatic cancer) and its ability to promote the specific release of cytotoxic drugs within. Modified pentapeptides were designed with the purpose of conjugating detectable molecules such as drugs to cancer specific antibodies to test the effectiveness of a valine-citrulline or valine-alanine cleavable bonds in cellular cancer models. Pentapeptide derived linkers were synthesized via solid phase organic synthesis, and characterized by high performance liquid chromatography and mass spectrometry, confirming the synthesis of five modified pentapeptide linkers. Antibody conjugation yielded unfavorable results based on SDS-PAGE and Western blot analysis, so future endeavors seek to improve conjugation and refine linker design.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Chemistry: Organic/Inorganic Section: 3rd place Undergraduate Research Competition)

Funded by Berea College URCPP

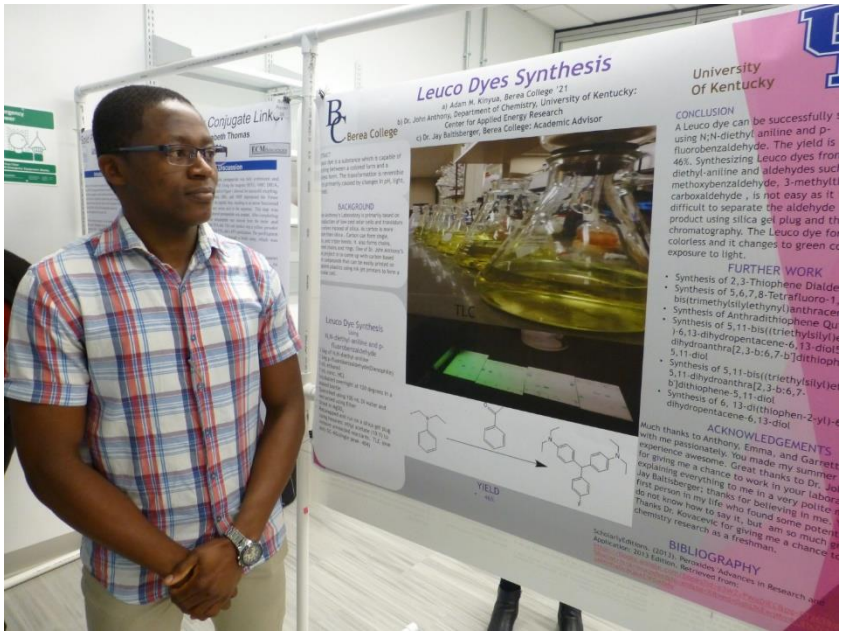
Synthesis of Leuco Dyes. Adam M. Kinyua[1] and John Anthony[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

A Leuco dye is a substance which is capable of switching between a colored form and a colorless form. The transformation is reversible and is primarily caused by changes in pH, light, and heat.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development



Integrin β1 Promotes KRAS-Mutated Lung Cancer Proliferation via MAPK-Independent Mechanism. Kateryna Nabukhotna[1], Lindsay Venton[2], Roy Zent[2], and Scott Haake[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

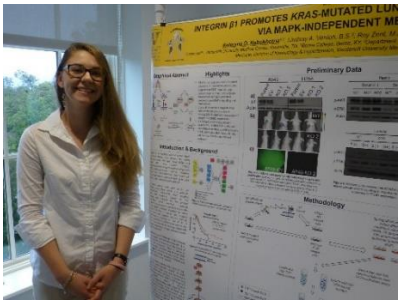
Lung cancer is the leading cause of cancer death in the United States. Integrins are transmembrane receptors consisting of 18 alfa- and 8 beta-subunits that combine to form 24 distinct heterodimers that function as the principal extracellular matrix receptors of the cell. KRAS is the most commonly mutated oncogene in lung cancer, and studies suggest that KRAS-mutated lung cancers require integrins to activate downstream mitogen-activated protein kinase (MAPK) signaling and form tumors. However, preliminary data from our group suggests that KRAS-mutated cells are able to activate MAPK signaling irrespective of integrin β1 (ITGB1) expression. In order to further understand the impact of β1 integrins on growth factor-mediated activation of MAPK signaling in KRAS-mutated lung cancer, we directly evaluated KRAS activation in human lung adenocarcinoma cell lines with CRISPR-mediated beta-1 knock out (KO). A KRAS-activation assay was performed to selectively pull-down GTP-KRAS from parental KRAS-mutated human lung adenocarcinoma cell lines and CRISPR-mediated integrin ITGB1-KO cells. Cells were either serum starved or spiked with calf serum and GTP-KRAS was quantified via immunoblotting. We observed increased GTP-KRAS in ITGB1-KO cells relative to wild-type cells, suggesting that KRAS is able to activate appropriately in ITGB1-KO cells. Therefore, ITGB1 promotes KRAS-mutated lung cancer via a MAPK-independent pathway, and increased KRAS signaling may represent a novel mechanism of compensation for loss of ITGB1-dependent signaling.

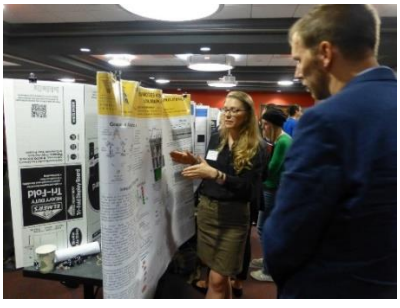
KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Cellular and Molecular Biology Section: 2nd place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University





***Clostridium* Isolate Growth in a Zinc-Limited Environment.** Kamila Nurmakova[1], Christopher Lopez[2], and Eric Skaar[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

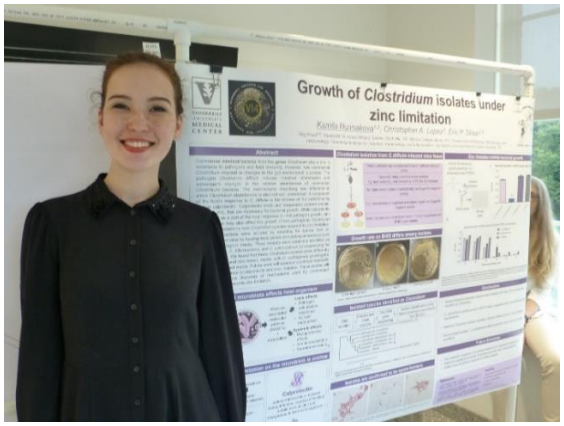
Commensal intestinal bacteria from the genus *Clostridium* play a role in resistance to pathogens and host immunity. However, how commensal *Clostridium* respond to changes in the gut environment is unclear. The pathogen *Clostridium difficile* induces intestinal inflammation and subsequent changes in the relative abundances of commensal *Clostridium* bacteria. The mechanisms describing how inflammation alters *Clostridium* abundances is not well understood. Part of the host's response to *C. difficile* is the release of the metal-binding protein calprotectin. Calprotectin binds and sequesters nutrient metals, including zinc, that are necessary for bacterial growth. While calprotectin is released as a part of the host response to limit pathogen growth, zinc sequestration may also affect the growth of non-pathogenic *Clostridium* species. To determine how *Clostridium* respond to zinc limitation, *Clostridium* were isolated by selecting for spores from *C. difficile*-infected mice by heating mice fecal pellets and plating anaerobically on rich Eggerth-Gagnon media. Three isolates were putatively identified as *C. sulfidigenes*, *C. bifermentans*, and *C. xylanolyticum* by sequencing 16s rRNA genes from isolates. We found that the *Clostridium* isolates grow differently in zinc-replete and zinc-limited media, with optimal growth of *C. sulfidigenes* occurring in zinc-limited media. Future work will examine clostridial metabolic changes in response to calprotectin and zinc-limitation.

