Winter Scene From Peachbloom Hill, Berea, Kentucky (Artist: Lisa Jones)

Berea College Undergraduate Research Abstract Journal 2019

INTRODUCTION

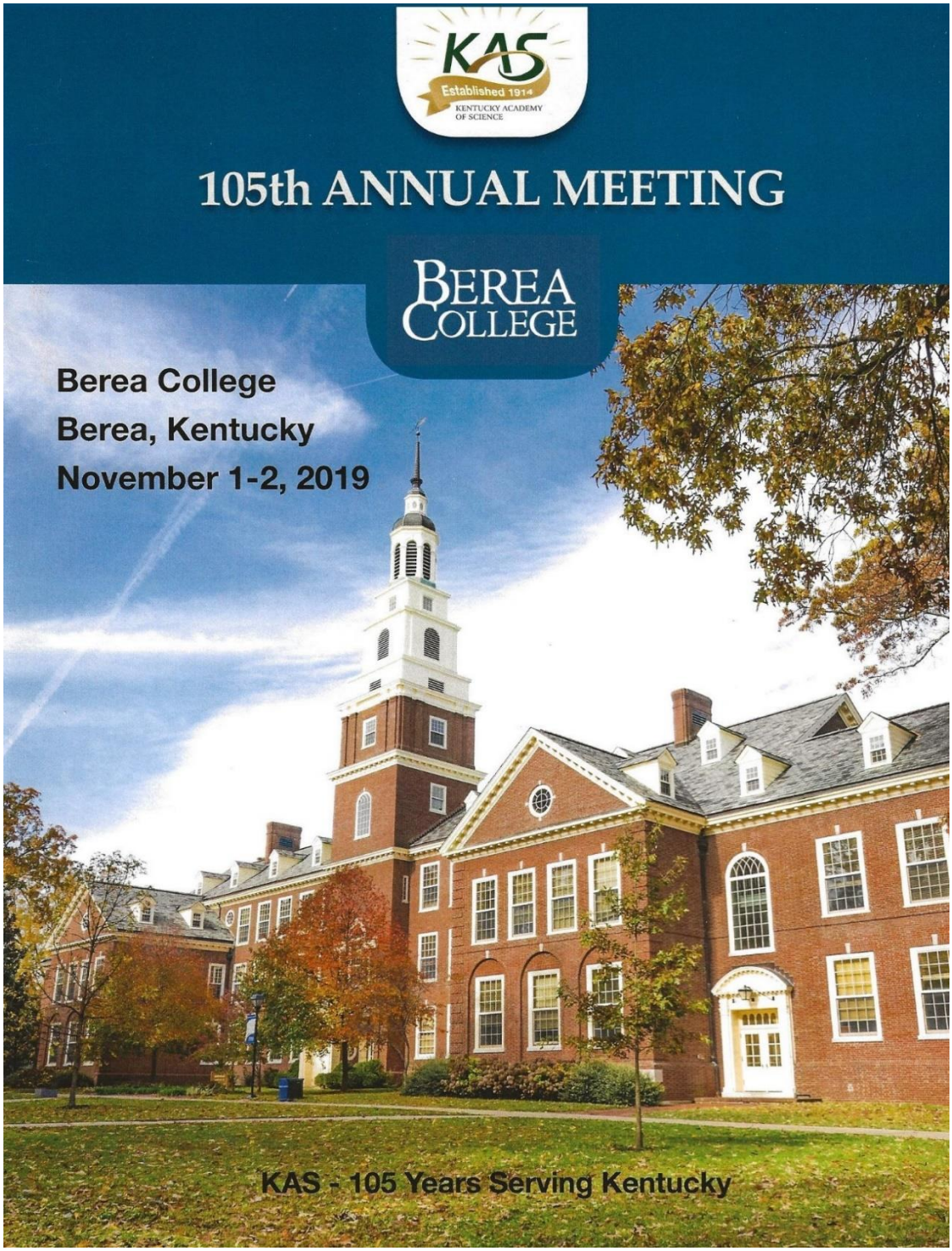
Editors: Jennifer Bentz (Senior Biology Major), Marranne Conge (Junior Biology Major) and Ronald B. Rosen (Professor of Biology)

This 14th (2019) issue of the "Berea College Undergraduate Research Abstract Journal" is comprised of 54 abstracts representing majors from 13 different Berea academic programs this year including Agriculture and Natural Resources {1}, Art and Art History {1}, Biology {15}, Chemistry {14}, Child and Family Studies {1 }, Computer Science {5}, Education Studies {1}, English {1}, Health and Human Performance {4}, Mathematics {1}, Physics {7}, Psychology {2} and Technology and Applied Design {1}. Twenty-nine of these abstracts represent research conducted on-campus with Berea College Faculty mentors. The common theme to the research presented in these abstracts is that the: (1) original proposal was peer-reviewed and/or (2) work was subsequently presented by undergraduates at on and/or off-campus meetings. Several projects were funded by academic departments; most on-campus research (23) 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 19th Berea Undergraduate Research Symposium (BURS) on October 18, 2019. Dr. Jessie Dotson, K2 Project Scientist, Ames Research Center, NASA, provided the plenary talk for this event entitled, "NASA's First Exoplanet Finding Mission – Kepler/K2." In the Appendix is a listing of 39 work internships that were also presented at BURS this year. A number of the research projects were subsequently presented at the 105th Annual Meeting of the Kentucky Academy of Science at Berea College where Berea students earned 17 awards (11 first place, 3 second place and 3 third place). This was the first time Berea College has hosted the meeting since 1954 when they jointly held the meeting with the University of Louisville. 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 Matt Saderholm, 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 and Sarah Broomfield for coordinating the URCPP 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. Additionally, we would like to acknowledge Lisa Jones (Mathematics Major – Class of 1983) for the original cover art. Finally, we would like to thank all the off-campus mentors at the following institutions/organizations for supporting Berea students during the summer of 2019 (number of Berea students in brackets): California Institute of Technology {1}, Johns Hopkins University School of Medicine {1}, Oak Ridge National Laboratory {2}, Ohio State University {1}, Smithsonian Institution {1}, University of Colorado Denver – Anschutz Medical Campus {2},

University of Illinois {1}, University of Kentucky {3}, University of Oklahoma {1}, University of Pennsylvania {1}, University of South Carolina {1}, and Vanderbilt University {10}. Special thanks to Berea alumni including Drs. Dennis Roop (University of Colorado, Denver) and Vanderbilt University faculty Drs. Julie Hudson, Billy Hudson, Roy Zent, Andre Churchwell and Kimberly Vinson for facilitating research opportunities at their respective institutions for Berea College students.



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Psychology Department

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Effects of Feeding Haylage on the Reproductive Performance of 2 Year Old Beef Cattle Raised in a Sustainable Production System at Berea College Farm. Sarah Whitaker[1], Celine Skrivanek[1], Esther Olabisi-Adeniyi[1], Marlon Knights[2], and Quinn Baptiste[3]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]BAFT, University of Trinidad and Tobago, Trinidad. [3]Agriculture and Natural Resources Department, Berea College, Berea, Kentucky, 40404.

Abstract

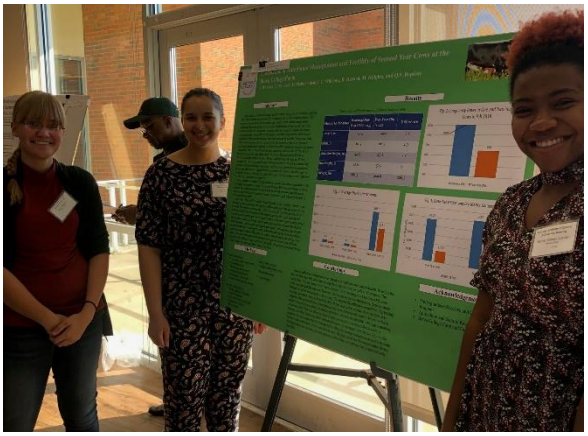
This research project focused on investigating the effects of feeding haylage (a high fiber feed) on the growth and reproductive performance of cattle that were raised in a sustainable production system at Berea College Farm. We completed weight and frame measurements of cattle (n =75) to analyze five years (2015 to 2019) of cattle growth and reproductive performance records. Consequently, we categorized cattle into four groups based on the year in which they either turned 2 years old (2017, 2018 and 2019) or will turn 2 years old (2020). The only group of cattle that were not fed haylage is 2017. Analyzed data suggest that the gastrointestinal tract of adult cattle managed in our sustainable production systems functions essentially as a young cattle gastrointestinal tract well into adulthood. Perceivably, the maintenance of specific anatomical functions into adulthood is the key feature which supports rapid movement of highly fermentable grains or immature fresh forage from the stomach for efficient intestinal digestion of non-fibrous feed materials. Indeed, two year old cattle fecal dry matter was low (12.45 %) but contained high fiber levels (NDF, 51.52 %), indicating the high moisture content of spring pasture forages but low fiber digestibility of the forage consumed. In comparison year old cattle fecal dry matter was also low (12.60 %) and fiber levels (NDF, 49.36 %) were also high. Hence, we perceive that the development of the digestive system between yearlings (young) and two year old (adult) is not vast, primarily because of our nutritional management approaches. The latter is good, because it supports the most efficient digestion of available fresh forages when it is grazed or fed as haylage during the winter period. Thus, switching to high fiber feed during the winter period is not advisable. In accordance the recent decision of Berea College Farm to feed low fiber haylage rather than hay during the winter positively impacted the development of both young (yearling) and two year old cattle. Indeed, despite similar birth weights, weaning and yearling weights were numerically higher in 2018 and 2019 compared to that of 2017 cattle. Similarly, even higher weaning and yearling weights were observed in 2020 versus the 2017 cattle. Additionally, 2018 but not 2019 cattle had higher liveweights than 2017 cattle at first pregnancy check. At the 2nd breeding, 2018 cattle maintained numerically higher weights than those of 2019. This apparent effect of feeding haylage on liveweight was apparently attributed to increases in girth. Plausibly, growth performance also affected reproductive performance. The weights of 2018 cattle was higher than that of 2017 cattle at the first pregnancy check but this difference was reversed in the following year at the second pregnancy check. Consequently, pregnancy rates at the first pregnancy check did not differ (89.47 vs 91.67 %) but numerically lower retention (31.8 vs 50 % and pregnancy rates (50 vs 75 %) were observed for 2018 cattle than 2017 cattle by the second pregnancy check, respectively. Arguably, these cattle may have experienced early embryo/pregnancy losses because rates of gain declined throughout the summer in both groups (2017 and 2018), and to a greater extent in haylage fed cattle (2018). Indeed, the current

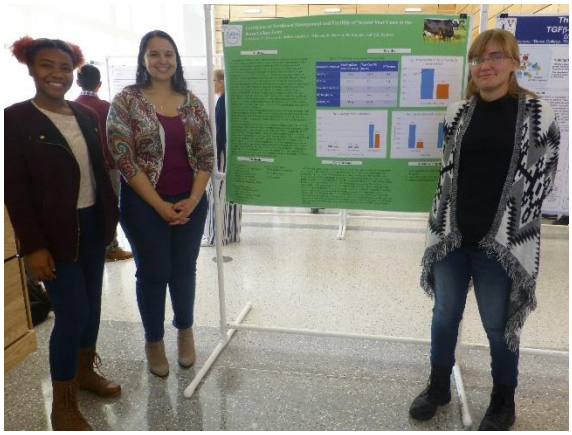
liveweight data on the 2019 cattle at second breeding suggest that their rates of gain may already be declining. Apparently, the higher rates of gain attained on haylage and spring grasses were not sustainable on summer forages in the 2nd year of breeding when using our nutritional management approaches. Nevertheless, approximately 50% of the 2019 cattle were observed to be in standing estrus before the introduction of the bull. Interestingly, this number is comparable to the 55% of the 2018 cattle that were detected with small to medium size follicles (another indicator of fertility). Furthermore, 92 % of the 2019 cattle had progesterone hormone concentrations which indicated a return to reproductive functions after calving, even before introduction of the bull to the herd. Additionally, 91 % of the 2019 cattle showed a positive response, indicating a high conception rate when estrus detection patches were used while they were exposed to the bull. Overall these results are encouraging and supportive of the continued use of haylage for developing replacement cattle and supporting high fertility in two year old cattle.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Agricultural Sciences Section: 1st Place Undergraduate Research Competition)

Funded by Berea College URCPP





Towards Exhibiting the Berea College Presidential Portraits. Sophie Bell, Jose Socarras Megan Doherty, and Daniel Feinberg. Art and Art History Department, Berea College, Berea, Kentucky, 40404.

Abstract

A seemingly simple task, to reinstall the Berea College presidential portraits, is actually wrapped up in a complicated dialogue – one that does not exist solely on college campuses, but in museums, academic buildings, and public spaces nationally and globally. How do we make every person who encounters a space feel welcome? How do we return spaces to those who had them taken from them? Internationally, monuments are being toppled, murals are being covered, and buildings are being renamed in response to these questions. Careful consideration of this dialogue has led us to think critically about the reinstallation of our own presidential portraits. Being hung on the wall of a building can give the portraits power over the surrounding space, and, as numerous interviews have revealed, this power dynamic creates an unwelcoming atmosphere for some students, faculty, staff, and visitors more broadly.

Our resulting exhibition, Sharing Space with Authority: Proposals for Installing the Berea College Presidential Portraits, seeks to act as a catalyst for more dialogue surrounding the decolonization of spaces. It will not create a specific solution, but rather will present a methodology that can be used by our institution and other institutions facing a similar conflict. Professors Meghan Doherty and Dan Feinberg have evolved their multi-year research on this topic into this exhibition through reaching out to family members of the presidents, faculty members of other institutions, and students in general studies curriculum. Working alongside two students, they have formulated six proposals to approach this dilemma.

Funded by Berea College URCPP

Overwintering of the Cercaria of the Digenetic Trematode, *Proterometra macrostoma*, within Its Snail Host. Melanie Andrews, Sarah Staat, Yogesh Budhathoki, Bernadette Kwisera, Hannah Jackson, Joseph Mecham, and Ron Rosen. Biology Department, Berea College, Berea, Kentucky, 40404.

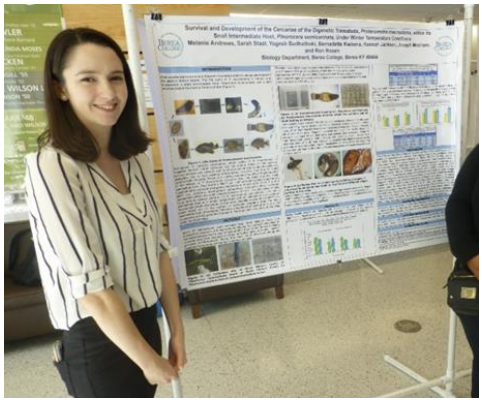
Abstract

Proterometra macrostoma is a digenetic trematode which is widely distributed in the eastern United States. The objectives of this study were to assess: (1) survival of intramolluscan stages (i.e., rediae and cercariae) of this trematode at a winter temperature and (2) whether or not cercarial development inside the redia ceases at or below its MDTT (minimum development temperature threshold; 10-12° C). Naturally infected snails were collected from North Elkhorn Creek. Baseline cercarial emergence was recorded over 7 days at 20° C for three replicates of 19 infected snails each. Replicates were then maintained at 7.5° C for 28 days followed by a post-cold treatment analysis of cercarial emergence over 7 days at 20° C. Approximately 95% (52/55) of infected snails shed cercariae following both the pre- and post-cold treatments, and significantly more cercariae were released/snail/7days following the post-cold treatment compared to the pre-cold treatment in two of the three replicates. No significant differences were found in the average number of the four cercarial stages within rediae pre- vs. post-cold treatment. These results suggest that during winter months there is no loss of infection with some further maturation of the Stage IV cercariae as indicated by our cercarial emergence data and not detectable by our staging criteria

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Zoology Section: 1st Place Undergraduate Research Competition)

Funded by Berea College URCPP



On the DNA and mRNA Mechanism of Low Glucose-Induced CD8T Cell's and NK Cell's Production of Cytokines. Austin Applegate[1], Charlie Lutz[2], and Steve Presnell[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

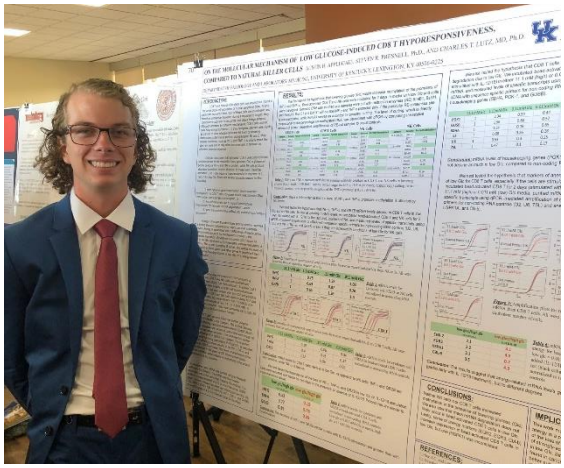
Abstract

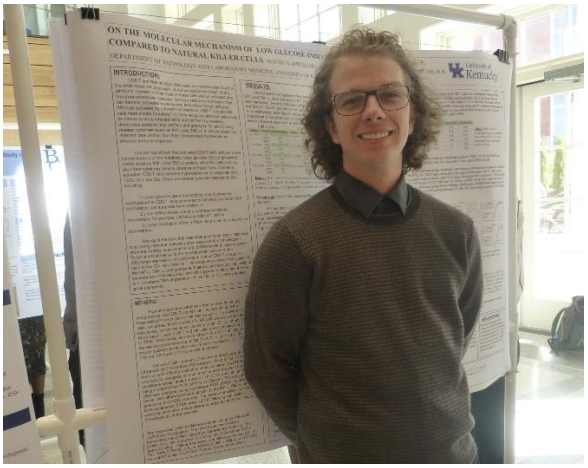
CD8 T cells cultured in low concentrations of the metabolic fuels of glucose or glutamine have deficient INF-g and TNF-a protein production, while NK cells do not. Therefore, activated CD8 T cells become hypo-responsive in their IL12/IL-18 induced cytokine secretion in low glucose. To understand the mechanisms behind this phenomenon we: 1.) investigated promoter methylation of the INF-g, TNF-a, and granzyme B genes, and analyzed the levels of transcription of these genes and other genes to determine if there was methylation of the respective sites. 2.) We investigated if there was massive RNA degradation in low glucose. 3.) We checked signs of low glucose-mediated anergy. What we found was that in both NK and CD8 T cells, we saw that the promoters responsible for cytokine production do not have increased methylation in the presence of lowering glucose. We also saw that mass mRNA degradation did not likely occur in bead-activated CD8 T cells in low glucose. Lastly, we saw that some of the markers for anergy that we tested (EGR2, EGR3, Cbl-b) increased expression in bead-activated CD8 T cells in low glucose, but one (HSPA1) did not.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Microbiology Section: 3rd Place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development





Plasticity of the Mesencephalic Neural Crest to Differentiate into Cardiac Neural Crest. Rodrigo Alcaraz Bogado[1], Marianne Bronner[2], and Maxellende Ezin[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]California Institute of Technology, Pasadena, California, 91125.