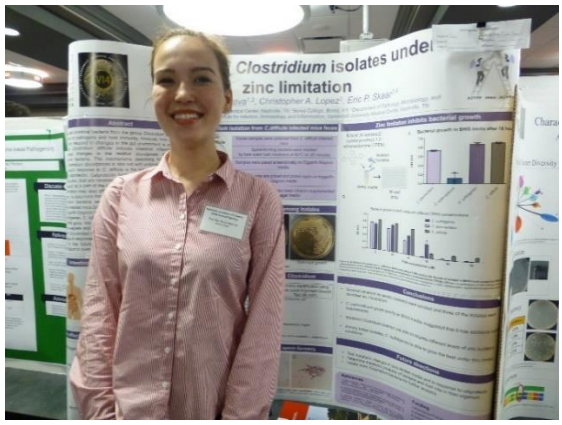
KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Microbiology Section)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University





Epidemiology of HPV-Associated Cancers: Changing Trends and Future Burden. Yeongha Oh[1] and Krystle Kuhs[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

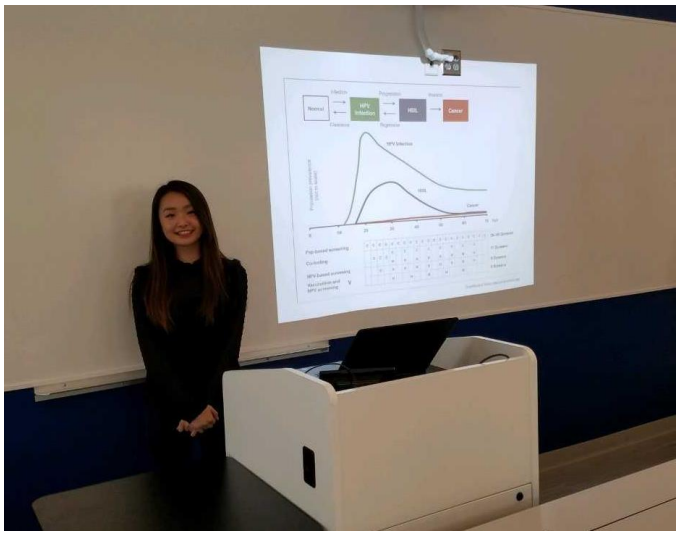
Abstract

The Southeast region of the United States has the highest incidence of HPV-related malignant cancers and the lowest HPV vaccination rates in the country. In order to facilitate HPV research, Vanderbilt created a consortium of researchers and students called HPV-ACTIVE. Three initial pilot projects were funded through this group. The objective of project 1 was to determine the burden of HPV-associated cancers and precancers and to create a virtual biorepository of all HPV-associated cancers and precancers diagnosed at Vanderbilt. Natural language processing was used to search for all pathology reports generated at Vanderbilt from 2005 to 2017 for HPV-associated keywords. These pathology reports are currently being manually reviewed to confirm the presence or absence of an HPV-related cancer or precancer. Of 29,618 identified pathology reports, 21,753 (73%) have been manually reviewed. To date, 798 cancers and 9,605 precancers have been identified. All information is housed in a secure online database (REDCap) that allows researchers to easily search for HPV-related malignancies and to link those cases with archived tissue specimens available for research. After the completion, this project has the potential to be the largest biorepository of HPV-related malignancies serving as an invaluable tool for future HPV research.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Health Science Section: 2nd place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University



Mapping the Binding Sites of Fatty Acid Synthase on Chikungunya Viral RNA. Clara Reasoner[1], Yuqi Bian[2], Jeffrey Jian[2], Katherine Rothamel[2], Byungil Kim[2], and Manuel Ascano[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

Chikungunya virus (CHIKV) is a zoonotic arbovirus with a positive-sense single-stranded RNA genome. Despite increasingly high rates of infection worldwide, the early stages of its entry and the host cellular machinery used to promote replication are not well understood. Past research has demonstrated that the absence of the host enzyme fatty acid synthase (FASN) results in a significant decrease in CHIKV replication. However, this work focused solely on the proviral enzymatic activity of FASN in lipid metabolism. Recently, using the novel technique VIR-CLASP, we determined that FASN is a non-canonical candidate RNA binding protein (RBP) that binds directly to the CHIKV RNA genome immediately upon viral entry. The impact of FASN binding to viral RNA genomes – let alone the function of FASN as an RBP – is under investigation. To formally establish that FASN is a bona fide RBP, we seek to identify the regions on FASN protein that confer RNA binding and to map the FASN binding sites on the CHIKV genome. I will describe my progress towards the localization of the binding site of FASN on CHIKV RNA. Towards this goal, I will describe my use of photochemical biological approaches via RNA-protein crosslinking and immunoprecipitation, followed by reverse-transcription and quantitative PCR. This project serves an essential first step for a structure-function based analysis towards understanding the mechanism of FASN proviral activity on CHIKV replication and infection.

KUH Summer Undergraduate Research Conference, August 1-3, 2018, Boston, Massachusetts (Poster Presentation)

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Physiology and Biochemistry Section)

Funded by Berea College Office of Internships and Career Development and Vanderbilt University

Procedure Improvement for FAPbI3 Perovskite Solar Cells. Valéria Rosa Rocha[1], Somin Park[2], and Kenneth Graham[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

Solar energy is likely the most promising and abundant source of renewable energy, and therefore, the study of new methods for using the sun's energy is crucial for the future of our society. Perovskite solar cells are a newly developed method to convert sunlight into energy that has impacted the renewable energy field by displaying a radical increase in laboratory efficiencies in a very short time. Efficiency of 17.9% was achieved after only 4 years of research while the state of the art silicon solar cells achieve a max of 25% in laboratory conditions. Perovskite cells are constructed using an organic-inorganic structure, building thin layers of chemicals that work as electron transporting layer (ETL) and hole transporting layer (HTL), framed by electrodes that close the circuit. Two challenges associated with perovskite solar cells are 1) finding substances that produce the best interface interactions and 2) finding an optimal procedure that can deliver stable, reproducible, and efficient cells. My work with such devices was focused on procedure improvement and identifying the impact of certain techniques on the perovskite film quality and final efficiency. Tests were performed on FAPbI3 perovskite cells in DMF and NMP. Variations were made in annealing temperature, HTL, anti-solvent and anti-solvent drop time, spin coating process, and other parameters. I will discuss the results of each variation made to the process.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physics and Astronomy Section)

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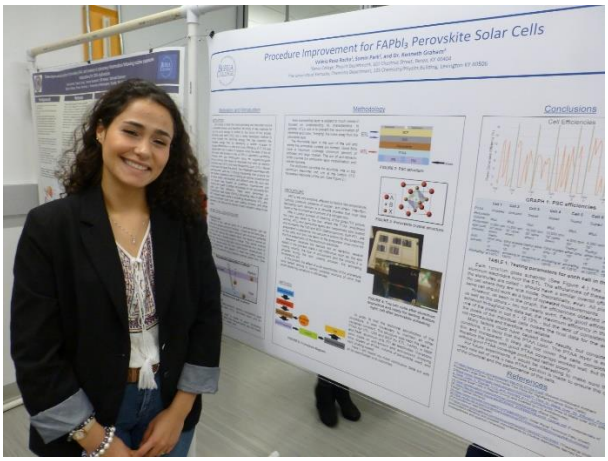


Using the Liquid Sampling-Atmospheric Pressure Glow Discharge with Capillary Channeled Polymer Fibers for Analysis of Protein Mixtures. Daisy Sullivan[1], Hung Trang[2], Edward Hoegg[2], and R. Kenneth Marcus[2]. Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Clemson University, Clemson, South Carolina, 29634.

Abstract

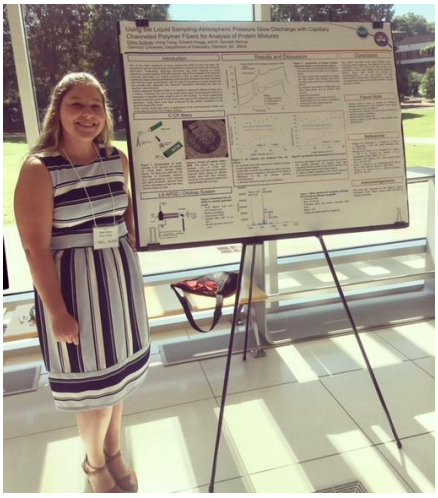
One of the major drawbacks of mass spectrometry (MS) to date has been the necessity to use two distinct types of instruments to analyze elemental and molecular information. Traditionally, elemental information has been acquired by using inductively coupled plasma (ICP) MS, however, due to the energetics of the plasma, molecular information (i.e. protein structure) is lost. In order to overcome these barriers the liquid sampling-atmospheric pressure glow discharge has been interfaced with Orbitrap mass spectrometers with the goal of developing a single system that can provide both elemental and molecular information eliminating the need for separate instrumentation. Another significant limitation of MS is its inability to distinguish different proteins from a mixture. Therefore, the use of high performance liquid chromatography (HPLC) is necessary to separate these proteins prior to MS analysis. For these experiments capillary-channeled polymer (C-CP) fibers were used as the stationary phase for the separation. These fibers have been employed for fast protein separations in the reversed phase (RP) mode. These results would open doors in applications of the pharmaceutical industry and would allow for quicker and cheaper analysis.

6th Annual Clemson University Summer Undergraduate Research Poster Symposium, July 27, 2018, Clemson University, Clemson, South Carolina

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Chemistry: Analytical/Physical Section)

Funded by Clemson University



Disruption of Choline Acetyltransferase (ChAT) by Congenital Mutations: Screening Potential Therapeutic Leads. Abigail Whitaker[1] and David W. Rodgers[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

Acetylcholine (ACh) is a vital neurotransmitter that is present throughout the nervous system and is synthesized by choline acetyltransferase (ChAT). Disruption of the synthesis or degradation of ACh can cause many neurodegenerative disorders. Mutations in ChAT are known to cause congenital myasthenic syndrome with episodic apnea (CMS-EA). Within the literature, it has been discovered that there are 24 missense mutations widely distributed throughout the enzyme. It was hypothesized that these mutations cause structural changes which are propagated to the active site, causing a decrease in enzymatic activity. Furthermore, it is thought that the poor core packing of ChAT allows these point mutations to easily affect the active site. Working closely with the L102P mutant, we screened a library of 31 compounds for possible ligands that bind in ChAT cavities, improving core packing and reducing the effects of point mutations. Our approach was to compare the effects of these ligands on both wild type ChAT and CMS-EA mutant ChAT, more specifically the L102P mutant, in vitro. A series of kinetic assays were performed using a Molecular Devices SpectraMax M5 plate reader and black, clear bottom 96-well plates. The wild type ChAT was treated as the control group for each compound and was tested against the L102P mutant. Out of the 31 compounds, a single compound designated (9)-F10 showed promising results as a potential therapeutic lead. Future work will consist of further development with this compound, such as obtaining a crystal structure to determine the binding site of the ligand.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physiology and Biochemistry Section)

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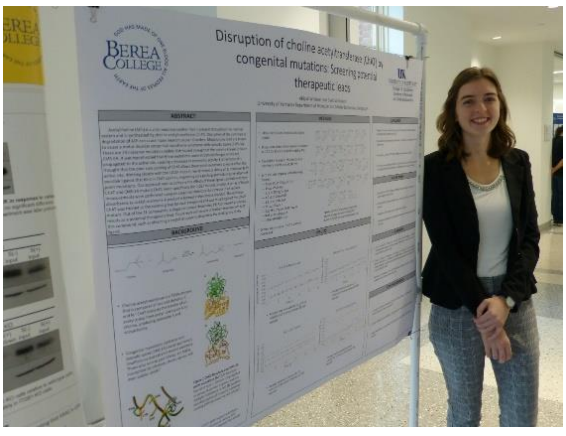

Reggio Emilia Inspired Practice at the Child Development Laboratory. Destiny Strange-Banks, Sienna Burgess, Katie Bledsoe-Houston, and Cindy McGaha. Child and Family Studies Department, Berea College, Berea, Kentucky, 40404.

Abstract

The purpose of this study is to document the transition to a Reggio-inspired model of curriculum at the Child Development Laboratory. During this initial phase of a 2-year study, we focused on interviewing teachers about their current planning practices. In addition, we gathered baseline data about children through videotaping their play in the classrooms. We developed a codebook to examine observed play and teacher responses to support play.

58th Annual East Tennessee State University Early Childhood Conference, July 13-14, 2018, Johnson City, Tennessee

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP

Simulations of Belief Propagation through Social Networks. E. Dove DeNigris, Miranda Goens, Jenna Hughes, Abdirahman Mohamed, and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

Abstract

Our algorithms simulate the propagation of beliefs through a social network over time. Within the network, weights on directed graph edges represent the amount of influence one node has on another. To simulate the diffusion of beliefs through a social network, our algorithm calculates a new belief strength for each node based on the preceding nodes' belief strength and level of influence, while accounting for the node's current belief strength, its level of uncertainty in that belief, and its likelihood of exposure. In a second model, we add in confirmation bias, modeling the notion that people who do not work to mitigate confirmation bias will strengthen their beliefs having found allies in the network and will then reject beliefs which are not in alignment with their own. Furthermore, for our networks, we explore two different graph structures: small world and Erdős. We produced multiple simulations of both models using both network structures in order to compare the differences in belief propagation through these social networks based on the presence or absence of confirmation bias and the small world or Erdős network topology. In addition, we visually represent all networks with graphs by utilizing the software packages NetworkX and Matplotlib.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

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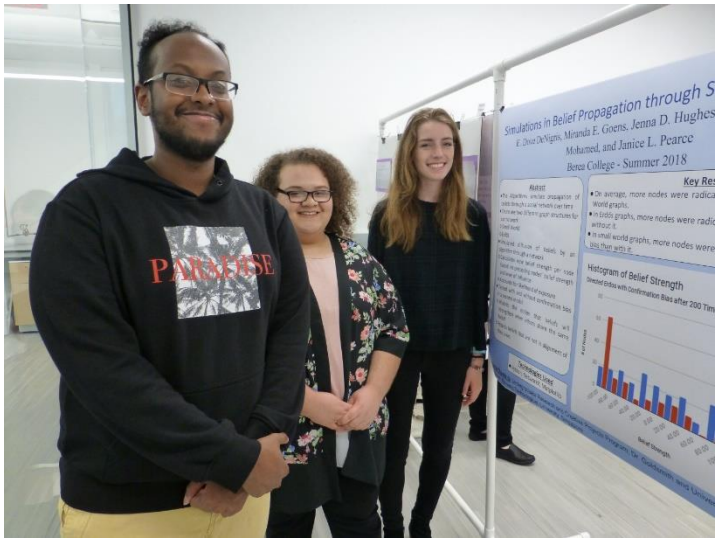

Analyzing Appalachian Media for Purposeful Usage. Ciara Felty, Clint Chaffins, and Maggie Robillard. Education Studies Department, Berea College, Berea, Kentucky, 40404.