Abstract

The neural crest is an embryonic cell population that gives rise to a variety of structures of the developing vertebrate embryo. The cardiac crest is a subdivision of the neural crest, and its disturbance may result in failure of heart septation and other of congenital heart diseases. Earlier work showed that the mesencephalic neural crest from late stage 10 embryonic development is unable to form cardiac neural crest derivatives. The present work tests and shows that the mesencephalic neural crest from early stage 7 is capable of forming cardiac neural crest derivatives. The mesencephalic crest was extirpated from transgenic donor chicken embryos at stage 7 or 10 and reserved. Subsequently, the ablated cardiac crest of stage 10 hosts was replaced with this mesencephalic neural crest graft. The grafted host embryos were re-incubated until stage 14 or Embryonic Day 6. Our preliminary research findings showed that the mesencephalic neural crest from stage 7 or 10 donors has the ability to migrate as cardiac crest cells by stage 14. In addition, the mesencephalic crest cells from stage 7 expresses the cardiac neural crest gene MafB. Lastly, the mesencephalic crest from stage 7 successfully populated the aorticopulmonary septum of the heart and expressed the cardiac marker smooth muscle actin, suggesting that the mesencephalic neural crest reprogrammed into cardiac neural crest. These results reflect the plasticity of the mesencephalic neural crest from stage 7 versus stage 10, implying that crest cell plasticity gradually decreases during neurulation, ending before organogenesis. Future directions focus on identifying molecular players that regulate plasticity.

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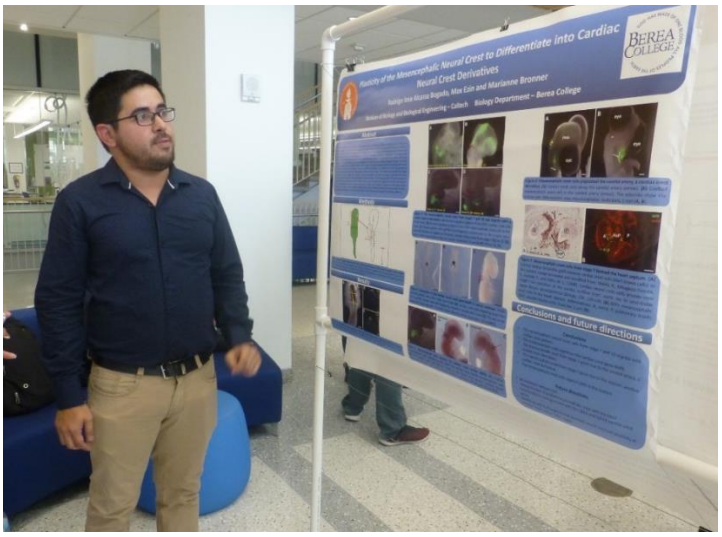


Targeting Endogenous Genes in Human Induced Pluripotent Stem Cells Using CRISPR/Cas9 (DNMT3B, KRT5, and KRT18). Yacine Choutri. Biology Department, Berea College, Berea, Kentucky, 40404. (Center for Regenerative Medicine and Stem Cell Biology, University of Colorado, Denver, 80045).

Abstract

One of the challenges in stem biology is searching for methods to differentiate iPSCs into specialized cells. It is valuable to monitor this differentiation in real-time. This can be achieved using several markers, and in our project, we used three marker genes: DNMT3B, KRT5, and KRT18. DNMT3B is a marker of pluripotency, KRT18 is a marker of premature keratinocytes, and KRT5 is a marker of differentiated keratinocytes. The differential expression of these genes was observed using three fluorescent reporters: BFP, tdTomato, and 3xWasabi, respectively. We constructed a targeting vector for each marker gene that had three elements. First, homology arms to increase the gene-targeting efficiency, and they were constructed from genomic DNA through PCR reactions. Second, a fluorescent reporter whose expression correlates with the expression of the marker gene. Third, a selection cassette to help identify a successful knock-in event. To assemble our targeting vector, we first digested the plasmid backbone, and then performed a Hifi-DNA assembly. These reactions were confirmed through gel electrophoresis. Our targeting vector was then amplified through bacterial transformation and plasmid prep, and characterized by Sanger sequencing. Three targeting vectors were constructed: DNMT3B(BFP), KRT18(tdTomato), and KRT5(3xWasabi). In the next step, the targeting vector was knocked-in into the specific locus of the endogenous marker gene within iC4-4 iPSCs. The gene-editing was achieved using CRISPR/Cas9 technique and nucleofection. We were able to identify the DNMT3B(BFP)+ cells using fluorescence microscopy and isolate them using flow cytometry. These cells were expanded for future use in human disease modeling.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Cellular & Molecular Biology Section)

Funded by Berea College Office of Internships and Career Development

Inclusion of Alkyl-amino Side-chains Improves Potency of Poly(beta-amino ester) Nanoparticle Delivery of Nucleic Acids. Marranne Conge[1], David Wilson[2], and Jordan Green[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Johns Hopkins University School of Medicine, Baltimore, Maryland, 21205.

Abstract

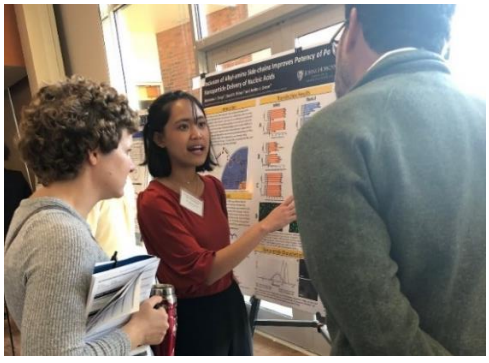
Gene therapy has the potential to effectively cure many diseases, however, there are certain challenges associated with delivering nucleic acids. Polymer poly(beta-amino ester)s (PBAEs) are a promising class of cationic polymers that are both effective for gene delivery and safe due to rapid degradation. By modulating the hydrophobicity of PBAEs, we aimed to increase nucleic acid encapsulation, and promote cellular endocytosis and endosomal escape. To achieve this, we synthesized PBAEs using amine monomers of differing alkyl side chain lengths in DMF using a Michael addition reaction followed by end-capping and ether precipitation. After synthesis of the PBAEs, the polymers and green fluorescent protein (GFP) mRNA/plasmid were mixed to form nanoparticles, which were then incubated with B16-F10 cells for 24 hours. We found that the incorporation of the hydrophobic amine groups in the polymer increased transfection efficacy (assessed a percentage of cells expressing GFP) for both mRNA and plasmid DNA compared to equivalent PBAEs with no hydrophobic amine groups. The degree of GFP expression in mRNA delivery was highest with the polymer incorporated with 1-dodecylamine. As for plasmid delivery, the more hydrophobic the polymer, the higher the degree of expression. Cell viability is not affected by the incorporation of the hydrophobic amine groups at the doses tested.

Johns Hopkins C.A.R.E.S. (Career, Academic, and Research Experiences for Students), July 25, 2019, Baltimore, Maryland

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Cellular & Molecular Biology Section: 1st Place Undergraduate Research Competition)

Funded by the National Science Foundation and Johns Hopkins Institute of Nanobiotechnology



One-Carbon Metabolism Biomarkers and Risk of Barrett's Esophagus and Esophageal Adenocarcinoma. Maria Alejandra Hernandez Diaz[1], Teodoro Bottiglieri[2], Helen G. Coleman[3], Conrad Wagner[4], Xiangzhu Zhu[4], Chang Yu[4], and Martha Shrubsole[4]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Baylor Institute of Metabolic Disease, Dallas, Texas, 75226. [3]Queen's University Belfast, Belfast, Northern Ireland. [4]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

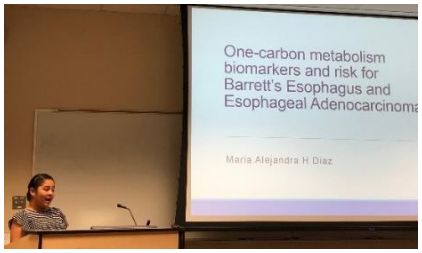
Esophageal adenocarcinoma (EAC) is a cancer that has had a substantial increase in incidence in the United States. Although it is the sixth most common cause of cancer death worldwide, its etiology is not yet clear. Most EAC develops from a condition known as Barrett's esophagus (BE), characterized by metaplasia of the cells that make up the internal lining of the esophagus. However, not all cases of BE develop into EAC and it is imperative to identify the factors that contribute to the metaplasia-dysplasia-carcinoma sequence that is thought to give rise to EAC. Evidence suggests an inverse association between one-carbon metabolism --the set of reactions that mediate amino acid and nucleotide metabolism through the transfer of one-carbon groups-- and risk of esophageal carcinogenesis because of its role in DNA methylation that can affect gene expression and contribute to the progression from BE to EAC. This study evaluated the associations between multiple metabolites of one-carbon metabolism (S-adenosylmethionine (SAM), S-adenosylhomocysteine (SAH), methionine, total homocysteine, betaine, choline, cystathionine, methylenetetrahydrofolate (MTHF), and pyridoxal-5-phosphate (PLP)) and risks of BE and EAC using a case-control study from Ireland (n=259 controls, n=218 BE cases and n=208 EAC cases). Stable-isotope dilution liquid chromatography-electrospray tandem mass spectrometry (LC-ESI-MS/MS) was used to determine plasma levels of metabolites. Logistic regression analysis was used to calculate odds ratios and 95% CI. After adjusting for confounders, the highest plasma level of PLP was associated with a substantially reduced risk of EAC (OR 0.12; 95% CI 0.04, 0.30) compared with the lowest level. High plasma levels of methionine, choline, and betaine were associated with 60-80% reduced risk of EAC. Low levels of SAM and cystathionine decreased risk of EAC. No significant association was observed with BE.

17th Annual Vanderbilt Summer Science Academy Student Research Symposium, August 1, 2019, Nashville, Tennessee

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section)

Funded by Vanderbilt University Pipeline Program



Disruption of the R789-D708 Salt Bridge in Discoidin Domain Receptor 1 to Test Its Effect on the Kinase Activity of the Full-Length Receptor. Sangyal Dorjee[1], Corina Borza[2], and Ambra Pozzi[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

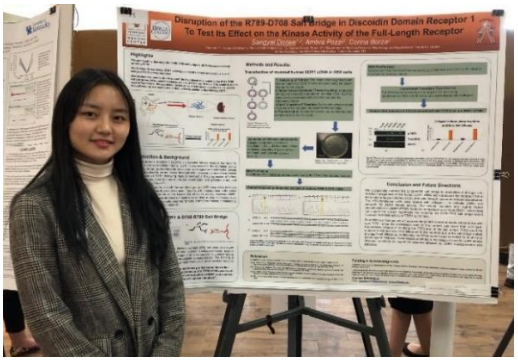
Discoidin domain receptor 1 (DDR1) is a tyrosine kinase receptor that binds to collagen, an extracellular matrix component. DDR1 regulates fundamental cellular functions in tissue development, however, increased expression and activation of DDR1 following injury contributes to the progression of fibrosis and chronic kidney disease. As such, DDR1 may be a viable therapeutic target. Importantly, this receptor shows promiscuity towards kinase inhibitors making it challenging to design selective DDR1 inhibitors. A current hypothesis is that DDR1 is less active and more promiscuous than other receptor tyrosine kinases due to the R789-D708 conserved salt bridge that stabilizes the inactive conformation of DDR1 and enables it to bind both type I (active) and type II (inactive) kinase inhibitors. We tested this hypothesis by mutating D708 to N in order to destabilize the salt bridge through site-directed mutagenesis of the human DDR1 cDNA and introduced the mutated DNA in the human embryonic kidney (HEK) 293 cells through liposomal transient transfection. The HEK-transfected cells were treated with collagen I, to activate DDR1, and analyzed for DDR1 kinase activity. The results indicated only slightly higher phosphorylation in DDR1-D708N mutant in comparison to wild type DDR1, which does not support the current hypothesis. To confirm our findings, we will express the D708N mutant at levels similar to the wild type DDR1 since the expression level of this mutant was lower than wild type.

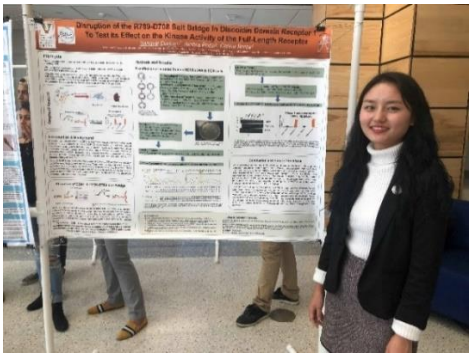
KUH Summer Undergraduate Research Conference, July 31 - August 2, 2019, Vanderbilt University, Nashville, Tennessee (Poster Presentation)

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Physiology & Biochemistry Section)

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





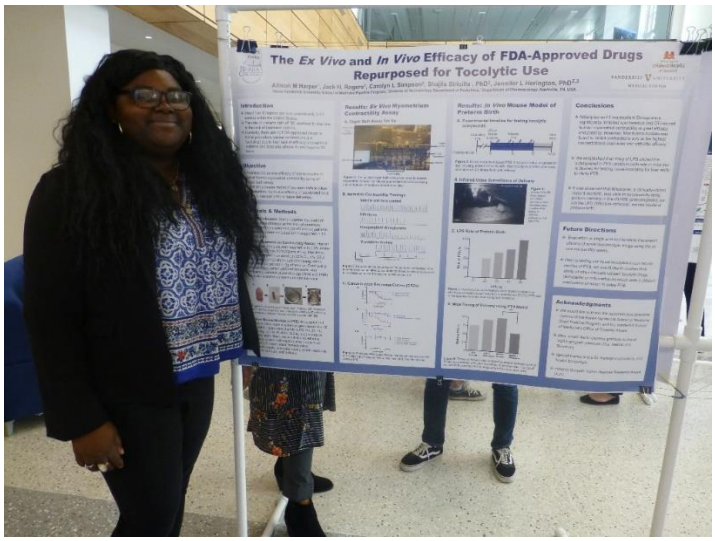
Examining the Ex Vivo and In Vivo Efficacy of FDA-Approved Drugs Repurposed for Tocolytic Use. Allison M Harper[1], Jack H. Rogers[2], Carolyn L Simpson[2], Shajila Siricilla[2], and Jennifer L. Herington[2,3]. [1]Biology Department, Berea College, Berea, KY 40404. [2]Division of Neonatology Department of Pediatrics, Vanderbilt University, Nashville, Tennessee, 37232. [3]Department of Pharmacology, Vanderbilt University, Nashville, Tennessee, 37232.