Abstract

When community scholars, undergraduate students, or professors at Berea College have research needs concerning Appalachian culture or history, Faber Library is a helpful resource that includes all sorts of information such as academic journals, reference materials, fiction, regional music, movies, and more. Hutchins Library and archives are also excellent research sources, but do not have an exclusive focus on Appalachia as does Faber Library. To succeed, users of the Faber Library rely in part on high-quality materials that are easily accessible but we knew from anecdotal evidence that problems existed in usage of Faber library; we felt we could enhance its function. We utilized articles analyzing Appalachian library organization, drew inspiration from other Appalachian libraries, surveyed data from stakeholders, and held focus group discussions to consider ways to ensure Faber Library would be more user-friendly for patrons. Our analysis confirmed some of our initial observations: that use of Faber Library was sometimes compromised by hours of operation, a general lack of awareness of the library, and difficulty in locating materials within the stacks. We worked to ameliorate some of these concerns by clarifying library hours; improving digital presence; reorganizing materials, especially music, movies, and Loyal Jones' collection; and designing clear informational signs to support its use, in addition to aesthetic improvements. The resulting changes address the unique needs of Appalachian scholars in a way that makes sense when studying the Appalachian region. The outcome of this process is that patrons can now more readily access Faber materials, although some changes are still in process. We predict increased use of library materials based on our work, although comparative data and patron feedback will need to be collected and analyzed before conclusions may be drawn. The resulting changes, if found to be successful, could be adapted by other Appalachian libraries to better support patrons.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

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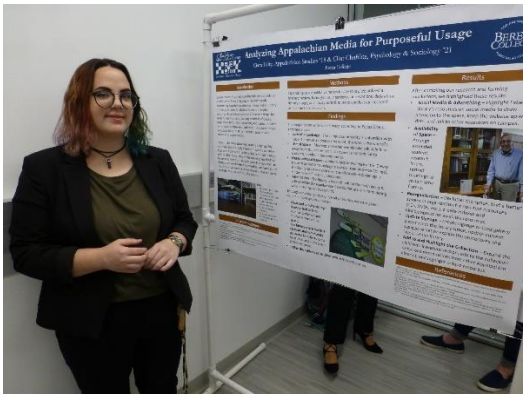


Physical Activity Intensity Levels in Outdoor Rock Climbing. Josh Wilson, Enrique Escobar, Michelle Thornton PhD., and A.J. Mortara Ed.D. CSCS. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

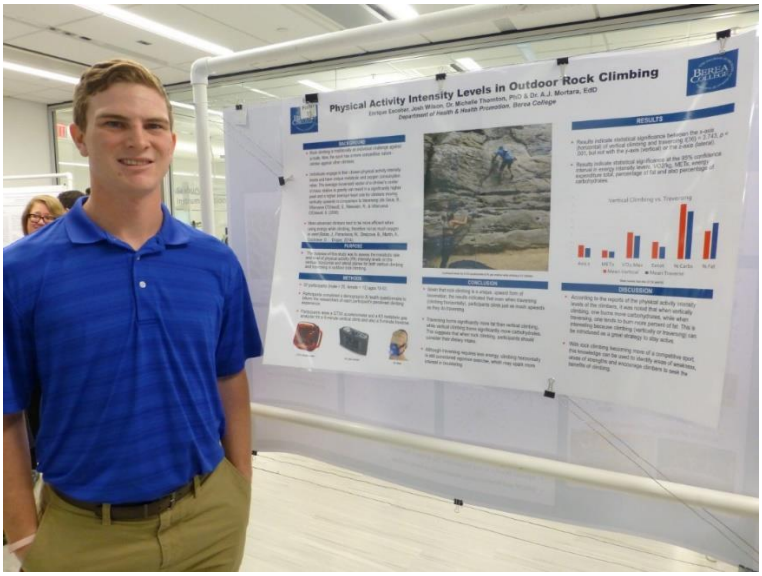
Abstract

The purpose of this study was to compare the metabolic rate and intensity of physical activity (PA) on both vertical top-rope climbing and horizontal traversing during outdoor rock climbing, and to determine differences, if any, in energy expenditure levels among the horizontal (x-axis), vertical (y-axis), and lateral (z-axis) planes of movement. Thirty-seven adults (25 males, 12 females), aged 18-53 participated in this project. Participants wore an ActiGraph GT3X accelerometer and K5 metabolic gas analyzer during two (one vertical and one traverse) 5-minute outdoor climbing sessions in central KY. ActiLife 6 software determined the accelerometer intensity levels of each climb. K5 data was downloaded and analyzed by the Omnia analysis software program. Data indicate statistical significance ($t(36)=3.743$, $p<.001$) between the x-axis of vertical climbing and the x-axis of horizontal traversing, which suggests that energy expenditure during vertical top-rope climbing is greater than during horizontal traversing. Results also indicate a statistically significant difference between vertical climbing and horizontal traversing in METs, total energy expenditure, VO2, respiratory quotient and relative carbohydrate and fat expenditure. Both vertical climbing and horizontal traversing required an energy expenditure which meets or exceeds the threshold for moderate to vigorous intensity exercise under American College of Sports Medicine guidelines. This indicates that either option can be an effective exercise modality to illicit health and performance improvements.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

Kentucky Association for Health, Physical Education, Recreation and Dance, November 11-13, 2018, Lexington, Kentucky

Funded by Berea College URCPP



Physical Activity and Health Patterns of Berea Trail Town Users. Jaden Johnson, Glendy Pineda, and Louisa Summers. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

Abstract

Berea, Kentucky was certified as a Kentucky Trail town in 2016. This relatively small city of 13,651 residents Berea has successfully created multi-use trails that connect the middle of city to the outlying areas, as well as easily accessible paths around town. The purpose of the study was to gather demographic information and physical activity patterns of users. The researchers utilized intercept surveys, infrared sensors, and observational data to record the information. Data collection occurred 12 hours on four different days in May and June of 2017 and 2018. The surveys were used to compare the users to one another and to the Surgeon General's Report and the State Indicators Report of Physical Activity (CDC, 2010). The US Surgeon General recommends 30 minutes or more of moderate intensity physical activity on five days per week. The results indicated that users on the Arena Theater and Indian Fort trails were spending an average of 47 minutes on the trail and 11 additional minutes of physical activity accessing the trails. Upon further examination, the researchers saw that the Lexington and in-state residents were active an average of three to four days a week, as compared to the Berea residents who were active five days per week. Lastly, 90% or more users of the trails stated they were in good (or excellent) health, as compared to the Center for Disease Control 57% of reported Kentuckians. In conclusion, the residents of Berea were meeting and exceeding the weekly and daily guidelines for physical activity, whereas some visitors were not.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Health Science Section)

Funded by Berea College URCPP

The Health and Economic Impact of the Pinnacle Trails in a Kentucky Trail Town. Glendy Pineda, Jaden Johnson, and Louisa Summers. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

Abstract

The Pinnacles at Indian Fort Theatre is located in a rural Appalachian city and is the number one attraction in the city of Berea Kentucky (https://www.tripadvisor.com/Attractions-g39187-Activities-Berea_Kentucky.html). The purpose of this study was to compare the health and economic impact of the trails in 2017 as compared to 2018 to interpret the importance of this trail for the community. Intercept surveys (Cook, O'Brien, Jackson, Findley, & Searcy, 2016), hand counts and infrared sensors were used to estimate the number and type of trail users. In 2017 and 2018, surveys were completed for 12 hours over four days during May, June and July. Participants completed a 15-question survey either before or after their trail use. In 2017, 82 surveys (51% male, and 49% female) were completed. Residents included 23%, and 77% of people were from out of town or out of state. Trail users averaged 95.4 minutes of physical activity on the trail, with 20.9% residents using the trail more than twice times per week. Trail users averaged $6.06 per person (range $10-$60). In 2018, a total of 186 people were surveyed (89 males and 97 females), and non-residents composed 69% of the sample. The average of money spent in the city of Berea increased to $15.83 (range $2-$275). This attraction and trail is providing two for one benefits, "Health for participants, and income for local businesses". Future data may improve annual usage and expenditures as there will be a connection of this trail straight to the city center.

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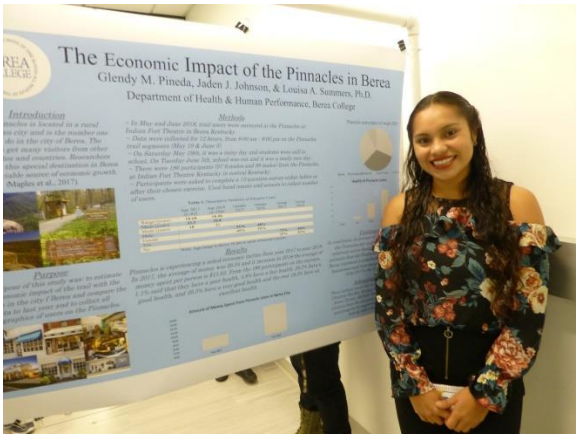

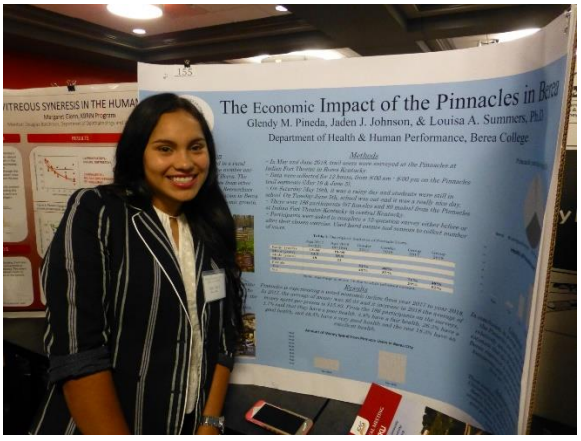

Application of Multi-Theory Model in Predicting Small Portion Size Consumption in Rural Appalachia. Sierra Turner, Sangyal Dorjee, and Ram Lakhan. Department of Health and Human Performance, Berea College, Berea, Kentucky, 40404.

Abstract

Background: About 81% of counties of the central Appalachia are experiencing nation's highest obesity rate. People are often aware of the fact that a consumption of large portion size is associated with obesity and many chronic diseases. Initiation and sustenance of small portion size consumption can address obesity and related consequences in the population. Among all public health theories, recently developed multi-theory model (MTM) has demonstrated ability of predicting initiation and sustenance of small portion size consumption behavior. Purpose: To predict a likelihood of initiation and sustenance of small portion size consumption behavior in rural Appalachia by applying MTM public health theory. Materials and Methods: A previously standardized MTM instrument for portion size consumption behavior was adapted and used for data collection. Six counties of rural Appalachian region of Kentucky defined as distressed, at risk, and transitional on socio economic indicators by the Appalachians Research Commission (ARC) were selected. A cross-sectional research design and a convenience sampling were applied. A multi regression model was applied to predict the likelihood of initiation and sustenance of small portion size consumption behavior. Results: A data of 156 adult ages from 18 to 91 years, 59% females and 40.4% males who consumed at least a large portion in 24 hours was analyzed. Majority participants were White (85.3%). More than half had high school education (51.9%). 61.5% were employed. Analysis of variance (ANOVA) for initiation ($F=41.52$, $p<0.001$) and sustenance ($F=33.03$, $p<0.001$) indicated suitability for regression modeling. MTM components of initiation model participatory advantage outweighing disadvantage, behavior confidence, and change in physical environment ($R^2 = 0.46$, $p<0.001$)) and for sustenance model emotional transformation, and practice for change ($R^2 = 0.41$, $p<0.001$) were found strong predictors of initiation and sustenance of small portion size consumption in rural Appalachia. The socio demographic factors including age, gender, ethnicity, education, and employment ($p>0.001$) did not contribute to the model. Conclusion: theoretical application of MTM in understanding initiation and sustenance behavior of small portion size consumption is predicted by its components. The study findings suggest crucial areas of intervention. A strategic public health intervention of reinforcing predictor components of both model can lead initiation and sustenance behavior of small portion size consumption among rural Appalachian residents.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

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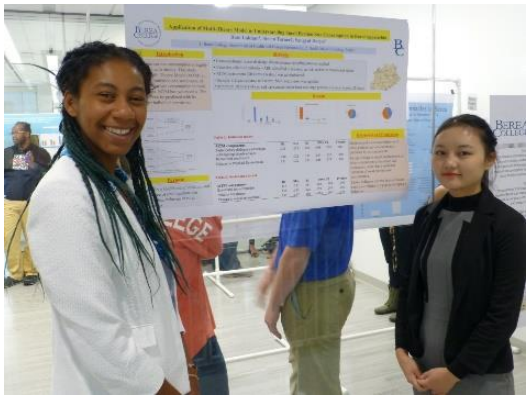

Playing 'Double Take' on a Graph. Sahet Dovranov and Kristen Barnard. Mathematics Department, Berea College, Berea, Kentucky, 40404.

Abstract

A graph is a discrete structure that shows a relation between two sets, the set of vertices (points) and edges (line segments connecting two points). A currently unsolved combinatorial game can be referred to as Take-Away on a Graph. Players would begin with a graph and, as in all true combinatorial games, players would move alternately until no more moves could be made. In this game, when it is a player's turn she can choose to remove an edge from the graph and leave the rest of the structure in tact or to remove a vertex from the graph and take with it all of its adjacent edges. Again, the statement of the game and its rules are very straightforward, but the analysis is still not complete for graphs in general. During this research experience, students chose to modify the standard game of Take-Away on a Graph by allowing the player to choose to remove up to 2 edges or a single vertex when it is her turn to play. This change in the rules changes the strategy of the game, and most known results are no longer valid with the addition of the new rule. Starting from scratch, each student focused on a particular graph structure to determine whether or not a strategy existed for that structure. Some of the structures analyzed yielded results leading to a strategy for playing the game. Others did not lend themselves as readily to finding an easily describable strategy.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

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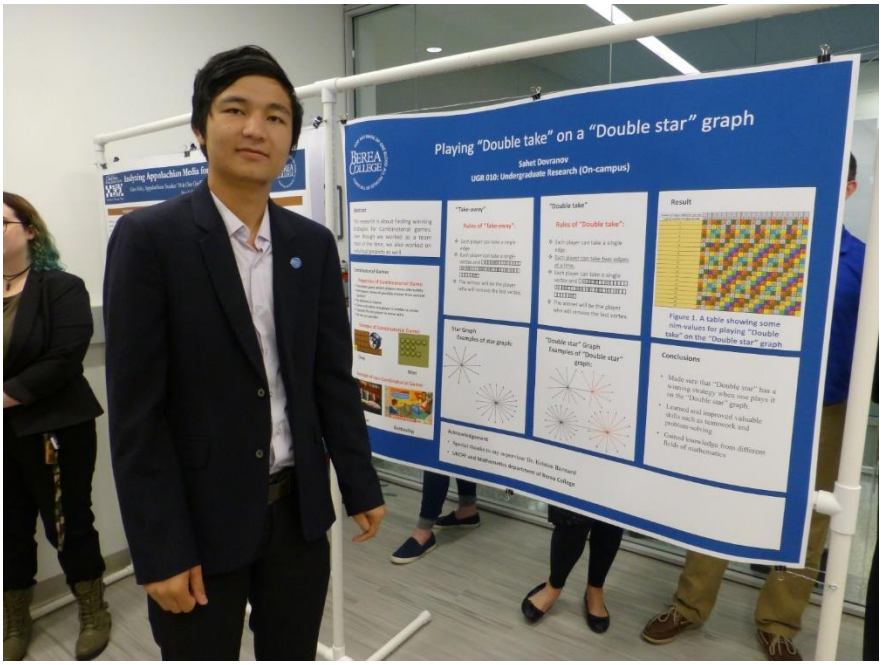

Combinatorial Game Theory and Graphs. Jacob Uzzle and Kristen Barnard. Mathematics Department, Berea College, Berea, Kentucky, 40404.