Abstract

Globally, prematurity is the leading cause of death in children under the age of 5 years. Consequently, approximately 1 million children die each year due to complications of pre-term birth (WHO). In humans, Pre-term birth constitutes as any birth prior to the 37 weeks of gestation. The currently administered tocolytic drugs are used off-label and lack FDA-approval due to their lack of efficacy and safety to both mom and fetus. Thus, we previously used a cell-based assay to screen 1,180 FDA-approved drugs for their ability to inhibit in vitro myometrial contractions. The objective of the study is to further test whether our most effective drugs on the cellular level are effective at inhibiting ex vivo uterine contractility and in vivo timing of labor. Human myometrium (uterine) biopsies were obtained at the time of cesarean deliveries at Vanderbilt University Medical Center, The tissue was then utilized in an ex vivo myometrium contractility assay and allowed to spontaneously contract and or induced contractions using 1nM oxytocin prior to receiving increasing concentrations of vehicle tocolytics. At the end of the experiment, tissue viability (using 75 mM of KCl) was examined following the highest concentration of drug. These uterine contractility experiments were recorded and analyzed using LabChart software and Microsoft Excel. Next, an in vivo mouse model of pre-term labor was utilized, which involved day 15 pregnant mice receiving an intraperitoneal injection of LPS in order to induce premature contractility. Then, test tocolytics were administered intravenously. The mice were observed using an infrared video recording in order to record the time of delivery.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Vanderbilt University Pipeline Program



Cercarial Swimming and Distome Emergence from the Tail Chamber in *Proterometra macrostoma* and *Leuceruthrus micropteri*. Hannah Jackson, Melanie Andrews, Sarah Staat, Yogesh Budhathoki, Joseph Mecham, Bernadette Kwisera, and Ron Rosen. Biology Department, Berea College, Berea, Kentucky, 40404.

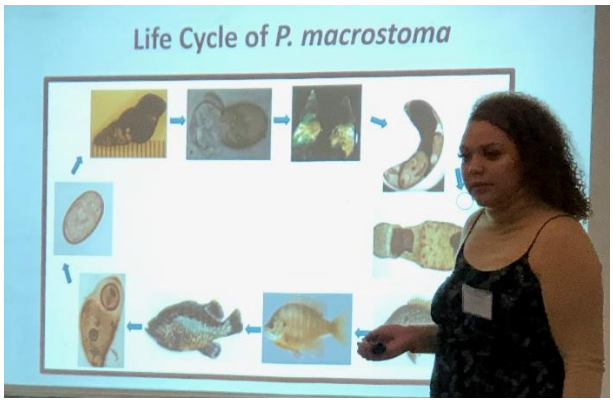
Abstract

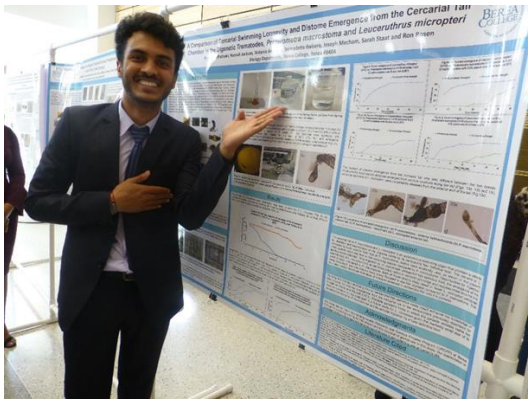
The objective of this study was to investigate factors that might lead to the observed lower intensities of infection of the digenetic trematode, *Leuceruthrus micropteri*, compared to the digenean, *Proterometra macrostoma*, in their centrarchid fish definitive hosts. To assess swimming longevity, freshly emerged cercariae from naturally infected snails were monitored each hour at 20° C in a 50 ml beaker filled with 45 mil of spring water. To stimulate distome release in the fish stomach, freshly emerged cercariae were pipetted into 10 ml beakers with 5 ml of cold-blooded saline adjusted to pH's of 1.5, 2.0 and 2.5 with or without pepsin at 20° C for 60 minutes. No cercariae of *L. micropteri* were observed swimming off the bottom of beakers after 8 hours, while 67% of *P. macrostoma* cercaraie were still swimming after 13 hours. Almost 100% of P. macrostoma distomes were released from their cercarial tail chambers in the six treatments, but the cercariae of *L. micropteri* did not emerge in pH's of 2.0 and 2.5 without pepsin, and release was slower compared to P. macrostoma with the addition of pepsin. These results may partly explain the lower intensities of infection observed in centrarchid fish with *L. micropteri* when compared to *P. macrostoma*.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Zoology Section: 3rd Place Undergraduate Research Competition)

Funded by Berea College URCPP





Differentiation of Induced Pluripotent Stem Cells into Three Germ Layers Using a Trilineage Differentiation Kit. Jharna Katwal[1] and Nicole Diette[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Univeristy of Colorado Anschutz Medical Campus, Aurora, Colorado, 80045.

Abstract

Reprogramming somatic cells into induced pluripotent stem cells (iPSCs) can be achieved through ectopic expression of the OCT4, KLF4, SOX2 and cMYC transcription factors (Yamanaka factors). This process provides an unlimited supply of cells with embryonic stem cell (ESC)-like properties, without the ethical concerns associated with the destruction of a human embryo. The resulting iPSCs have proven to be a promising tool to study human development and disease. Kogut et al. have optimized a protocol to generate iPSCs with the development of a highefficiency RNA-based reprogramming method. Pluripotency refers to the ability of a cell to differentiate into the three primary germ layers of human embryo development- endoderm, mesoderm, and ectoderm. The objective of my research was to validate the differentiation capacity of iPSCs into these three germ layers using a commercially available trilineage differentiation kit. An iPS cell line was cultured, collected, and seeded into germ layer-specific medium provided by the kit. Cells were cultured and allowed to differentiate into endoderm, mesoderm, and ectoderm in their respective medium over a number of days. Immunofluorescent staining using lineage-specific markers was performed, demonstrating successful differentiation of iPSCs into the endoderm, mesoderm, and ectoderm germ layers.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Cellular & Molecular Biology Section)

Funded by Berea College Office of Internships and Career Development

The Cytoplasmic Tail of Integrin β1 is Required for TGFβ-Induced Cell Proliferation in Adenocarcinoma. Sharon Lee[1], Lindsay Venton[2], Allen Luna[2], Scott Haake[2], and Roy Zent[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

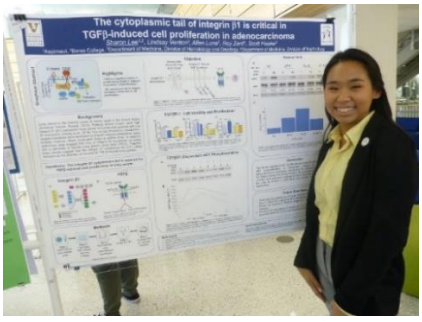
Lung cancer is the leading cause of cancer death in the United States. Patients whose adenocarcinoma have high integrin β1 expression have poorer outcomes than patients with lower β1 expression. Due to this correlation, ectodomain-targeted therapies were developed to prevent integrin-extracellular matrix binding; however, these treatments failed in clinical trials. In addition, preliminary data suggest that loss of integrin β1 expression correlates with a decrease of transforming growth factor beta (TGFβ). Together, these results suggest that the integrin β1 cytoplasmic tail (CT), which therapies do not address, is required for TGFβ-induced tumor growth. To define this mechanism, we used Western blotting techniques to analyze the role of integrin β1 in TGFβ signaling of lung cancer. We exposed TGFβ and TGFβ receptor 1 (TGFβR1) inhibitor to multiple cell lines: TGFβR1 inhibitor in wild type (WT) β1 and TGFβ in β1-knock out (KO) cells that express either a full-length β1 (WT-R), only a functioning tail (Tac-β1), or a non-functional/mutated tail (β1 mt-tail). WT cells, treated with a TGFβ inhibitor, showed a significant decrease in protein kinase B (AKT) activation, a protein that is critical in cell proliferation and non-canonical TGFβ signaling. In addition, WT-R and Tac-β1 cells restored TGFβ-induced AKT activation when compared to KO cells, whereas β1 mt-tail cells failed to rescue AKT activation. These results suggest that the integrin β1 CT is required for TGFβ-induced AKT activation and cell proliferation. This proposes a mechanism of resistance for failed cancer treatments and a new approach for integrin β1 drug therapies.

KUH Summer Undergraduate Research Conference, July 31 - August 2, 2019, Vanderbilt University, Nashville, Tennessee (Poster Presentation)

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Cellular & Molecular Biology Section)

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



Possible Predators (Non-Hosts) of the Digenetic Trematode Cercaria, *Proterometra macrostoma*, at North Elkhorn Creek, KY. Joseph Mecham, Melanie Andrews, Yogesh Budhathoki, Hannah Jackson, Bernadette Kwisera, Sarah Staat, and Ron Rosen. Biology Department, Berea College, Berea, Kentucky, 40404.

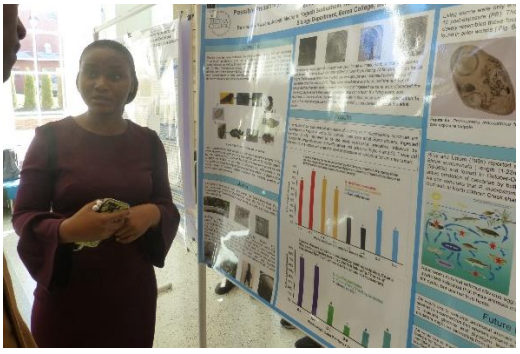
Abstract

The life cycle of the digenetic trematode, *Proterometra macrostoma*, is indirect, incorporating a snail intermediate host (*Pleurocera semicarinata*) and a centrarchid fish definitive host. The large cercaria of *P. macrostoma* engages in sustained cyclical, vertical swimming bursts which is a highly adaptive behavior that promotes ingestion by not only its fish definitive host, but possibly non-host predators as well. The objective of this study was to evaluate possible invertebrate (Red Swamp crayfish, Kentucky River crayfish, dragonfly larvae and damselfly larvae) and vertebrate (adult leopard frogs, bullfrog tadpoles, Cope's Grey Tree Frog tadpoles and mosquito fish) predators of the *P. macrostoma* cercaria. Naturally infected snails shedding *P. macrostoma* cercariae were collected from North Elkhorn Creek, Scott County, Kentucky. Animals were then exposed to two levels of cercaraie less than three hours post-release from their snail hosts for seven hours. All animals, with the exception of adult leopard frogs, ingested cercaria. Crayfish appeared to be the most successful predators, followed by mosquito fish, dragonfly larvae, damselfly larvae and tadpoles, but there was no distinct pattern of predation with regard to level of exposure to cercaria. These results indicate that the cercaria of *P. macrostoma* is likely a significant component of the aquatic food web in North Elkhorn Creek.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Ecology Section: 2nd Place Undergraduate Research Competition)

Funded by Berea College URCPP



Collagen Type IV 7S Provides Novel Insights of Lysyl Oxidase-Like 2 Kinetic Parameters. Aloyce Riziki[1], Roberto Vanacore[2], and Mark Athanason[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

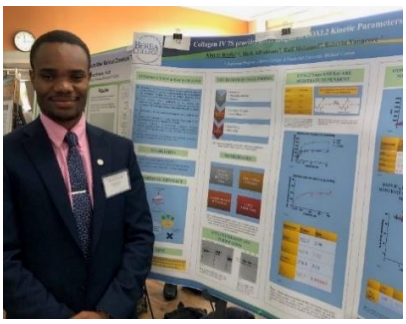
Fibrosis is a common result of disease-related injury in all organs, however, drug therapies to combat fibrosis are lacking. As LOXL2 has a well-documented pathogenic role in many fibrotic diseases, this enzyme has emerged as a strong candidate drug target for the prevention and potential reversal of fibrosis. LOXL2 has been shown to catalyze the formation of covalent cross-links in the 7S dodecameric region of type IV collagen. Currently, small amine-based substrates, are routinely used to determine the enzymatic activity of LOXL2 in the biochemical assays. Here, we hypothesize that a biological substrate, collagen IV 7S purified from a LOXL2 knock-out PFHR9 cell line (L2KO7S), will provide realistic LOXL2 kinetics insights. Active rLOXL2 was purified from HEK293 cell culture media nickel affinity chromatography. Kinetic parameters, of the LOXL2 inhibitor (BAPN) were determined using DAP, DAB, Llysine, and L2KO7S, by use of the amplex red assay. Highly active, pure and specific to substrate human rLOXL2 enzyme was successfully produced. Using both collagenous and small-molecule substrates for the determination of rLOXL2 specific activity suggested a subjective nature of LOXL2 kinetics dependent on the substrate used. The determination of Km and IC50 constants provided unique values; demonstrating that a characterized biological substrate can provide enhanced confidence when determining kinetic parameters of LOXL2 in future biochemical assessments.

KUH Summer Undergraduate Research Conference, July 31 - August 2, 2019, Vanderbilt University, Nashville, Tennessee (Poster Presentation)

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Health Sciences Section: 1st Place Undergraduate Research Competition)

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



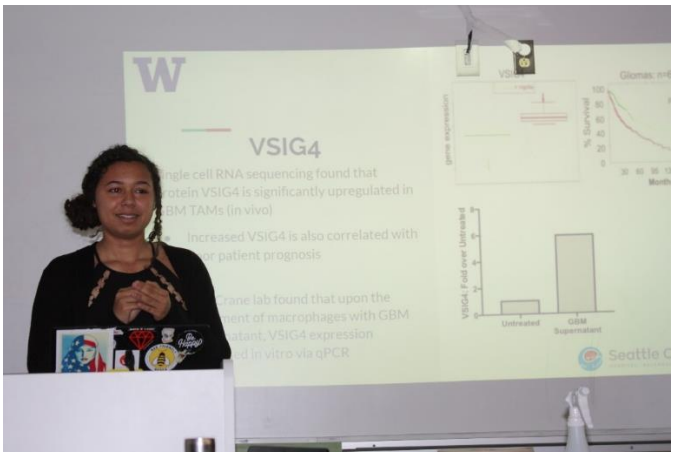
Identifying the Function of VSIG4 as Seen in the Tumor Microenvironment of Glioblastoma. Cienna-Paige Alexandria Slattery[1] and Nicole Lieberman[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Ben Towne Center for Childhood Cancer Research, Seattle Children's Research Institute, Seattle, Washington, 98101.

Abstract

Glioblastoma is the most aggressive primary brain tumor with a five-year survival rate of less than 10%. Due to the intrinsic properties of the tumor, surgeries and immunotherapies have proven to be unsuccessful. In efforts to understand the tumor microenvironment of Glioblastoma, the Crane lab is studying tumor associated macrophages and have determined that protein VSIG4 is significantly upregulated in these cells as a result of polarization by the tumor. Following this finding, we analyzed changes in global gene expression as a result of the upregulation of VSIG4. Our results showed an upregulation of enzyme Glutamine Synthetase and enzyme Glyceraldehyde-3-Phosphate Dehydrogenase, indicating a shift in the cells away from a glucose metabolism into a fatty acid metabolism. This finding defines the mechanism by which tumor associated macrophages are able to survive within the tumor microenvironment of Glioblastoma, and highlights the tumor cells' ability to manipulate surrounding somatic cells into supporting tumor cell proliferation.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

Funded by Berea College Office of Internships and Career Development and the University of Washington



Expression of miR-146a Downregulated Due to Its Promoter Hypermethylation.

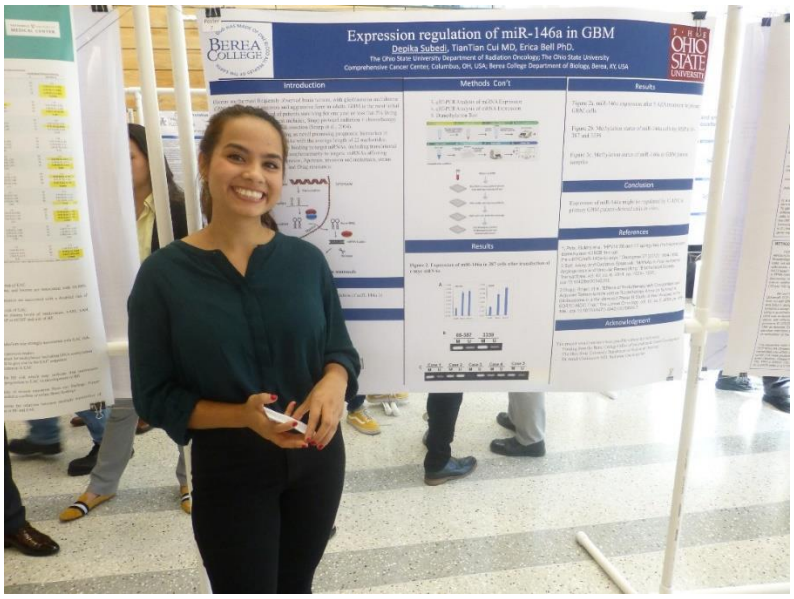
Depika Subedi[1] and Erica Bell[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Ohio State University, Columbus, Ohio, 43210.

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.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development



Synthesis of Thermoelectric Materials with a Parent Compound. Imaru Agholor, Megan Grey, and Mary Robert Garrett. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

The goal of this research was to synthesize tetracenes, a promising compound that when combined with two thio bridges and doped with iodine creates an electron flow due, to the resonance structures in the aromatic rings, to be used as Thermoelectric (TE) materials. TE materials have been used in many aspects of power sources by converting heat to electric energy. Tetracenes with electron-donating groups (EDGs) have already successfully been synthesized at high percent yields; however, electron-withdrawing groups (EWGs) have been less successful due to their nature of keeping electron density to themselves. This has led to difficulties in closing the aromatic ring structures of the synthesized tetracenes. The research team collaborated on a new technique of closing the aromatic rings for electron-neutral, electron-deficient, and electron-rich substrates. Our specific team focused on the neutral substrates by starting with 2-butyne-1,4-diol followed by three reported steps from the literature. The first reaction is synthesizing the diiodo compound which had a 94-98 % yield. Using this compound and an aryl zinc chloride reagent, our next step was to synthesize symmetrical diols which after crystallization had a 2.24-19.5% yield. The final step our team reached was the synthesis of dialdehydes which had one excellent yield of 77%. We were unsuccessful to reach the next step of the tetrachlorides which theoretically would aid in the closing of the aromatic rings, but will continue that work in the future. Each compound was analyzed using infrared (IR) spectroscopy, TLC (thin-layer chromatography), ^{1}H NMR, and ^{13}C NMR (nuclear magnetic resonance) spectroscopy analysis which was cross-referenced with the literature. Subsequent research is planned for the Spring 2020 semester to complete our original research goal.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

The American Chemicals Society 2020 National Conference, March 20-24, 2020, Philadelphia, Pennsylvania (Poster Presentation)

Funded by Berea College URCPP and Kentucky's National Science Foundation Established Program to Stimulate Competitive Research—Research Scholars Program (KY NSF EPSCoR-RSP)

Summer 2019 JEOL ECZR500 NMR Research. Zackary Boothe, Cletus Mbalida, and Jay Baltisberger. Chemistry Department, Berea College, Berea, Kentucky, 40404.

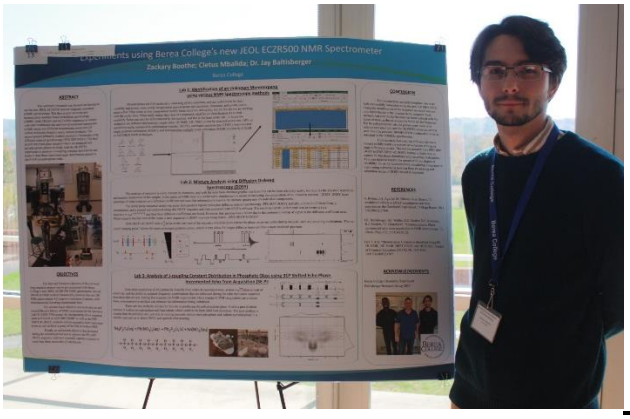
Abstract

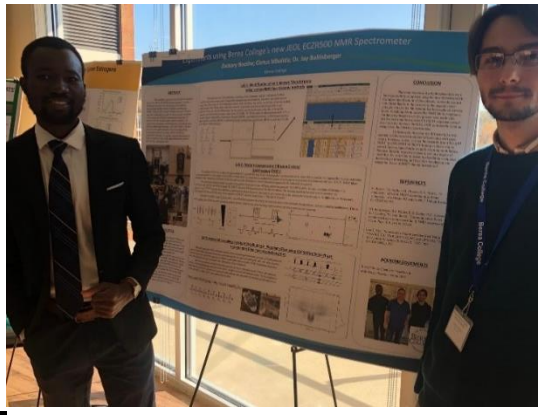
During summer 2019, we spent the last 4 weeks working up at the Ohio State University in the laboratory of Philip Grandinetti (our long-time collaborator). We did some glass research (as I have done in the past) but we mostly focused on learning to use the new JEOL ECZR500 nuclear magnetic resonance (NMR) spectrometer. The first project involved new heteronuclear multiple bond correlation spectroscopy (HMBC, both CIGAR and ACCORD) sequences in concert with other traditional one and two-dimensional experiments to fully assign ten different monoterpene molecules (10 carbon molecules found in many natural products). The HMBC-CIGAR is used to give correlations between hydrogen atoms located 2 or 3 bonds away from a carbon atom in the molecule. This will provide a new experiment to use in my CHM470 course this fall. The second project primarily studied mixtures of molecules using diffusion ordered spectroscopy (PFG-BPP DOSY.) We tried this experiment with two kinds of mixtures, one was a mixture of small organic molecules and the other was a mixture of various polyphosphate anions. In both cases, the various sequences proved challenging to reliably separate the various molecular species. The best sequence was one called ONESHOT-45 which was designed to remove J-coupling modulations from the final data, but even this had phase twisted lineshapes that proved difficult to measure diffusion constants. The third project involved my more traditional glass research where we prepared some lead pyrophosphate glasses to study with the SE-PIETA experiment to measure J-coupling constant distriubtions, and begin to map these onto bond angle distributions present in the P-O-P pyrophosphate units. These sequences were fairly straightforward to port from the old ECX-300 instrument and implement on the ECZR-500.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Chemistry: Analytical & Physical Section: 1st Place Undergraduate Research Competition)

Funded by Berea College URCPP





Investigating HMPV Phosphoprotein Function. Amber Earlywine[1] and Trevor Creamer[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

HMPV is a respiratory virus that effects children, elderly, and those who are immunocompromised. Each year HMPV leads to many children and elderly being hospitalized and can lead to death in severe cases. Creamer and Dutch labs at the University of Kentucky are collaborating on this project to research the mechanisms by which HMPV replicates and spreads. Recently, data has shown that the Phosphoprotein (P protein) has a significant role in HMPV replication. We have identified that the P protein is involved in the formation of inclusion bodies within viral infected cells and these inclusion bodies seem to be a viral replication site. The goal of this project is to identify the function of the P protein in HMPV viral replication and, ultimately, find a way to inhibit replication and viral spread.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Physiology and Biochemistry Section: 2nd Place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development

Mechanism of Quinolone Resistance in 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.

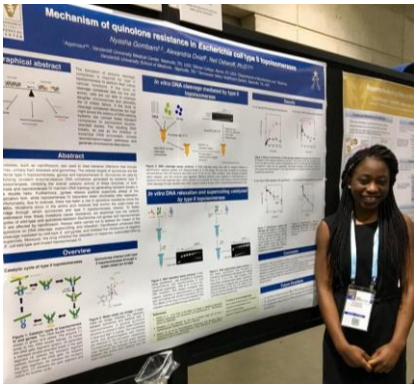
Abstract

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 topoisomerases, 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 quinolone-resistant Escherichia coli gyrase are affected by ciprofloxacin. Assays were carried out to assess the impact of the ciprofloxacin on gyrase-meditated DNA supercoiling and DNA cleavage. Ciprofloxacin demonstrated a greater ability to inhibit the introduction of negative supercoils for wild-type (IC50 ≈17μM) compared to the GyrAS83L drug resistant mutant (IC50 ≈79μM). In contrast, ciprofloxacin was unable to induce DNA cleavage with GyrAS83L gyrase. Based on our findings, we propose that quinolones kill E. coli cells primarily by enhancing enzyme-mediated DNA cleavage but they also rob the cell of the critical catalytic functions of gyrase. Similar studies are currently underway with the Neisseria gonorrhoeae gyrase.

KUH Summer Undergraduate Research Conference, July 31 - August 2, 2019, Vanderbilt University, Nashville, Tennessee (Poster Presentation)

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

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



The Synthesis of Thermoelectric Materials with an Electron Donating Group. Areli Medina Hernandez and Mary Robert Garrett. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

The synthesis of tetracenes with electron-withdrawing groups (EWG) that could possibly act as thermoelectric materials (TMs), is the overarching goal of this research. Thermoelectric materials have the ability to use the free energy from waste heat to create a temperature difference that can then be used to conduct electrical energy. The synthesis of tetracenes with electron-donating groups (EDGs) has been successful in terms of producing them in high yields and in economically friendly ways, yet the synthesis of tetracenes with electron-withdrawing groups (EWGs), such as halogens remains unaccomplished. This specific project focused on the synthesis of tetracenes with electron-donating groups. By demonstrating that this new procedure is effective for substrates with EDGs, it gives hope that EWGs will also be successful. The synthesis of tetracenes was a multi-step project which began with the synthesis of (E)-2, 3-diiodobut-2-ene-1, 4-diol from 2- butyne-1, 4-diol, resulting in a yield of 94-98%. The following step of converting (E)-2, 3-diiodobut-2-ene-1, 4-diol to (E)-2, 3-bis (4-methylbenzyl) but-2-ene-1, 4-diol was done under an atmosphere of nitrogen producing yields ranging from 7% to 49%. The yield was improved as purification and recrystallization techniques improved. The diol was then oxidized into 2, 3-bis (4-methylbenzyl) fumaraldehyde under aerobic conditions with a 74% yield. The identity of all compounds was confirmed using thin layer chromatography (TLC), single pulse 1H and 13C NMR, all which matched the data reported in the literature. The progress of the research stopped with the synthesis of 2, 3-bis (4-methylbenzyl) fumaraldehyde due to time constraints, but upon completion of the research, the possibility of these compounds demonstrating good heat conducting can be examined.

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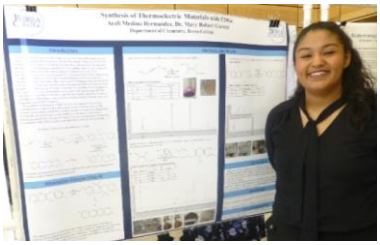


Naphthalenemonoimide Based Fluorescent Chemosensors for Detection of Metal Ions and Anions. Pedro Herrera, Temtsel Och Ulziisaikhan, and Erendra Manandhar. Chemistry Department, Berea College, Berea, Kentucky, 40404.

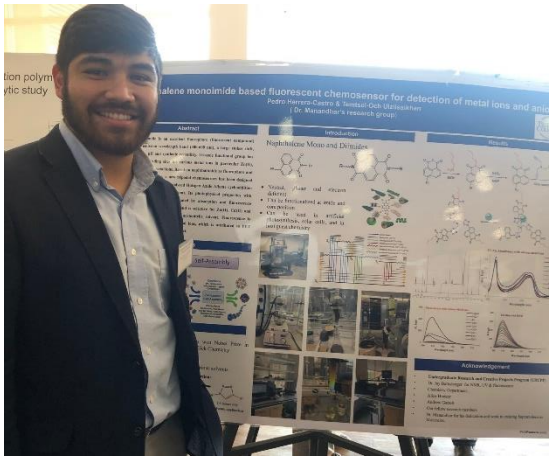
Abstract

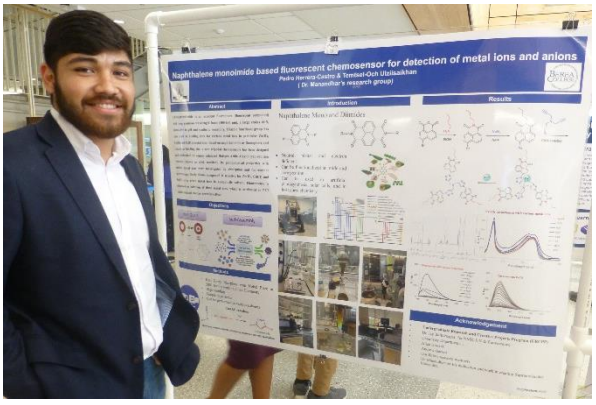
1,8-Naphthalimide is an excellent fluorophore (fluorescent compound) with long emission wavelength band (400-600 nm), a large stokes shift, insensitive to pH and synthetic versatility. Triazole functional group has been used as binding sites for various metal ions, in particular, Zn(II), Cu(II) and Fe(III) metal ions. Based on naphthalimide as fluorophore and triazole as binding site, new tripodal chemosensors have been designed and synthesized by coppercatalyzed Huisgen Azide Alkyne cycloaddition reaction (known as click reaction). Its photophysical properties with various metal ions were investigated by absorption and fluorescence spectroscopy. Study shows compound is selective for Zn(II), Cd(II) and Fe(III) over other metal ions in acetonitrile solvent. Fluorescence is enhanced on the addition of these metal ions, which is attributed to PET (photoinduced electron transfer) effect. Dipicolylamine (DPA) is another common chelating group used for binding of metal ions, in particular, Zn (II) ion. Moreover, DPA-Zn (II) complex has been used for detection of various anions such as pyrophosphate (ppi), adenosine triphosphate (ATP), adenosine diphosphate (ADP) and adenosine monophosphate (AMP). In this project, a fluorescent chemosensor is designed and synthesized by coupling naphalenemonoimide with DPA unit by click reaction. Naphthalenemonoimide acts as a fluorophore while triazole and DPA unit as chelating groups. A detailed study of the compound with various metal ions and anions will be carried out in next summer.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Chemistry: Organic / Inorganic Section: 2nd Place Undergraduate Research Competition)

Funded by Berea College URCPP





Waste Management at Berea College Farm: Analysis of Soils for Available Phosphorus.
Stephanie Itumba, Chipo Kambarami, and Paul Smithson. Chemistry Department, Berea College, Berea, Kentucky, 40404.

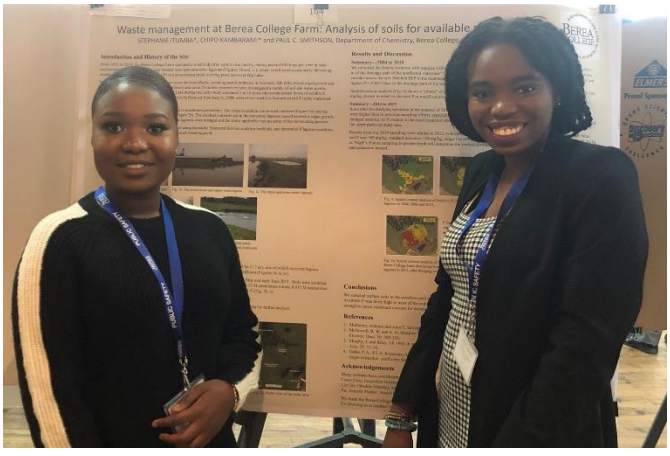
Abstract

Berea College operated from 1972 to 2010 a small confined swine facility, using anaerobic lagoons to manage waste. The lagoons occasionally overflowed, delivering excess nutrients to a downstream stock watering pond and causing eutrophication. The site comprises two small watersheds below the lagoons, one watershed receiving lagoon overflow and the other not. From 2004 to 2019 we measured soil available (Mehlich III) phosphorus (P) in the two watersheds. Spatial analysis of the data using ArcGIS™ software in 2004, 2006 and 2010 showed a "plume" of elevated soil P in the overflow drainage path, higher ($P < 0.001$) than in the surrounding upland, and higher ($P < 0.001$) than in the drainage path of the unaffected watershed. In 2012 the lagoons were dredged and the slurry sprayed onto the nearby pasture, including our study area. Sampling later in 2012 indicated high P levels in the upper areas of both watersheds. In May 2019 we collected 158 georeferenced topsoil (0 to 5 cm) samples from the watersheds. Soils were extracted with Mehlich III solution and analyzed for orthophosphate P by the molybdate blue method. Results were similar to the 2012 study, with high P levels especially in the upper part of both watersheds. Mean soil P was 160 mg/kg, standard deviation 130 mg/kg, range 1 to 690 mg/kg. (Kentucky Extension considers anything over about 65 mg/kg as "high"). Future sampling to greater depth will determine the vertical distribution of soil P, but these high surface soil P levels present a eutrophication hazard.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Environmental Sciences Section)

Funded by Berea College URCPP



Investigation of Amyloid Precursor Protein and Small Molecules Interactions in Bicelles.

Kamila Nurmakova[1], Manuel Castro[2], and Charles Sanders[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

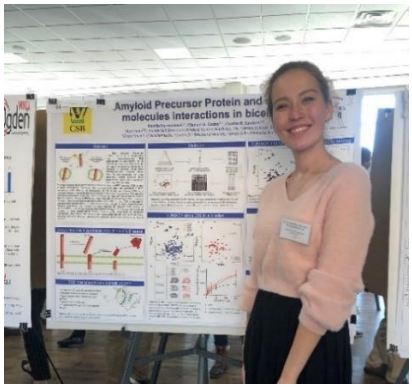
Abstract

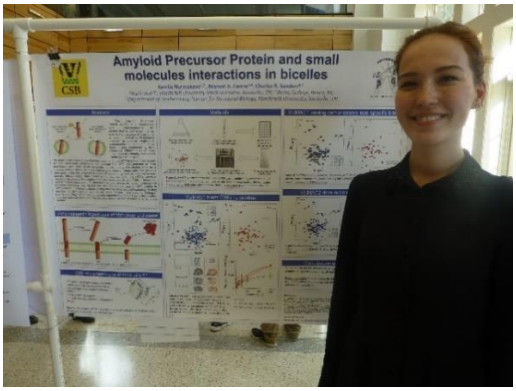
The Amyloid Precursor Protein (APP) is a single-pass type I transmembrane (TM) protein that is well known for its role as the precursor of Amyloid ?, an agent involved in Alzheimer's disease. In general, single-pass transmembrane proteins have been largely neglected by drug discovery efforts because they have been traditionally considered 'undruggable' targets. Previous studies have shown that the transmembrane APP fragment, C99, is able to bind cholesterol, motivating the concept that C99 has potential to form complexes with other small molecules. In this study, we employ C99 as a disease-relevant model to probe interactions between single-pass TM proteins and small molecules, using the Notch-1 TM protein fragment as a control for non-specific effects. Using NMR-based high throughput screening (HTS): previous research discovered two compounds that were able to bind C99 in detergent based model membranes. To determine binding events in more physiologically relevant conditions, we titrated the two compounds against C99 protein in D6PC/DMPC (dihexanoylphosphotidyl-choline/dimystristoylphosphotidylcholine) bicelles, a lipid environment which more closely resembles a biological membrane. Only one of the compounds reproducibly bound C99 in the bicelles, inducing chemical shift perturbations in residues in and around transmembrane domain. We did not observe chemical shift perturbations in the Notch-1 transmembrane domain, suggesting that the binding is unique to C99. These results are preliminary evidence of C99 complexing specifically with a small molecule, validating the utility of the NMR-based HTS for single-pass TM proteins.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Physiology & Biochemistry Section)

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





Early Detection of HPV-Driven OPC Using E6 Sero-Marker. Yeongha Oh[1], Krystle Kuhs[2], Lindsey Dalton[2], and Brionna Tolbert[3]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University Medical Center, Nashville, Tennessee, 37232. [3]Fisk University, Nashville, Tennessee, 37208.