Abstract

A graph is a discrete structure that shows a relation between two sets, the set of vertices (points) and edges (line segments connecting two points). A currently unsolved combinatorial game can be referred to as Take-Away on a Graph. Players would begin with a graph and, as in all true combinatorial games, players would move alternately until no more moves could be made. In this game, when it is a player's turn she can choose to remove an edge from the graph and leave the rest of the structure in tact or to remove a vertex from the graph and take with it all of its adjacent edges. Again, the statement of the game and its rules are very straightforward, but the analysis is still not complete for graphs in general. During this research experience, students chose to modify the standard game of Take-Away on a Graph by allowing the player to choose to remove up to 2 edges or a single vertex when it is her turn to play. This change in the rules changes the strategy of the game, and most known results are no longer valid with the addition of the new rule. Starting from scratch, each student focused on a particular graph structure to determine whether or not a strategy existed for that structure. Some of the structures analyzed yielded results leading to a strategy for playing the game. Others did not lend themselves as readily to finding an easily describable strategy.

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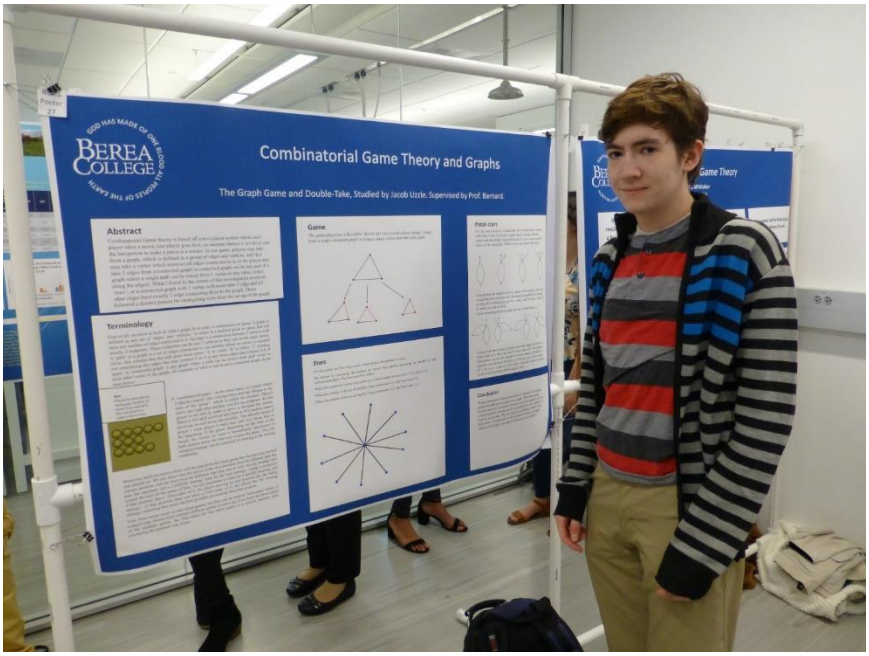

Combinatorics Game Theory. Jessie Whitaker and Kristen Barnard. Mathematics Department, Berea College, Berea, Kentucky, 40404.

Abstract

A graph is a discrete structure that shows a relation between two sets, the set of vertices (points) and edges (line segments connecting two points). A currently unsolved combinatorial game can be referred to as Take-Away on a Graph. Players would begin with a graph and, as in all true combinatorial games, players would move alternately until no more moves could be made. In this game, when it is a player's turn she can choose to remove an edge from the graph and leave the rest of the structure in tact or to remove a vertex from the graph and take with it all of its adjacent edges. Again, the statement of the game and its rules are very straightforward, but the analysis is still not complete for graphs in general. During this research experience, students chose to modify the standard game of Take-Away on a Graph by allowing the player to choose to remove up to 2 edges or a single vertex when it is her turn to play. This change in the rules changes the strategy of the game, and most known results are no longer valid with the addition of the new rule. Starting from scratch, each student focused on a particular graph structure to determine whether or not a strategy existed for that structure. Some of the structures analyzed yielded results leading to a strategy for playing the game. Others did not lend themselves as readily to finding an easily describable strategy.

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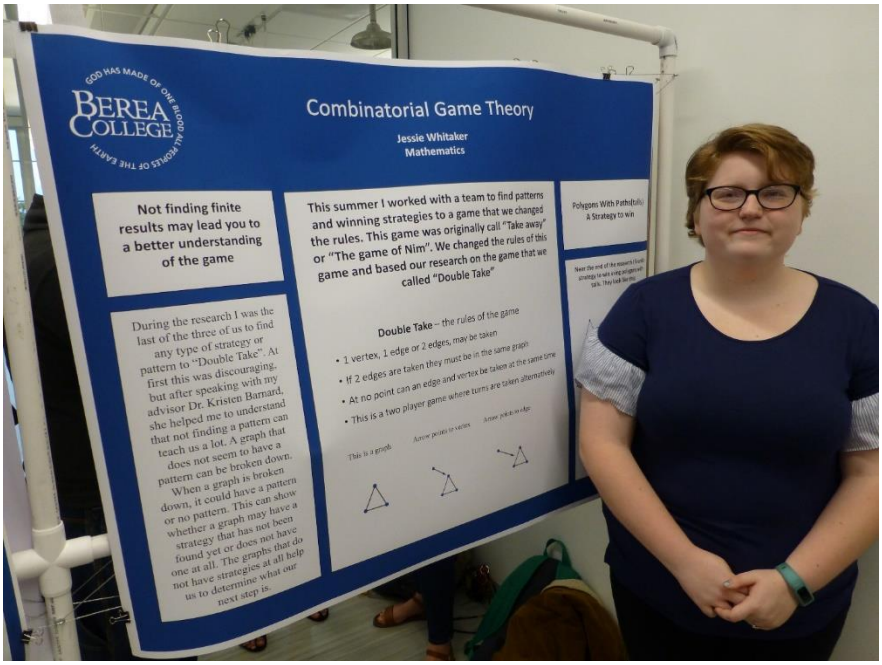

Dependence of Helium Atmospheric Pressure Plasma Jet (APPJ)-Induced DNA Damage on Voltage Pulse Frequency and Irradiation Time. Kemo Jammeh[1] and Sylwia Ptasinska[2]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]University of Notre Dame, Notre Dame, Indiana, 46556.

Abstract

Interest in Atmospheric Pressure Plasma Jets (APPJs) has increased due to the great potential they have in medical applications. In this study, the dependence of APPJ-induced DNA damage on voltage pulse frequency was investigated. The APPJ source consists of two cylindrical brass electrodes and a dielectric silica capillary connected to a power supply and a pulse generator. The plasma generated from the source is used to irradiate DNA samples at different frequencies and the damage (single-stranded breaks, double-stranded breaks, and denatured DNA) resulting from the irradiation is quantified using agarose gel electrophoresis and imaging techniques. It was found that total DNA damage increased with increasing frequency. Time of irradiation studies was also performed, and the results showed that total DNA damage was higher for longer times of irradiation at a constant frequency. Furthermore, it was found that, while this time dependence trend holds for other frequencies, the extent of damage varied significantly for the same set of irradiation times.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Oral Presentation-Physics and Astronomy Section)

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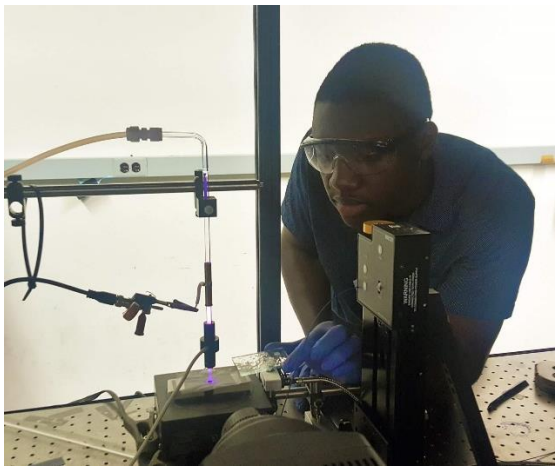

Measurements of the Entanglement of Quantum of Lights Due to Spontaneous Parametric Down Conversion. Eli Prater, Brian Leist, Mo Thi Ghimire, and Martin Veillette. Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

This project investigates the quantum nature of single photon, a quantum a light. Single photons were produced by a process known as spontaneous parametric down conversion. Starting with a powerful blue laser (405 nm), this process divides the initial beam (or pump) into two light cones (the signal and the idler). This process is different from the use of a beam splitter because it involves dividing a photon into two through a Beta Barium Borate crystal, a nonlinear medium that combines wide transparency, phase matching and a large non linear susceptibility coefficient. The two photons must obey the conservation of energy and momentum. Consequently, the two light cones must each have twice the wavelength of the pump (810nm) and they must be separated by an angle of 3.0° in both directions from the direction of propagation of the pump. Only in a billion blue-photon will undergo such spontaneous parametric down conversion. We have measured coincidence photons with a correlation coefficient of (0)=0.689±0.162 demonstrating that we produced single photons. In addition, we have design a Mach-Zehnder (MZ) interferometer on a kinematic stage. Actuating of the mirrors of the MZ interferometer, we have observed single photon interference with a visibility of V= 0.3. We demonstrated that spontaneous parametrical down-conversion delivers sufficient power for both single photons and coincidence counting. The SPDC contained biphoton states that cannot be attributed to coincidences of the classical field.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

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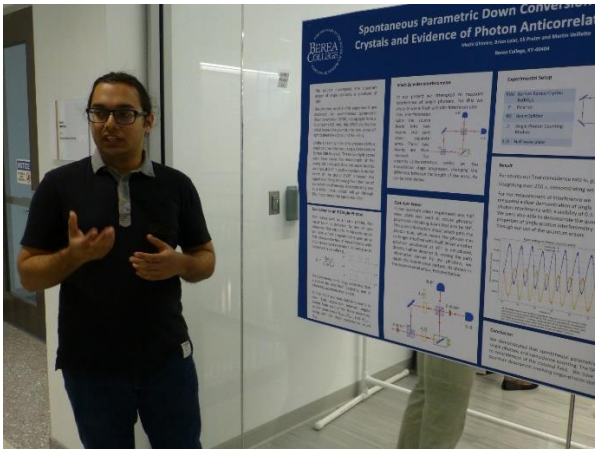

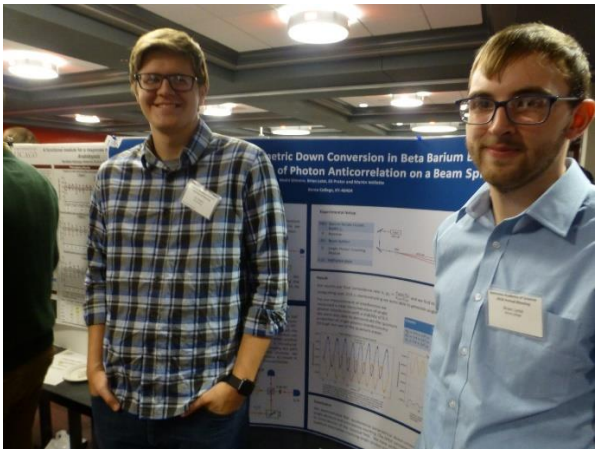

Self-Assembly of Spheres on a Cone Surface. Talha Rehman[1], Nabila Tanjeem[2], and Vinothan N. Manoharan[2]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, Massachusetts, 02138.

Abstract

Self-assembly in a confined space is interesting because the geometrical constraint due to a finite size can lead to unique 3-D structures. We studied self-assembly of submicron-sized colloidal spheres on cone surfaces which have zero Gaussian curvature like cylinders, however unlike cylinders, cones have a varying diameter. Depletion interaction which is a short-ranged between the spheres, and between the spheres and conical surface is responsible for the self-assembly. This assembly would lead to different crystalline structures depending on the ratio of the particle diameter to the cone circumference at a particular length. Since, only a certain number of particles can be accommodated at a particular circumference of the cone, densest packing is achieved by having a defect, which arises from packing constraints when a perfect crystal cannot be accommodated. We manufactured our cones using the 3-D lithography tool called Nanoscribe as well by using micro-pipette puller. Initial results show progress in manufacturing of cone surfaces on which depletion can take place. To improve the crystal lattice on the surface various techniques were explored. We observed crystal growth as well as formation of unique defects.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physics and Astronomy Section)

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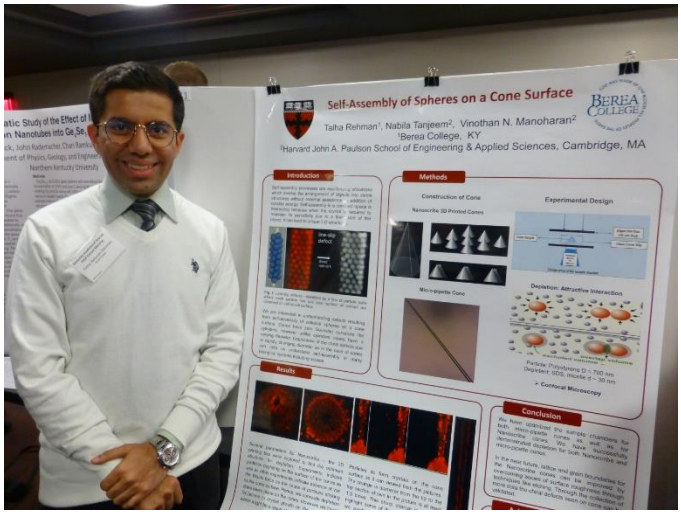

Analyses of Jet Measurements in Relativistic Heavy Ion Collisions. Ricardo Santos[1], Christine Nattrass[2], Soren Sorensen[2], Redmer Bertens[2], James Neuhaus[2], Austin Schmier[2], Jerrica Wilson[2], and Mariah McCreary[2]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]University of Tennessee, Knoxville, Tennessee, 37996.

Abstract

The Quark Gluon Plasma is a state of matter that is formed when heavy ions collide at relativistic speeds. These collisions are conducted at the Large Hadron Collider (LHC) in Geneva, Switzerland. Detectors such as ALICE (A Large Ion Collider Experiment) are used to capture details of the progression of the medium since the QGP only occurs for a fraction of a second. The way to study the medium is to observe jets, collimated sprays of high energy particles created by partons which have traversed through the QGP. The measurement of jet suppression further confirms expectations of the nuclear modification factor using different approaches of jet quenching. Charged jet suppression provides information on the differences between different resolutions parameters used to observe the collision. Experimental analyses were implemented in the RIVET framework to make systematic comparisons between data and Monte Carlo models developed by the JETSCAPE collaboration. The implementation of the jet measurements in the RIVET framework will be presented.

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Funded by Berea College Office of Internships and Career Development

Investigating the Efficacy of Histotripsy on Drug Delivery. Heather Thompson[1], Benjamin Wollant[2], and Kenneth Bader[3]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]St. Olaf College, Northfield, Minnesota, 55057. [3]University of Chicago, Chicago, Illinois, 60637.