Abstract

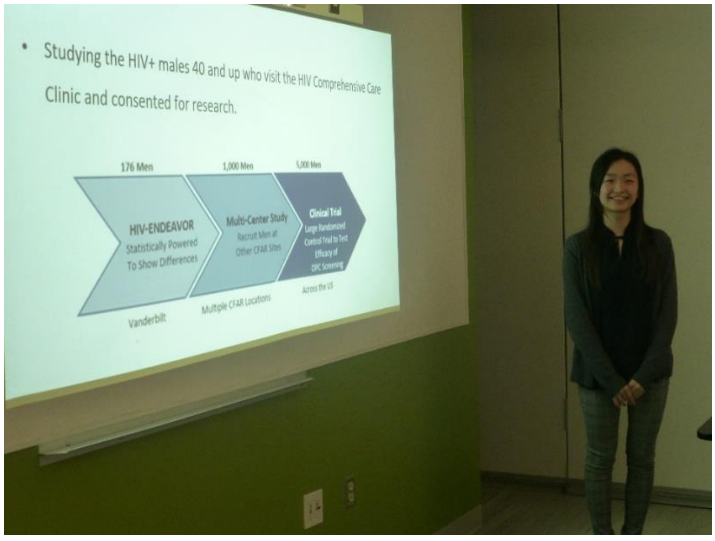
The incidence of oropharyngeal cancer (OPC), a type of head and neck cancer, is rapidly increasing in the US and has been attributed to human papillomavirus (HPV) infection. OPC cases now outnumber cervical cancer cases in the US, approximately 85% of which occur among men. Unlike cervical cancer, where the introduction of highly effective screening has significantly reduced the incidence and mortality of cervical cancer in women, there are no methods for early detection of HPV-OPC in men. Recently, HPV16 E6 antibody positivity has been identified as a promising early biomarker for HPV-OPC. Previous work from our group showed that HPV16 E6 antibodies are present in up to 90% of HPV-OPC patients and appear more than 10 years prior to diagnosis. The object of this study is to use the HPV16 E6 biomarker to develop a cohort of individuals who are at highest risk of HPV-OPC. We will capitalize on the pre-existing infrastructure at Vanderbilt to test residual blood samples from healthy men aged 45-70 without diagnosed cancer for the presence of HPV16 E6 antibodies to estimate the seroprevalence of HPV16. OPC.

17th Annual Vanderbilt Summer Science Academy Student Research Symposium, August 1, 2019, Nashville, Tennessee (Poster and Oral Presentation)

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section)

Funded by Vanderbilt University Pipeline Program



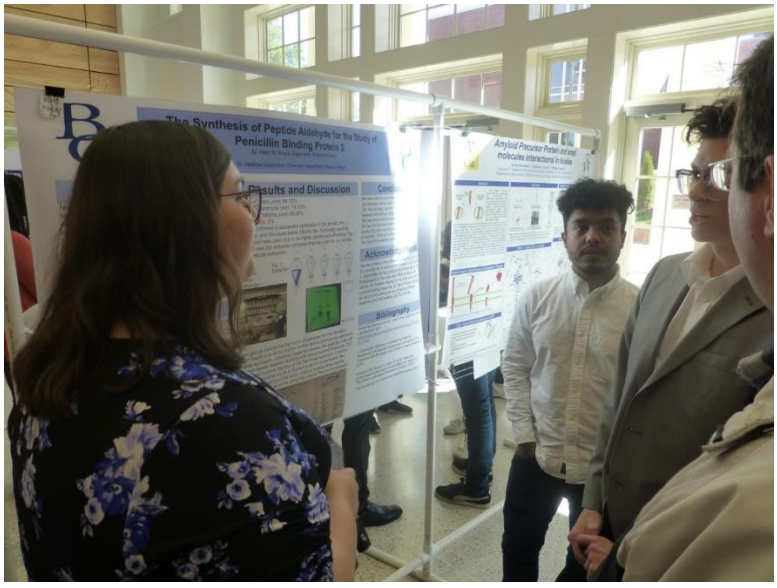
The Synthesis of Peptide Aldehyde for the Study of Penicillin Binding Protein 2. Edgar Ortiz, Adam Kinyua, Garett Combs, and Matthew Saderholm. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

Neisseria Gonorrhoeae is the infectious bacteria responsible for the sexually transmitted infection gonorrhea. Infections by gonorrhea can cause infertility, increase risk of dangerous ectopic pregnancies in women, and increase risk of infection by HIV. Infection rates of gonorrhea have been increasing rapidly due to the bacteria's frequent mutations causing it to become resistant to nearly all antibiotics used to treat it. This resistance stems from a mutation in the active site of Penicillin Binding Protein 2 (PBP2). The mechanism behind the binding of the substrate to the active site is still unknown. However, by creating a peptide aldehyde we can permanently bind our substrate to a modified PBP2 with a thiol group in place of the usual hydroxyl group. This binding could be studied and our understanding of this mechanism could be improved. We will create a peptide aldehyde by creating a non-standard amino acid from fmoc-d-alanine using a lithium aluminum hydride reduction state and the liberty lite automatic solid-state peptide synthesizer to build the rest of the peptide chain.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Chemistry Department



Synthesis of Fluorinated Thermoelectric Material. Jordan Pollard, Jacob Downs, and Mary Robert Garrett. Chemistry Department, Berea College, Berea, Kentucky, 40404.

Abstract

The goal of this summer research project was to synthesize a tetracene that has fluorine substituents. When tetracene is bonded by two thio bridges and doped with iodine it forms a substance known as tetrathiotetracene, a potential thermoelectric material (TM). Tetracene derivatives have already been successfully synthesized with electron-donating groups (EDGs), but they have not been successfully synthesized with electron-withdrawing groups (EWGs). The reason fluorine was chosen was because of its high electronegativity, and being one of the best EWGs. The possible benefit of a fluorinated tetracene would be that its electrical capacity would be increased, potentially allowing for a better TM. The problem with synthesizing tetracene with EWGs, is that EWGs draw the electrons towards the fluorine atoms. This condition makes it difficult for tetracene to form from its previous substrate which requires a nucleophilic attack to close the four-ring tetracene structure. The research team discussed ways to form tetracenes with EWGs, and settled on a pathway. By starting with 2-butyne-1,4-diol the research team added iodine to form a diiodobutene diol product, with very high yields of 97.35%-97.65% yield. The next step was to add a fluorobenzyl compound to the diiodobutene diol product replacing the iodines, and was completed in 21.98% yield. The next step was to oxidize the hydroxyl groups giving aldehydes in 66.37% yield. The last step that was reached during this eight-week period was replacing the aldehyde carbonyl oxygens with methylenedichlorogroups. The yields for this step was negligible for the first run, but has great potential.. Each product was observed by IR spectroscopy, 1H NMR spectroscopy, 13C NMR spectroscopy, and GC-MS. Future research will be conducted in the spring semester of 2020 in which another attempt will be made to develop tetracenes.

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Characterizing Preferential RNA-Binding Targets of ELAVL1 during an Immune Challenge. Clara Reasoner[1], Sarah Zelle[2], Katherine Rothamel[3], and Manuel Ascano[3]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Iowa State University, Ames, Iowa, 50011. [3]Vanderbilt University Medical Center, Nashville, Tennessee, 37232.

Abstract

The ability of an mRNA transcript to be translated into protein is regulated by interactions with RNA-binding proteins (RBPs). ELAVL1 is a highly conserved RBP that binds to AU-rich elements (AREs) typically within 3' untranslated regions of target mRNAs. ELAVL1 association with AREs is thought to stabilize the half-lives of target mRNA transcripts leading to prolonged protein expression. Although previous work has identified the importance of ELAVL1 in innate immunity, it remains unclear which effects are direct. Knockdown of ELAVL1 expression in mouse cells decreases the ability of cells to resist infection by viruses. On the contrary, knockout of ELAVL1 in murine myeloid cells led to increased mRNA levels of pro-inflammatory cytokines. To reconcile these conflicting reports and better understand how ELAVL1 modulates an immune response, our lab identified the transcriptome-wide mRNA targets of ELAVL1 in a human monocytic cell line, during naive and immune activated states. To verify these results, we seek to biochemically measure the binding affinity of recombinant ELAVL1 against short RNA sequences that represent target regions identified within endogenous mRNAs. In addition, using the novel technique VIR-CLASP, we found that ELAVL1 binds directly to the Chikungunya viral (CHIKV) RNA genome immediately upon viral entry. Alphaviruses such as CHIKV are known to sequester RBPs in the cytoplasm, preventing RBPs from stabilizing the transcripts needed for antiviral response. We seek to map the binding sites between ELAVL1 and CHIKV RNA in order to better understand how ELAVL1: CHIKV interactions affect viral replication and the host transcriptome. Mapping the binding sites of ELAVL1 under different cellular conditions elucidates how RBPs shape an immune response and how such regulation can be disrupted by viruses.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Cellular & Molecular Biology Section: 1st Place Undergraduate Research Competition)

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

Cobalt Protoporphyrin Stimulation Induces Heme Oxygenase-1 Expression in Mouse Peritoneal Macrophages. Sarah Shaikh[1], Yasir Alsiraj[2], Mark Ensor[2], Sean Thatcher[2], and Lisa A. Cassis[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]University of Kentucky, Lexington, Kentucky, 40506.

Abstract

A previous study showed that Hmox1 mRNA abundance was markedly increased in abdominal aortas from female compared to male AngII-infused Ldlr-/- mice. In addition, Hmox1 expression in microarrays was increased in smooth muscle cells (SMCs) or whole aortas exhibited differential sex- and/or AngII- dependent regulation. These results suggest that Hmox1 may protect females from AngII-induced AAAs, and that activation of HO-1 may have efficacy against AAA formation and/or progression. Studies have shown that cobalt protoporphyrin (CoPP) has the ability to significantly up-regulate HO-1 protein and activity levels when administered to rodents at a dose range of 1-5 mg/kg. The hypothesis of this study was that CoPP would induce HO-1 in naÃ¯ve C57BL/6 female mice. These preliminary results demonstrate that CoPP administration can stimulate HO-1 expression in some target tissues, but there was no effect of CoPP on HO-1 expression in aorta, the primary target tissue for future studies. Results also demonstrate that multiple dosing is necessary for CoPP induced stimulation of HO-1.

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105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Physiology & Biochemistry Section)

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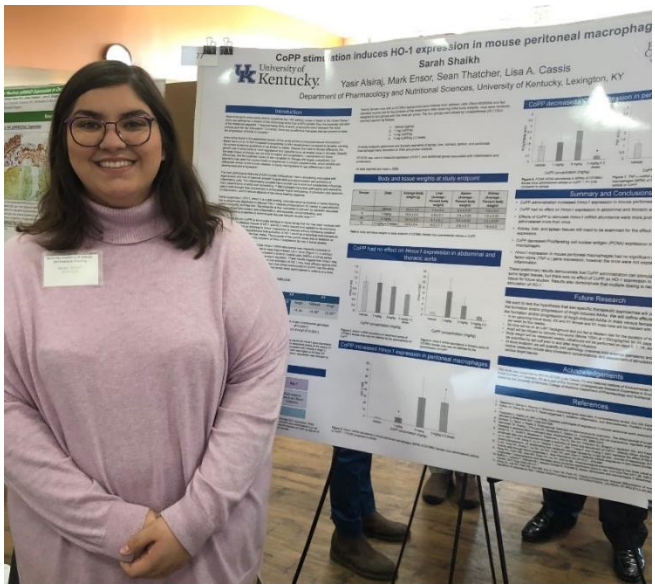


Using Titanite to Determine Magmatic Thermal Histories of Granites. Austin Weber[1] and Michael Ackerson[2]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Smithsonian Institution, National Museum of Natural History, Washington, D.C., 20560.

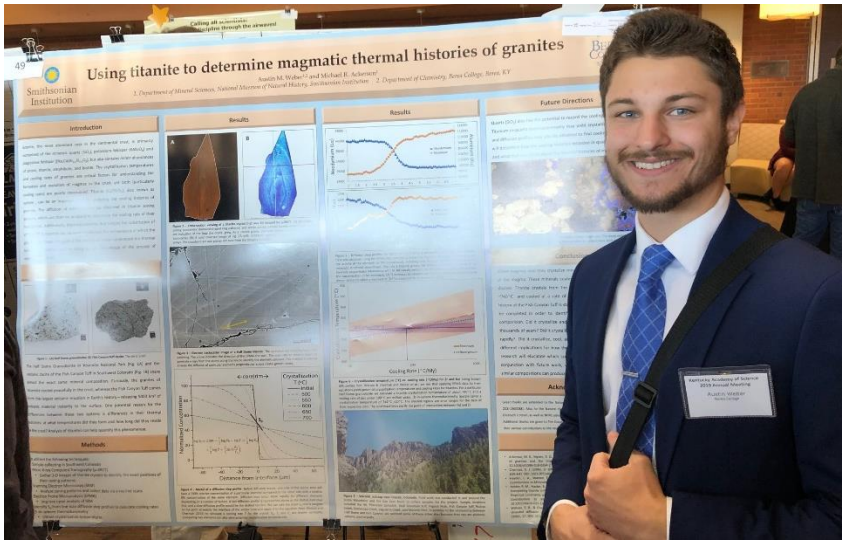
Abstract

Granite, the most abundant rock in the continental crust, is primarily comprised of the minerals quartz, potassium feldspar, and plagioclase feldspar, but also contains minor abundances of zircon, titanite, amphibole, and biotite. The crystallization temperatures and cooling rates of granites are critical factors for understanding the formation and evolution of magmas in the crust, yet both (particularly cooling rates) are poorly constrained. Titanite, also known as sphene, can be an important tool for analyzing the cooling histories of granites. The diffusion of elements can be observed in titanite zoning patterns, which can be analyzed to determine the cooling rate of their host granite. Additionally, thermobarometry that utilizes the substitution of Zr4+ for Ti4+ in titanites can be used to calculate the temperature at which the granite crystallized. The goal of this study is to better understand the thermal histories of granites, and in doing so gain knowledge of the process of continental crust formation.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation - Geology Section: 1st Place Undergraduate Research Competition)

Funded by the National Science Foundation



Developing an Animal Affinity or Philozoa Scale. Micaela Berry, Evie Eastham, and Neil Mecham. Child and Family Studies Department, Berea College, Berea, Kentucky, 40404.

Abstract

The study of human's connections to non-human animals immerged as a serious field of study in the early 1980s and has gained momentum ever since. This emergence has created a plethora of scales measuring different types of human non-human animal connections and interactions. The majority of scales have focused on emotional attachments, primarily with companion animals. The focus of this project was to create a scale with broader application possibilities. The Animal Affinity or Philozoa Scale (AAoPS) was designed to measure a person's general affinity towards animals which includes, but goes beyond, companion animals. Animal affinity was conceptualized as having three dimensions: fascination, interconnectedness and attitudes and/or beliefs. An individual's affinity towards animals, as viewed through these dimensions, is evidenced in measurable behaviors and opinions. A pool of over 100 questions, focusing on a person's behaviors and attitudes towards animals, was generated then narrowed down to a set of forty- five. These forty-five questions comprised the first pilot scale which was made available online to a convenient sample. One hundred and sixty-four individuals completed the scale. An overall Cronbach's Alpha score of .955 indicated sufficient reliability but further analysis of individual mean and standard deviation scores of the questions indicated further refinement of some questions could produce an even stronger scale. Key words: Human – animal interactions, animal affinity, biophilia, animal interaction scale.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

Funded by Berea College URCPP

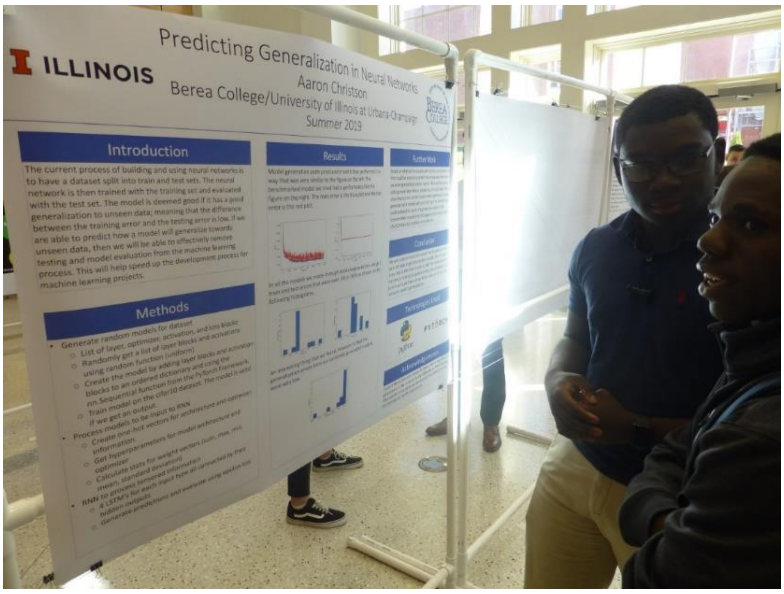
Predicting Generalization in Neural Networks. Aaron Christson[1], Sanmi Koyejo[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]University of Illinois, Champaign, Illinois, 61820.

Abstract

The current process of building and using neural networks is to have a dataset split into train and test sets. The neural network is then trained with the training set and evaluated with the test set. The model is deemed good if it has a good generalization to unseen data; meaning that the difference between the training error and the testing error is low. If we are able to predict how a model will generalize towards unseen data, then we will be able to effectively remove testing and model evaluation from the machine learning process. This will help speed up the development process for machine learning projects.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Computer Research Association's Distributed Research Experiences for Undergraduates



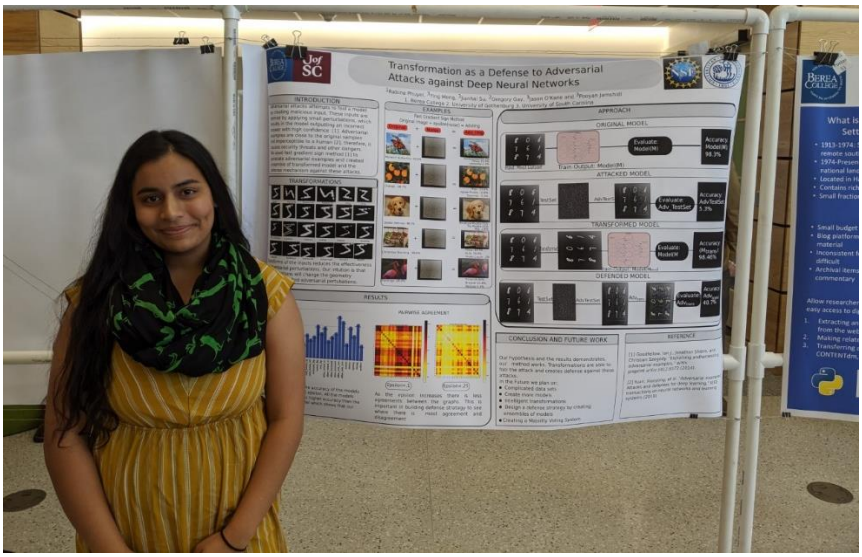
Transformation as a Defense to Adversarial Attacks against Deep Neural Network. Rabina Phuyel[1], Ying Meng[2], and Pooyan Jamshidi[2]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]University of South Carolina, Columbia, South Carolina, 29208.

Abstract

Machine learning models, including deep neural networks, misclassify adversarial examples which are formed by applying small but intentionally perturbations to attack the model created from the data set, which results in the model outputting an incorrect answer with high confidence. Early attempts at explaining this phenomenon focused on non linearity and over fitting. Our contribution includes creating ensemble of transformed model and the defense mechanism against these attacks. We expect these transformations to act as a defense against these attacks. Our intuition is that transformation change the geometry of carefully crafted adversarial perturbations and the transforms of the input reduce the effectiveness of the adversarial perturbation. We generated adversarial example by attacking MNIST dataset with the fast gradient sign method. After the attack, the accuracy of the original model was significantly lower than the models with transformation.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by the National Science Foundation and University of South Carolina



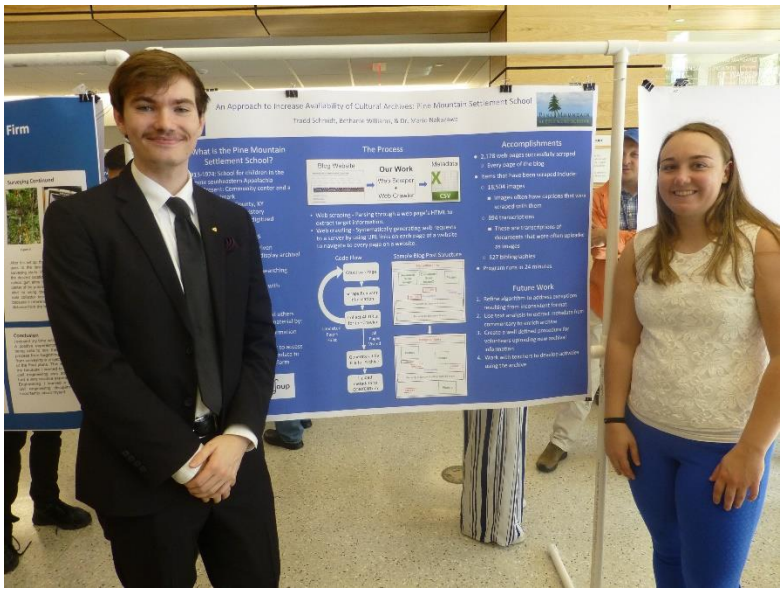
An Approach to Increase Availability of Cultural Archives: Pine Mountain Settlement School. Tradd Schmidt, Bethanie Williams, and Mario Nakazawa. Computer Science Department, Berea College, Berea, Kentucky, 40404.

Abstract

The Pine Mountain Settlement School has an extensive collection of interesting and important material that has been slowly digitized, but the images and metadata were incorporated into a WordPress blog about the school. This platform is not usable for research because archived items are often stored separately from its metadata in the backend, and they are paired in a blog post, often interspersed with interpretative information. To make connections or search items, the user often travels from post to post. Even the platform's search function often does not work as expected. We developed a web crawler and web scraper using a Python library called BeautifulSoup that extracts from the entire blog site all the filenames of visual and document photographs, any relevant metadata that can be associated with these images, pairs the information together, and finally outputs the combined data into a comma separated value spreadsheet. All original scanned items were then uploaded into an archiving platform called CONTENTdm along with the corresponding metadata, making searching and research more effective. The ultimate goal is to provide an effective tool for the community members and other researchers of the Pine Mountain Settlement School.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP



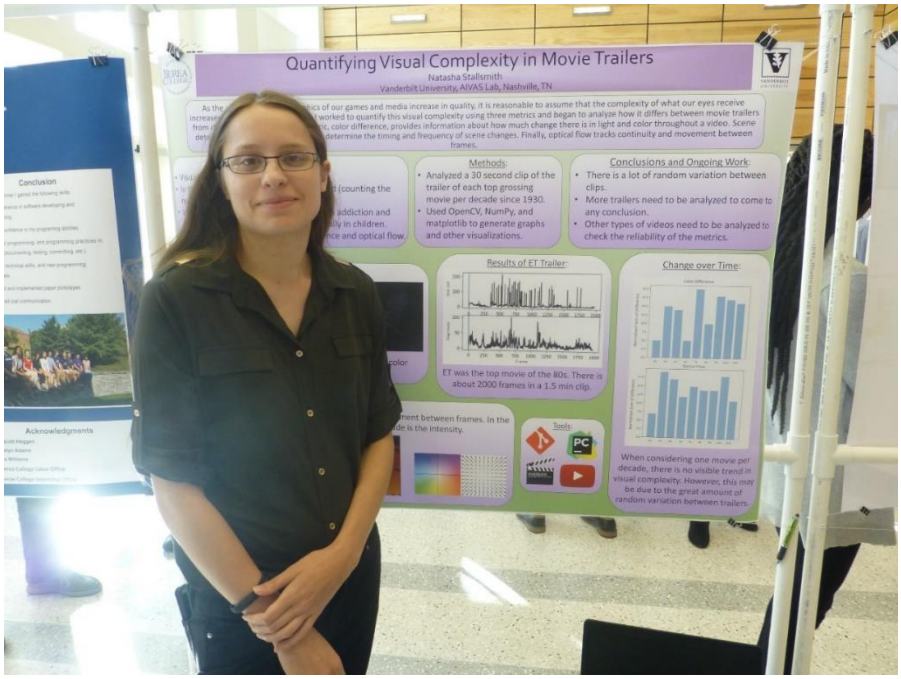
Quantifying Visual Complexity in Movie Trailers. Natasha Stallsmith[1], Maithilee Kunda[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Vanderbilt University, Nashville, Tennessee, 37235.

Abstract

As the special effects and graphics of our games and media increase in quality, it is reasonable to assume that the complexity of what our eyes receive increases as well. Over the summer, I worked to quantify this visual complexity using three metrics and began to analyze how it differs between movie trailers from different decades. The first metric, color difference, provides information about how much change there is in light and color throughout a video. Scene detection uses the color difference to determine the timing and frequency of scene changes. Finally, optical flow tracks continuity and movement between frames.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College Office of Internships and Career Development



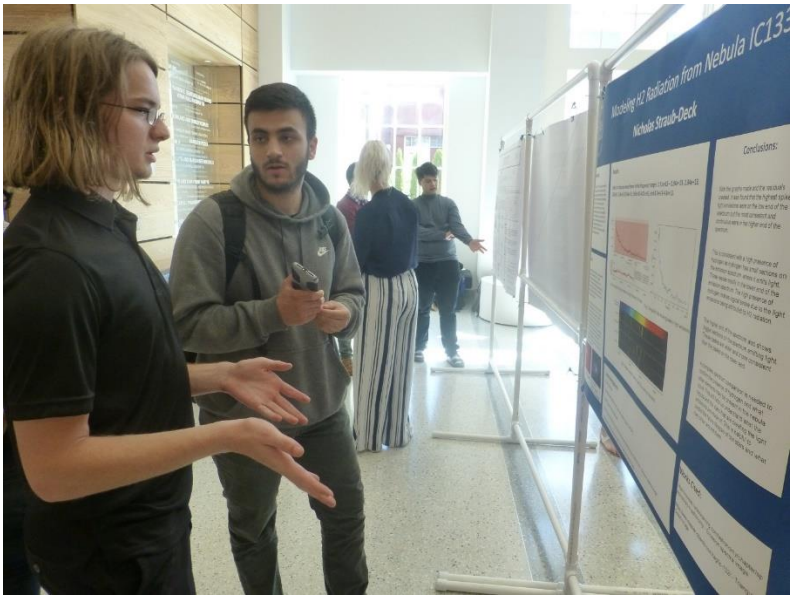
Modeling of H2 Radiation Emissions from Nebula IC133. Nicholas Straub-Deck[1] and Tracy Hodge[2]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

Bright, hot regions in nebulas are evidence of newly formed stars. These new stars heat up the gas around them and cause these areas to appear bright. Natural elements reflect light at different wavelengths, allowing us to see what a nebula is made of based on what wavelengths of light are shining the brightest. This project is to model these light emissions from Nebula IC133 via images that were taken above the atmosphere with filters filtering different wavelengths of light. This was done so we can go back and see what elements are present in the nebula cloud.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP



The Design and Implementation of the Inaugural Yahng Discovery Center "Berea Solution Seekers" STEM Camp. Shy Bowers[1], Isaiah Esham[1], Faisal Kimbugwe[2], and Jon Saderholm[1]. [1]Education Studies Department, Berea College, Berea, Kentucky, 40404. [2]Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

This creative project was created by Shy Bowers, Isaiah Esham, and Faisal Kimbugwe with faculty support from Jon Saderholm. We developed and implemented two one-week all-day camps to local Berea Independent and Madison County students from rising 5th through 9th grades and did not segregate students by gender or age. 29 students enrolled for the first camp and 19 enrolled for the second camp. Each morning students worked on an extended LEGO Robotics design project and each afternoon students engaged various active-inquiry science projects centered around the effects of climate change and the technology that can ameliorate its causes. The development of these summer STEM camps was guided by a design research methodology incorporating a continuous cycle of evidence-based reflection and adaptation. Consequently, in addition to gathering evidence of impact on student knowledge and dispositions, we gathered data describing our design effectiveness and implementation fidelity. The camps were supported by funds from the URCPP fund and the Jessie Bell DuPont fund, with logistical support from Partners for Education and Berea Kids Eat.

Funded by Berea College URCPP

Pine Mountain Settlement Archival Research Project. Alana Pass, Bethany Bigler, and Jason Cohen. English Department, Berea College, Berea, Kentucky, 40404.

Abstract

Together, Jason Cohen and Mario Nakazawa conducted a twinned research project focused on renewing attention to Appalachia's neglected ecological and agricultural heritage through a URCPP that develops two closely related threads of work. The first element of this proposal developed a secondary school (grades 8-12) environmental education curriculum in partnership with Pine Mountain Settlement School (PMSS) in Harlan County, Kentucky. We wrote over 75 lesson plans across 20 units, and we assembled several hundred pages of organized primary source sets for use by teachers in the high school classroom. The lessons touched on every subject area except mathematics, and they were keyed to KY Curricular Core standards. This work grew out of an NEH curriculum development grant also being conducted in partnership with PMSS. The present proposal carried our work together into the high school educational context for the first time. The second element of the URCPP created a new copy (and database migration) of the website hosting PMSS archival documents from an outdated WordPress installation to a modern content management system designed for archives and collections management. We migrated a copy of the current digitized archive without destroying the WordPress site. Thus, this migration served Pine Mountain because it provided them with a more sustainable, long-term solution to their own data management and archival preservation needs while allowing users of the current format access to the original material. This process also enabled a broader audience better access to the archives, with better search and visualization tools, and better controls for future archive development.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

Funded by Berea College URCPP

Physical Activity and the Peabody Picture Vocabulary Test on Preschool-Aged Children. Juan Chavez Casiano, Austin Glasgow, and Michelle Thornton. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

Abstract

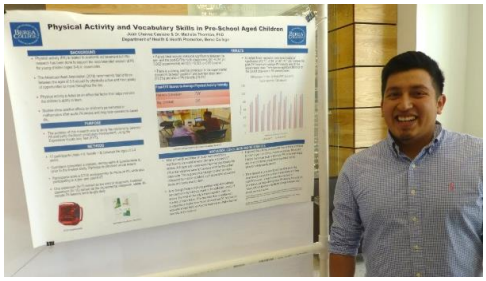
Health and physical activity (PA) is related to academic achievement, such as on-task behaviors, improvement of test scores, attendance rates and behavioral issues, in school-aged children. However, little research has been completed on academic achievement, primarily vocabulary skills, on pre-school aged children. Given that children can sometimes spend nearly half their time in childcare, it is imperative for teachers to incorporate planned PA lessons to help aide with the children's cognitive development. Seventeen pre-school age (3-4 years) children (male = 9, female = 8) from two classrooms, participated in a 6-week study. Participants' guardians completed a consent form and general information questionnaire prior to the study. From the beginning to the end of the school day, participants wore a GT3X accelerometer to measure PA and levels of intensity. Prior to the start of the study, participants completed the Peabody Picture Vocabulary Test (PPVT). One classroom served as the experimental group and had 10-minute PA lessons taught to them each day. At the end of the study, all participants completed a post-PPVT. Results from two paired t-tests indicate statistical significance between the pre-PPVT and the post-PPVT results for the experimental classroom $t(9) = -3.436$, $p < .007$, but not for the control classroom $t(6) = -1.892$, $p < .107$. Multiple linear regressions between the post-PPVT scores and activity do not indicate statistical significance for the control classroom $F(2,4)=.930$, $p <.466$, $R2 = .317$ nor for the experimental classroom $F(2,7)=.797$, $p <.488$, $R2 = .185$. As there was a significant difference between classrooms from the pre- and post-PPVT, there appears to be a trend toward significance for the experimental classroom and their report PA. This could indicate that longer bouts of PA should be taught daily or that more weeks of incorporating activity should be included prior to completing the post-PPVT. To corroborate with this research, future studies could include featuring full, daily PA lesson plans and/or a semester-long study.

Kentucky Association for Physical Education, Recreation, and Dance, October 14, 2019, Louisville, Kentucky

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section)

Funded by Berea College Health and Human Performance Department



The Effect of Fatigue on Muscle Recruitment within Healthy Young Males and Females.

Jose Gonzalez, Logan Taylor, and A.J. Mortara. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

Abstract

Background: While performing resistance training exercise, participants regularly manipulate exercise types, equipment, sets and repetitions to maximize muscle fiber recruitment and performance. The primary purpose of this study was to determine the effect of bar type on muscle fiber recruitment during the deadlift exercise. A secondary outcome was to examine differences in muscle fatigue during a recovery period. Methods: Three males and two females 20-22 years of age participated in this study. Participants were physically active and experienced weightlifters. A one repetition maximum (1RM) protocol for the deadlift exercise was completed with an Olympic (straight) and using a trap (hexagonal) bar separated by no less than one hour and no more than 24 hours. Electromyography was measured on the right side of the body at the following muscles: rectus femoris, biceps femoris, gluteus maximus, and the multifidus. Prior to measurement, the skin was shaved and abraided with alcohol. Maximum Voluntary Isometric Contractions (MVIC) were performed prior to the deadlift protocol and used to normalize EMG readings for analysis. A repeated measures ANOVA was used to analyze muscle recruitment patterns between the two deadlift conditions. Results found no significant differences between the two lifting conditions.