Abstract

In recent studies, therapeutic ultrasound has the potential to be developed into a non-invasive tool that can be used to advance therapeutic drugs into cancerous tissue and deep-vein thrombi using histotripsy, a focused ultrasound that uses microbubbles. Using the mechanical action of microbubble clouds produced by histotripsy, we hypothesized that such action will improve drug delivery methods by increasing penetration and diffusion of therapeutic drugs. The effects of histotripsy on drug-delivery was investigated by administering Evans Blue Dye through a flow loop located in an in vivo agar phantom. The agar phantom was used to mimic the tissue-fluid interface between thrombi and blood within a vessel. The phantom was subjected to an ultrasound that produced different peak negative pressures with the same pulse duration and frequencies in order to produce microbubbles. Dye was administered to model the diffusion of chemotherapeutic or thrombolytic agents in order to indicate the effect of histotripsy on the diffusion. A camera was used to document the diffusion of dye throughout the flow phantom in order to quantify the extent of drug delivery. Modeling the perfusion of therapeutic drugs proved to be inconclusive given the noise present from the passive diffusion of the dye although a tunneling phenomenon was observed. Quantifying the extent of drug delivery is a fundamental step in understanding the means by which histotripsy can be used to improve treatment of disease pathologies such as deep vein thrombosis and cancer.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Poster Presentation)

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physics and Astronomy Section)

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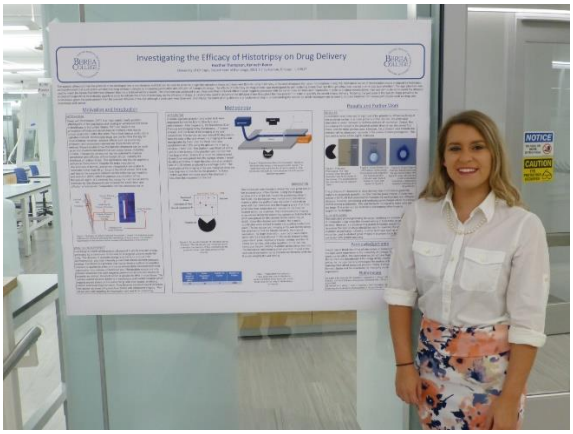
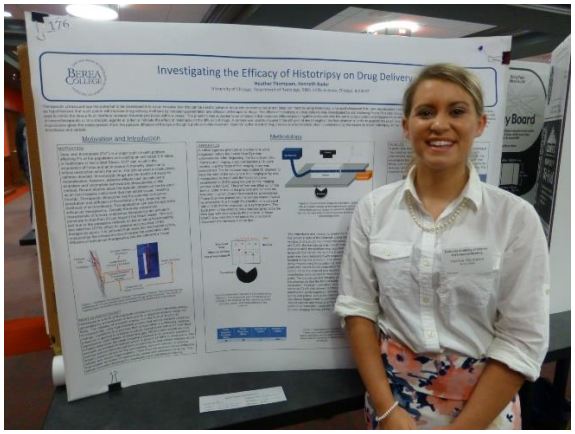




Improving Accuracy of Parity Violation Measurements for NOPTREX Experiment at LANL. Daniela Olivera Velarde[1], Danielle Schaper[2], and Christopher Crawford[2]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

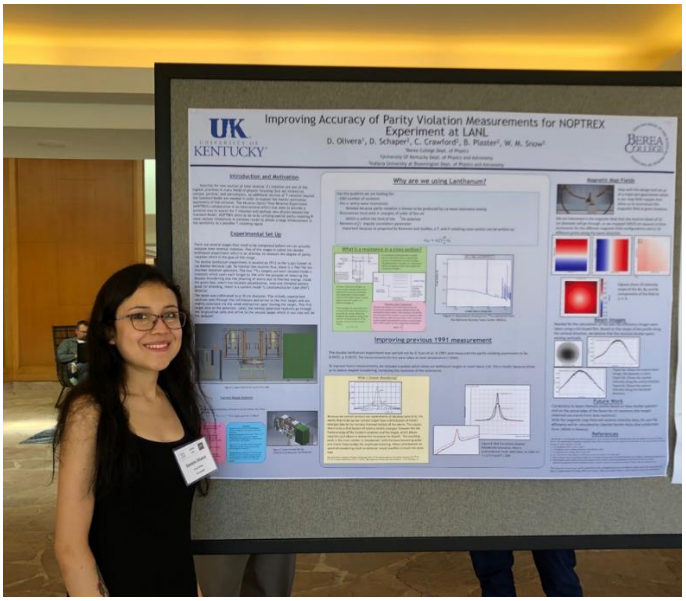
The main goal of the Neutron Optics Time Reversal Experiment is to look for new sources of time reversal (T), which could explain the matter/antimatter asymmetry in the universe. As part of our search, we need higher (within 1%) accuracy measurements of the parity-violating spin-dependent forward neutron scattering amplitude in La-139 and other nuclei, which share the same matrix element as time-reversal odd amplitudes. Since lanthanum has a large (~10%) PV transmission asymmetry, we can use it as both the polarizer and target (analyzer), which eliminates the tedious measurement of the neutron polarization and associated systematic uncertainties that accompany the use of a traditional 3He polarizer. This presentation will discuss the magnetic field mapping techniques, the analysis of the beam intensity profiles (necessary to calculate the neutron spin-flip efficiency) of data collected at Los Alamos National Lab.

18th Annual Berea College Undergraduate Research Symposium, October 19-20, 2018, Berea College, Berea, Kentucky (Oral Presentation)

Fifth Joint Meeting of the Nuclear Physics Divisions of the American Physical Society and Japanese Physical Society, October 23-27, 2018, Waikoloa Village, Hawaii

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Physics and Astronomy Section)

Funded by the US National Science Foundation under award OIA-1355438 and the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under Award Number DE-SC0014622.



Appraisal: The Effect of Electronic Media on Decision Making. Yabsira Ayele, Aaron Clark, Dave Porter, and Rob Smith. Psychology Department, Berea College, Berea, Kentucky, 40404.

Abstract

Social norms have primed most of humanity to behave pro-socially even when it is irrational. With the rise of technology some social norms have been subverted. Electronic media can enhance or subvert social cues and norms, this research studies the effect of electronic media on social norms that influence appraisal and decision making through the use of the Prisoners' Dilemma. Thirty undergraduate students all from low to middle class social economic background participated in an iteration of the Prisoner's Dilemma for the opportunity to win a cash prize. The participants were divided into three conditions - text, video conference, or face to face. The participants communicated via the media with a confederate, tasked with showing signs of compliance, for no longer than five minutes. At the end of five minutes participants made the decision to cooperate and or defect. The results for defecting behavior were not analyzable because of the unbalanced groups. Out of the entire sample, only three participants defected. However, there was a significant difference in the level of confidence in appraisal between text and video, as well as text and face to face. The results indicate that the most accurate and confident appraisals on average are made in the video condition. Future research should change reward structure to find differences in decision making behavior and encompass a more economically diverse research sample.

104th Annual Meeting of the Kentucky Academy of Science, November 2-3, 2018, Western Kentucky University, Bowling Green, Kentucky (Poster Presentation-Psychology Section: 2nd place Undergraduate Research Competition)

Senior Psychology Capstone Project

Sustaining Attention: The Effects of Fidgeting and Break Type. Briana Beckler. Psychology Department, Berea College, Berea, Kentucky, 40404.

Abstract

The responsibility of holding attention to a task is one that experienced by nearly every person at some point. That holding attention to tasks becomes more difficult as time passes is known as vigilance decrement and considerable research has been dedicated to alleviating this circumstance. While breaks have been found to do this, nature breaks may have a restorative effect unlike other breaks. Additionally, the creation of attentional tools such as fidget devices depend on perceptual load theory to support the positive effects of fidgeting on attention. Can perceptual load theory be used to develop tools to improve attention? To answer these questions, 26 Berea College students participated in a study with 3 fidget device conditions and 2 break type conditions. Results showed no difference in scores between nature and video game conditions. Results showed that people in the puzzle condition scored significantly worse than the cube and control conditions, who had very little difference between them. While the evidence shows that break types do not affect attention differently and perceptual fidgets do not improve attention, further research may want to look deeper into this issue.

Senior Psychology Capstone Project