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section)

Funded by Berea College Health and Human Performance Department

Effects on Fat Metabolism During Aerobic Exercise in High Carbohydrate Diet, Fasted, and Mixed Meal Conditions. Stefany Reyes, Logan Taylor, A.J. Mortara, and Louisa Summers. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

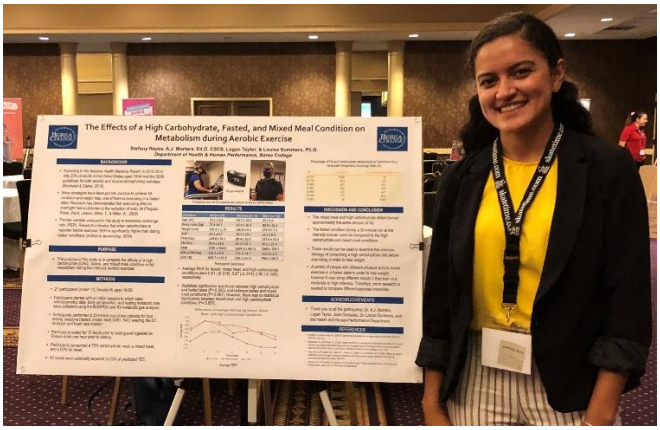
Abstract

A popular strategy to facilitate fat loss is to manipulate the quantity and timing of macronutrients. Some advocate fasting for up to 12 hours before exercise, while others advocate for a large bolus of carbohydrates. The purpose of this experiment was to determine what effect, if any, fasting or high carbohydrate feeding has on metabolic rate has on low intensity steady state cardiovascular exercise. Twenty-one volunteers participated in this study, which involved three 30 minute treadmill runs at 60% of age predicted maximum heart rate. Respiratory exchange ratio (R), heart rate, oxygen consumption, total energy expenditure, and minute ventilation were continuously monitored via metabolic gas analyzer. Effects were compared to a liquid shake mixed meal equal to 25% of subject's estimated daily caloric needs in the following proportions: 40% carbohydrates, 25% proteins, and 35% fasts. The high carbohydrate meal consisted of a liquid shake of equal calories to the mixed meal, but contained 75% carbohydrates, 20% fats, and 5% proteins. Fasting subjects underwent a 12 hour or greater fast. Results indicate statistically significant Respiratory Exchange Ratios between the high carbohydrate and fasted conditions ($p=0.005$); and also between the fasted and mixed meal states ($p=0.001$). No significance was found between the mixed meal and high carbohydrate conditions ($p=0.857$). Average RER during fasted, mixed meal, and high carbohydrate conditions were 0.81 (±.016), 0.87 (±.014), 0.86 (±.020), respectively. The data indicates that during a 30 minute low intensity cardiovascular exercise session fasting for 12 or more hours will likely result in greater fat consumption than consuming a high carbohydrate or mixed meal.

Kentucky Association for Physical Education, Recreation, and Dance, October 14, 2019, Louisville, Kentucky

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section: 1st Place Undergraduate Research Competition)

Funded by Berea College Health and Human Performance Department



Comparison of the Effects of Low Intensity Cardiovascular Exercise after Fasted, Fed, and High Fat Meals in Adults. Logan Taylor, Stefany Reyes, and A.J. Mortara. Health and Human Performance Department, Berea College, Berea, Kentucky, 40404.

Abstract

Objective: To examine the effects of fasted, fed, and a high fat meal on metabolism during low intensity cardiovascular exercise (60% of maximal heart rate) in adults. Methods: 21 healthy participants (9 female, 11 male; ages 18-58) performed five sessions; the initial session tested for basic anthropometric data: body composition, resting metabolic rate (RMR), height, body mass, and blood pressure. Participants then performed four 30 minute, low intensity, treadmill runs/walks. Fed conditions were comprised of participants consuming a shake equivalent to 25% of their individual daily needs one hour prior to testing. The fed conditions were modified to produce the varying fed states: high carbohydrate (75% carbohydrates), high fat (60% fats), and the mixed meal which contained the proper proportion of carbohydrates, proteins, and fats (50%, 30%, and 20% respectively). For the fasted session, subjects were asked to fast for a minimum of 10 hours prior to the test. Results: The average respiratory exchange ratio (RER) of the fasted, mixed meal, and high fat meals were 0.802 (±0.092), 0.861 (±0.087), and 0.817 (±0.083) respectively. No significant differences between the three variables were observed. Conclusion: respiratory exchange ratio (RER) does not appear to be influenced by fasting, mixed meal, or high fat meal conditions.

Kentucky Association for Physical Education, Recreation, and Dance, October 14, 2019, Louisville, Kentucky

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section)

Funded by Berea College Health and Human Performance Department

Identification of Risk Factors and Their Association with Neck and Lumber Fracture. Victoria Pham[1,2] and Comron Saifi[3]. [1]Mathematics Department, Berea College, Berea, Kentucky, 40404. [2]Economics Department, Berea College, Berea, Kentucky, 40404. [3]Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, 19104.

Abstract

The objectives of this research were: 1) to identify major causes for cervical and lumbar fractures and 2) association of risk factors with both type of fractures. Evaluation of best treatment approaches in cervical and lumber fractures Introduction: There are about 6.8 million vertebral fractures occurring each year in the U.S. Incidence of vertebral fractures differ with the age. The age of vertebral sufferer impacts with the intervention and rehabilitation process. Therefore, it is important to identify age related causative factors of vertebral fractures in the population. Methods: This presentation emerged from my internship at the Hospital of University of Pennsylvania. This study uses national data from National Electronic Injury Surveillance System (NEISS) 2009 to 2018 available in public domain. It is a cross-sectional research design that attempted to identify major causes of neck and lumber injuries and their association. Results: Causes of neck and lumber fracture were not found significantly different ($x2 = 253.00$, $df = 255$, $p=0.524$) among people from 0 to 19 years of age. Our results indicates that prevention strategies developed to address all types of risk factors can reduce occurrence in both types of fractures. Conclusions: Findings of this study suggests that different risk factors play role in neck and lumber injuries at different age. Public health preventive strategies targeted to the specific causes of injuries can reduce burden of neck and lumber fracture in the population.

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Health Sciences Section)

Metallicity Gradients of Simulated Dwarf Galaxies. Anahi Favela. Physics Department, Berea College, Berea, Kentucky, 40404. (University of Oklahoma, Norman, Oklahoma, 73019).

Abstract

Low-mass dwarf galaxies can be described as any galaxy that has a smaller mass than the Milky Way Galaxy. Low-mass dwarf galaxies are within low-mass halos with low gravitational potential wells and low escape velocities, and they are highly sensitive to stellar feedback as compared to more massive galaxies. Generally, older stars within low-mass galaxies have a higher orbiting radius than the younger stars. This is because stars migrate outward when the specific star formation rate (sSFR) falls during the periods of net outflow and then migrate inward once gas falls back into the galactic center and the sSFR rises. In a long enough time, scale (>1 Gyr), stars show outward migration that continues to increase with stellar age. Younger stars tend to be more metal-rich than older stars because younger stars have formed from the remains of the stars that have gone supernova and have left behind several gases. It was thought that the metallicity of low-mass galaxies would decrease as radius increased, but it was discovered that, in fact, the metallicity is constant. This is what my research was based off of this summer, and through my presentation, I will display the preliminary results of the project.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

Funded by the University of Oklahoma

Berea College's New Telescope. James Henderson and Tracy Hodge. Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

Variable stars are a class of stars which vary in brightness from a few hours to years. In preparation for the installation of Berea College's new 20 inch optical telescope, we analyzed raw data of properties of a select group of short-period variable stars extracted from a astronomical archives, including Gaia DR2, Kepler, SIMBAD, and VizieR. From the calculated data, we identified interesting targets for study using the new telescope once it is installed. In conjunction with this, the team continued work at the dome site, preparing remote access to the telescope and electronic maneuverability of the dome top. Calculations of some important properties of the telescope were made with direct specifications.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP

Fitting Neural Networks to Thermal Equations of State for Use in FLASH Models. Eli Prater[1], Bronson Messer[2], and Hannah Carver[3]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]Oak Ridge National Laboratory, Oak Ridge, Tennessee, 37830. [3]Clemson University, Clemson, South Carolina, 29634.

Abstract

In High-Performance Computing (HPC) code used for simulations of complex physical processes, such as FLASH for SuperNovae explosions, Equations of State (EOS) must be modeled to calculate values such as energy and entropy. A complex EOS, such as the Helmholtz EOS used in FLASH simulations, can be difficult to model and execute efficiently. In the example of the Helmholtz EOS values are stored in a table and used to interpolate intermediate values during run time, while this method is faster than others it can lead to events where a value cannot be interpolated, leading to a stoppage of the entire simulations. To combat this issue Dense Fully Connected Neural Networks were trained on data from the Helmholtz EOS in order to reproduce the data efficiently and robustly. All networks were modeled to take temperature, density, and electron composition as input and individually output energy, entropy, and pressure. These values were then used in a simulation of a Type 1a SuperNovae explosion and compared to a simulation using the unedited FLASH Helmholtz EOS. It was found that the Neural Network was able to reproduce values of energy for the Helmholtz EOS within 2% error. The results show that a Neural Network can reproduce the results of an equation of state and are more robust than interpolation methods currently used.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Physics & Astronomy Section: 3rd Place Undergraduate Research Competition)

Funded by Berea College Office of Internships and Career Development

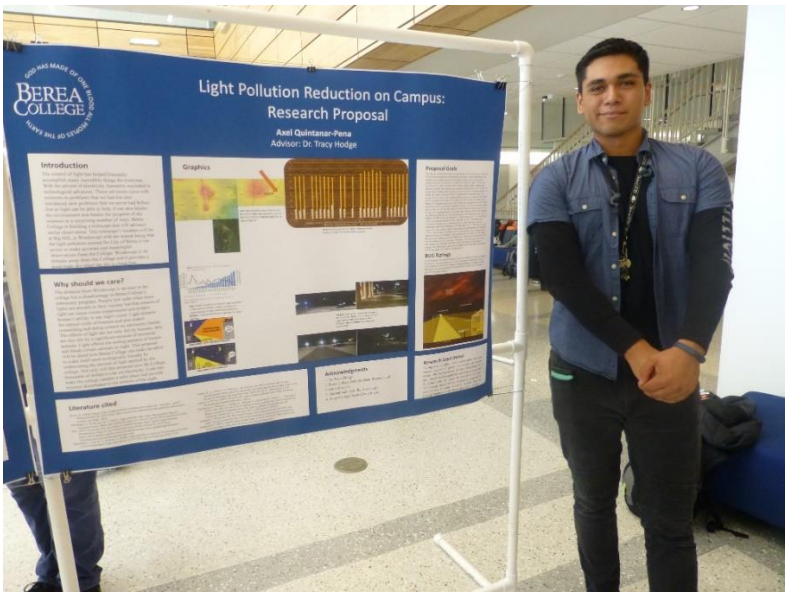
Light Pollution and Its Effects on Berea College. Axel Quintanar and Tracy Hodge. Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

The control of light has helped humanity accomplish many incredible things for everyone. With the advent of electricity, humanity exploded in technological advances. These advances came with solutions to problems that we had but also introduced new problems that we never had before. Just as light can be able to help, it can also hinder the environment and hinder the progress of the sciences in a surprising number of ways. Berea College is building a telescope that will advance stellar observation. This telescope's location will be at Big Hill, in Windswept with the reason being that the light pollution around the City of Berea is too severe to make accurate and meaningful observations from the College. Windswept is 10 minutes away from the College and it provides a good night sky when the clouds are free from the sky. The distance from Windswept is an asset to the college but a disadvantage to Berea College's astronomy. People feel safer when more lights are present in their vicinity but that amount of light can cause vision impairments and hinders human's ability of night vision. Light disturbs the natural cycle of humans and also makes researching and doing science on astronomy harder than ever before. The effects of light are not only felt by humans, they are also felt by a significant amount of nocturnal animals. Light affects the mating patterns of insects and blinds certain animals at night. This proposal will be about how Berea College can make an effort to make itself more ecologically friendly by undercutting the amount of light emitted by the college. Not only will this proposal save the College thousands of dollars a year on electricity, it can also make the college campus a safer place and provide minimal disturbance to the animals of the night.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP



Magnetic High-Entropy Alloys. Valéria Rosa Rocha, Abby Nash, John-Paul Cesare, and Troy Messina. Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

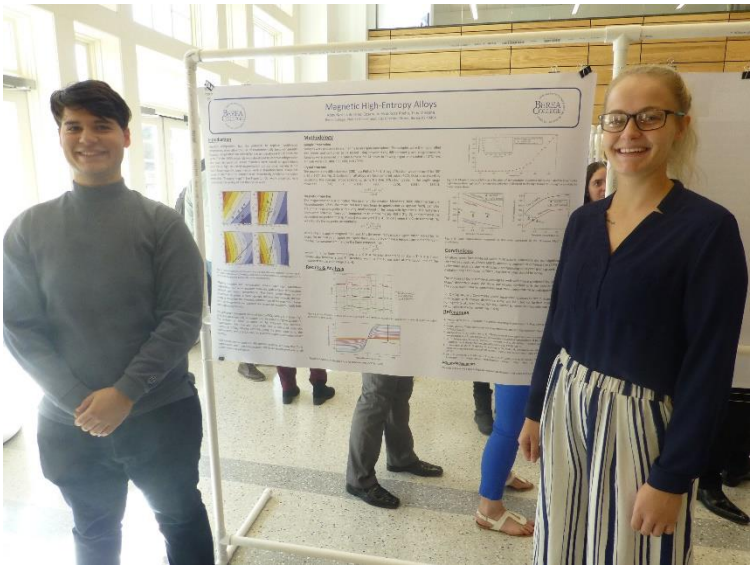
Magnetic high-entropy alloys are a promise for many fields. From cryogenic to aircraft and spacecraft applications, the possibilities are varied but one thing is necessary: to have a better understanding of the properties of these materials in order to put them to good uses. Korman et al., made predictions for the Curie Temperatures (Tc) of HEAs of the form CrxCoFeNiQx with Q being Pd, Cu, Ag, or Au. In our study, we focused on the Pd alloys varying both Cr and Pd in order to check the accuracy of the Tc predictions. Using the 'Treasure Maps' provided by Korman et al. we chose combinations of Cr and Pd that were predicted to have a Tc near room temperature. Based on our work, we found the maps to be very reproducible with the procedure used, which is further explained in this presentation.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Physics & Astronomy Section: 1st Place Undergraduate Research Competition)

American Physical Society March Meeting, March 2-6, 2020, Denver, Colorado

Funded by Berea College URCPP



Testing Silicon Photomultipliers for Use in the nEDM Experiment. Ricardo Santos[1], Vince Cianciolo[2], and Syed Kavish Imam[3]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]Oak Ridge National Laboratory, Oak Ridge, Tennessee, 37830. [3]University of Tennessee, Knoxville, Tennessee, 37996.

Abstract

The existence of the neutron electric dipole moment (nEDM) would create a new type of parity violation in the standard model, however, to find it a high level of precision is required. Silicon Photomultipliers (SiPM) will be used within the nEDM measuring apparatus, being constructed at Oak Ridge National Lab, to measure scintillation light that will be used to find an upper limit of the nEDM. The SiPM that will be used in the experiment must be tested in order to ensure that they are working at max efficiency. We designed a testing apparatus for the SiPM and then created a python script to analyze the output generated from our experiment. Using some sample data from one of the SiPM we were able to create a working rough draft of the analyzes, though a dark rate correction component still needs to be added to find the peak efficiency.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Oral Research Presentation)

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Physics & Astronomy Section)

Funded by Berea College Office of Internships and Career Development

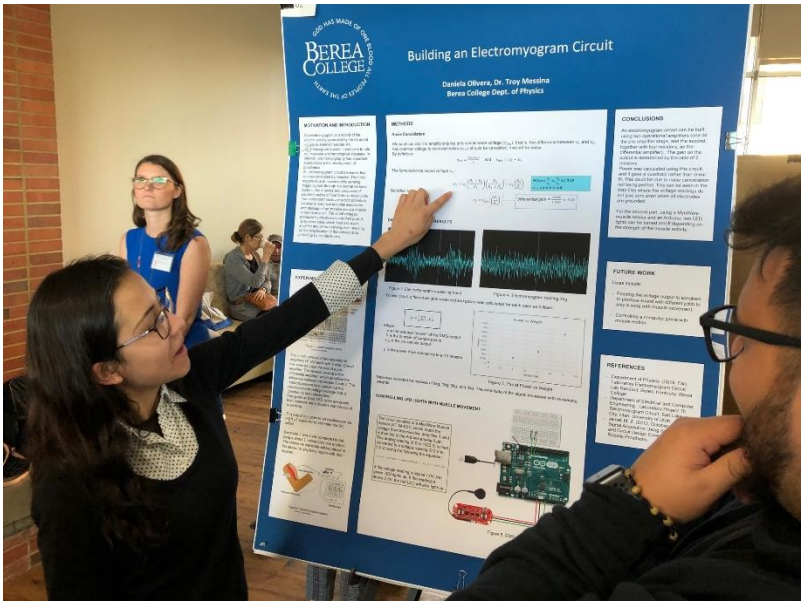
Building an Electromyogram Circuit. Daniela Olivera Velarde and Troy Messina. Physics Department, Berea College, Berea, Kentucky, 40404.

Abstract

An electromyogram is a record of the electric activity generated by the neuronal activity in skeletal muscles. An electromyogram is used in medicine to rule out muscular and neurological diseases. In addition, electromyography has important applications in the development of prosthetics. I will discuss the building of a circuit consisting of electrodes, pre-amplifiers, and a differential amplifier. Using this circuit, the resulting electromyograms displayed on an oscilloscope will be used to compare the activity of nerves and muscles when doing multiple tasks.

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Poster Presentation – Physics & Astronomy Section)

Funded by Berea College URCPP



Decision Making Across Cultures: A Study of Risk Aversion in the United States and Republic of Indonesia. Jenifer Fidelia and Ian Norris. Psychology Department, Berea College, Berea, Kentucky, 40404.

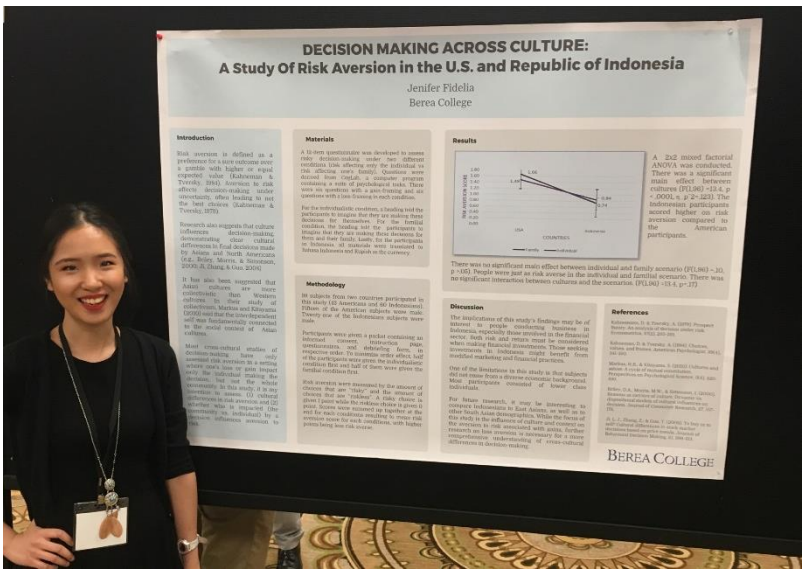
Abstract

Culture affects one's decision-making process. When making a decision, oftentimes risk is involved. Furthermore, eastern cultures tend to be more collectivistic, and western cultures tend to be more individualistic. In this study, I assess whether a person's aversion to risk depends on whether the perceived risk could potentially affect one's community, or whether it could be assumed to impact only the individual himself. My hypothesis is that the collectivistic population would become more risk-averse in the setting where others will be impacted by their decision, while the individualistic population would show no changes across the two conditions. I also expected the collectivistic population to be more risk-averse than the individualistic population in the setting where no others except for the individual are impacted by the loss or gain.

Participants (N=103) from an individualistic culture (United Stated) and from a collectivistic culture (Republic of Indonesia) were given a set of questionnaires to assess their risk aversion. Participants were asked to make decisions under two conditions: one where others were impacted by their decision and the other where the decision did not impact anyone but themselves. A 2x2 mixed ANOVA was performed indicating that Indonesians are more risk-averse in general, regardless of who is impacted. Therefore, one must be aware that some cultures could be more or less risk-averse than others, especially when working with individuals from different backgrounds.

Midwestern Psychological Association, April 11-13, 2019, Chicago, Illinois

105th Annual Meeting of the Kentucky Academy of Science, November 1-2, 2019, Berea College, Berea, Kentucky (Oral Presentation - Social Sciences: Anthropology, Psychology, and Sociology Section: 1st Place Undergraduate Research Competition)



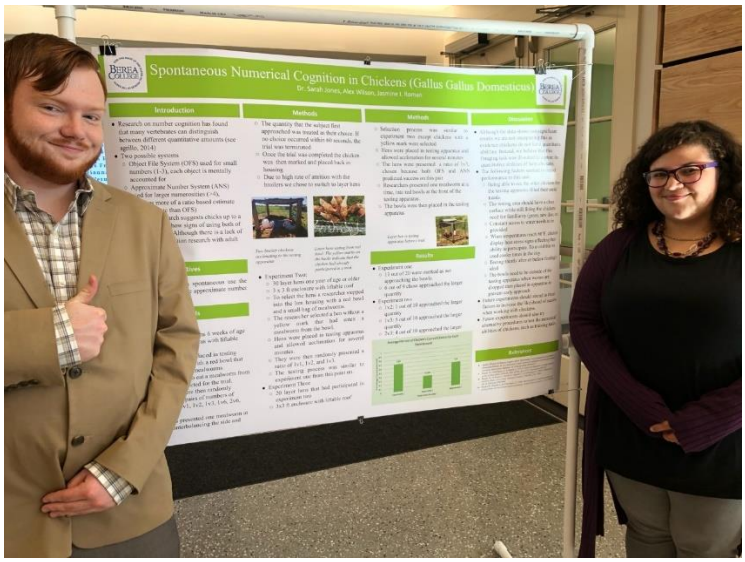
Spontaneous Numerical Cognition in Chickens (*Gallus Gallus domesticus*). Jasmine Roman, Alex Wilson, and Sarah Jones. Psychology Department, Berea College, Berea, Kentucky, 40404.

Abstract

The purpose of this study was to determine if a foraging task could be used to assess numerical cognition in adult *Gallus gallus domesticus* (Domesticated Chickens). Initially, quantities were chosen to determine how the Object File System and the Approximate Number System play a role in their choices. Researchers ran three experiments where they presented six-week broiler G. domesticus and one-year-old layer hens with various semi-randomized pairs of mealworms in a 3 by 3 ft. enclosure and allowed to consume one of the two sets of mealworms. Binomial analyses were ran on the three experiments and no significant data was found. Although the data shows no significant results we are not interpreting this as evidence that *G. domesticus* do not have quantitative abilities. Instead, we believe that this foraging task was ill-suited to capture the quantitative abilities of farm *G. domesticus*. The following factors we found impacted the performance of the *G. domesticus*: having their social needs fulfilled, familiar surfaces, constant supply to water, avoiding heat stress, testing before or shortly after feeding, and a barrier to prevent early approach. Future experiments should attend to these factors to increase likelihood of success when working with *G. domesticus*.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by Berea College URCPP



Design a Solar-Powered Vehicle. Hayes Clark, Wilkensley Thervil, Jeremiah M. Radosevich**,** and Wei Wu. Technology and Applied Design Department, Berea College, Berea, Kentucky, 40404.

Abstract

The American Solar Challenge (ASC) is founded by the innovator Educational Foundation (IEF) to encourage college students to learn, design, build and test a solar-powered, human-operated vehicle. The objective of this URCPP project is to investigate on how to design a solar-powered vehicle for Berea College. During this 8-week study, we not only studied electrical Brushless DC motor, fixed cascaded H-bridge motor controller, tested 206 pieces of solar panels, designed steering and brake system for a donated solar car "Black Nova", we also visited Appalachian State University solar car group and participated in the solar car race event (FSGP) in Texas as a guest team to learn from other teams.

Typically, the solar car consists two main systems: mechanical system and electrical system. Mechanical system includes aero-shell with solar panel attached, carbon-fiber body or Aluminum or Steel support chassis, driver roll cage, hydraulic brake system, steering system, A-arm suspension system, wheel and battery protection box. The mechanical design process of solar-powered vehicle is highly focused on aerodynamics, efficiency, cost and reliability. The performance modeling is given as

$Total\ vehicle\ drag, DRAG_{total} = Aero\ DRAG\ , D_a + Mass * Acceleration + Rolling\ Resistance\ D_r, D_r + Incline\ Force\ , D_i$

- $Aero\ DRAG$: $D_a = \frac{1}{2}\ \rho\ C_d A v^2$
- $Rolling\ Resistance$: $D_r = C_r W$
- $Incline\ Force$: $D_i = W\frac{\%grade}{100}$

Where, $\rho = Mass\ densit$; $C_d = Drag\ coefic$; $A = Cross\ section\ Area$; $v = velocity$; $C_r = rolling\ coefficient$; $W = vehicle\ weight$

This model shows the total power usage of this vehicle: $Power = DRAGtotal * Velocity$. Based on the performance model, the key factor of power usage is the overall weight of the vehicle, rolling resistance of tires, vehicle projected area and the vehicle velocity. To achieve an efficient vehicle Mechanical finite element analysis (FEA), stress analysis, computational fluid analysis and heat transfer analysis are highly recommended during design phase.

Electrical system includes solar array design, maximum power tracking system, Lithium based battery pack balancing, battery protection system, driver operation panel, turn signals, brake lights, electrical motor and motor controller. The electrical design process is focused on energy harvesting and battery protection. Based on the electrical motor and driver operation requirement, along with the available surface area of aero shell, the total amount of solar panel and battery can be determined. All batteries need to be characterized and group carefully to ensure the maximized performance.

This solar vehicle design is all about design trade-off and optimization. For example, to reduce the aero drag, it is desired to have a smaller cross section area, however, to harvest more solar energy, it is desired to have more surface area for solar panels which may result in a larger cross section area. The lighter of the vehicle, the better energy efficiency it has. Hence, all system cannot be designed separately, communication between team members is critical for overall vehicle optimization.

19th Annual Berea College Undergraduate Research and Internship Symposium, October 18, 2019, Berea College, Berea, Kentucky (Poster Presentation)

Funded by the Rayburn Solar Power Fund and Berea College URCPP

APPENDIX: WORK INTERNSHIPS

African American Studies Department

55. Partners for Youth Internship. Aliyah Hocker[1], Briana Persley[2], Angie Green[2], Trace Williams[2], and Dariane Johnson[2]. [1]African American Studies Department, Berea College, Berea, Kentucky, 40404. [2]Partners for Youth, Lexington, Kentucky, 40507.

Agriculture and Natural Resources Department

56. Climate Change in Alaska. Luis Salazar Guzman[1], Sarah Hall[2], and Andrea Woodward[3]. [1]Chemistry Department, Berea College, Berea, Kentucky, 40404. [2]Agriculture and Natural Resources Department, Berea College, Berea, Kentucky, 40404. [3]Sociology Department, Berea College, Berea, Kentucky, 40404.

Biology Department

3. **Determinants of Health in Underserved Communities.** Jennifer Bentz[1], Wendy Klein[2], and Sarah Blank[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Health Brigade, Richmond, Virginia, 23230.

4. **Basic Butterfly Gardening.** Morgan Cottrill[1], Christopher Kline[2], and Neil Douglas[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Butterfly Ridge Conservation Center, Rockbridge, Ohio, 43149.

5. **Veterinary Internship.** Jose Diaz[1], Mariel Gonzales[2], and Dawn Anderson[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Kanuga Animal Clinic, Hendersonville, North Carolina, 28739.

6. **Audience-Ape Behavioral Study.** Deshawn Phillips[1], Clia Hancock[2], Hannah Purvis[2], Peter Hanes-Gonzalez[2], and Brian Slatterly[2]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Lincoln Park Zoo, Chicago, Illinois, 60614.

7. **Integrated Pest Management and Outreach Activities.** Maddy Richmond[1], Jerome Grant[2], and Ron Rosen[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]University of Tennessee, Knoxville, Tennessee, 37996.

8. **Wildlife Rehabilitation at PAWS.** Caitlyn Rickman[1], Lauren Caruso[2], and Ron Rosen[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]PAWS Wildlife Center, Lynnwood, Washington, 98087.

9. **King's Eye Care Internship**. Laly Rivera[1], Sarah King[2], and Megan Hoffman[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]King's Eye Care, Berea, Kentucky, 40403.

10. **Center on Trauma and Children Internship.** Megan Voorhees[1], Jessica Eslinger[2], and Megan Hoffman[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Center on Trauma and Children, University of Kentucky, Lexington, Kentucky, 40509.

11. **Foraging Behavior of Indian Elephants.** Izabella Walker[1], Kerri McCrea[2], Alex Johncola[2], and Megan Hoffman[1]. [1]Biology Department, Berea College, Berea, Kentucky, 40404. [2]Kindred Spirit Elephant Sanctuary, Chiang Mai, Thailand.

Child and Family Studies Department

12. **Physical Therapy Internship.** Glendy Pineda[1], Christopher Gridley[2], and [3]Louisa Summers. [1]Child and Family Studies Department, Berea College, Berea, Kentucky, 40404. [2]PIVOT Physical Therapy, Canton, North Carolina, 28716. [3]Health Human Performance Department, Berea College, Berea, Kentucky, 40404.

Computer Science Department

13. **Wedding photography Internship.** Oluwatobi Adejumo[1], Jay Lim[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Jaylim Studio, New York, NY 10012.

14. **Creating Plugin-Servers that stream telemetry data via GRPC transport protocol in GPB wire format.** Jamal Aw Yonis[1], Gavin Cato[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Dell Inc., Santa Clara, California, 95054.

15. **Berea College Software Developers.** Hailey Barnett[1], Brad Miller[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Runestone Interactive, LLC, Decorah, Iowa, 52101.

16. **Comparing the Model-View-Controller Architectural Design.** Alex Bryant and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

17. **Web Development Intern.** Nmasichi Chukwuemeka[1], Alex Clay[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Suran Systems, Versailles, Kentucky, 40383.

18. **Data Management.** Guillermo Cruz, Scott Heggen, and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

19. **Elasticsearch.** Selemawit Gebremedhin[1]**,** Daniel Adams[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Marketing and Communications Department, Berea College, Berea, Kentucky, 40404.

20. **The Performance Comparison of MySQL and SQLite.** Elaheh Jamali, Dr. Scott Heggen, and Dr. Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

21. **Software Development.** May Jue, Scott Heggen, and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

22. **Application Design and Development.** Samriddha KC[1]**,** Stephanie Mondo[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Morgan Stanley, New York, New York, 10036.

23. **Advantages of detection architecture combined with classification in camouflage circumstances.** Giorgi Lomia[1], Aliyah Pandolfi[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Kashmir World Foundation, Great Falls, Virginia, 22066.

24. **Web Application Design and Software Development.** Hila Manalai and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

25. **Design and Implementation of a Single-Page Web Application.** Raymond Okyere-Forson[1]**,** Stephanie Mondo[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Morgan Stanley, New York, New York, 10036.

26. **Global Technician Specialist.** Anne Otieno[1]**,** Nuriel Garrett[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Google, New York, New York, 10011.

27. **SSDT 2019 Intership.** Luis Riera, Scott Heggen, and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

28. **Software Development Experience.** Sherzodjon Sanginov[1], Stephanie Mondo[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Morgan Stanley, New York, New York, 10036.

29. **Software Programming.** Roberto Santos-Hernandez, Scott Heggen, and Jan Pearce. Computer Department, Berea College, Berea, Kentucky, 40404.

30. **Interactive Learning from a Near-Peer Perspective.** Gerardo Soto[1], Jesse Walker[1], John Martin[1], Rusty Dotson[1], Rebekah Whitford[1]**,** Bradley Miller[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Runestone Interactive, LLC, Decorah, Iowa, 52101.

31. **Network Planning Tools (NPT).** Tirtha Subedi[1], Dan Chambers[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]UPS Information Technology.

32. **Open Source Software Development in Agile Environment.** Dostonbek Toirov[1], Jennifer Albertson[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Red Hat, Raleigh, North Carolina, 27601.

33. **Robotic and Intelligent Process Automation.** Elyor Tukhtasinov and Jan Pearce. Computer Science Department, Berea College, Berea, Kentucky, 40404.

34. **Utilizing Electronic Dental Record Data to Automatically Assign Periodontal Diagnosis.** Ahad Zai[1], Thankam Thyvalikakath[2], Jay Patel[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Indiana University School of Dentistry, Indianapolis, Indiana, 46202.

35. **The Use of MVC Architecture (Model-View-Controller Pattern) for Android Mobile Applications.** Emely Alfaro Zavala[1], Aliyah Pandolfi[2], and Jan Pearce[1]. [1]Computer Science Department, Berea College, Berea, Kentucky, 40404. [2]Kashmir World Foundation, Great Falls, Virginia, 22066.

History Department

36. **Never to Come Again: Encounters with the Market in the Diary of Mary Brainard.** Hamilton Craig[1], Field Horne[2], and Joshua Guthman[1]. [1]History Department, Berea College, Berea, Kentucky, 40404. [2]Saratoga Springs History Museum, Saratoga Springs, New York, 12866.

Mathematics Department

37. **Dementia Friendly Communities**. Tiana Moorer[1], Sally Pitt[2], and Chelsea Ridley[2]. [1]Mathematics Department, Berea College, Berea, Kentucky, 40404. [2]Tennessee Department of Health, Nashville, Tennessee, 37219.

Physics Department

38. **Making Space for Assistive Technology.** Justin Vankirk[1], Emerson Ysayama[2], and Tracy Hodge[1]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]Community Lifestyle Support, Kalkie, Australia.

39. **Summer Internship with Civil Engineering Firm.** Jose Zapata Meza[1], Jim Albert[2], and Martin Veillette[1]. [1]Physics Department, Berea College, Berea, Kentucky, 40404. [2]LDA Engineering, Knoxville, Tennessee 37701.