Student Research Poster Display

Caputo Hall Lobby
October 20-25, 2017

Applied Engineering, Safety and Technology
Biology  Physics  Chemistry
Earth Sciences  Mathematics

College of Science and Technology
Welcome Message from the Dean

On behalf of everyone in the College of Science and Technology, welcome to the 17th Annual Fall Student Research Poster Display. In your program, you will find sixteen abstracts of student/faculty research that are representative of the excellent and innovative work being done within the College.

Student/faculty research has a rich history at Millersville University with the goals of this event being to
- celebrate the breadth of research inquiry and scholarly activity within the College,
- promote and create a sense of excitement about the research students and faculty are collaboratively engaging in, and
- recognize the hard work and dedication of our students and faculty.

Engaging undergraduates in research is critical to a student’s development as a scholar and innovator as well as a key feature in Millersville University’s strategic plan, Our Bold Path. Identified as a high-impact practice, research experiences place the content knowledge students learn in the classroom into the context for how it is used within the discipline and by practitioners in the field. I would like to thank Dr. Aaron Haines, Ms. Marianne Frantz, and Ms. Lynnea Holler for organizing the event and Ms. Megan Greenplate for creating the brochure.

I hope you enjoy perusing the poster displays and the fine work performed by our students and faculty.

Sincerely,

Michael Jackson
Dean, College of Science and Technology
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1. From Stormwater to Stream - How Will We Keep Our Waterways Clean and Generous for Ourselves and for Our Future Generations?

McEvoy, Patricia (MU 2016); Lauer, Bonita (MU 2016); Murray, Timothy (MU 2016); Khalighi, Mehdi*

Department of Applied Engineering, Safety & Technology, Millersville University, Millersville, PA 17551

Pennsylvania has nearly 4,000 lakes, reservoirs and ponds, all linked and fed by over 83,000 miles of streams and rivers. This research looks at stormwater control programs in Lancaster County and the surrounding municipalities, as poorly monitored stormwater runoff is having major impacts on our precious water resources.

We identify programs that have been the most successful in order to utilize their practices as a template for other stormwater management programs to emulate. The goal is to show what impacts stormwater management programs have had on our waterways, both positive and negative.

2. Exposure to Bisphenol A on Millersville University Campus

Warner, Randi; Waugh, Rita (MU 2017); Wagner, Brandon (MU 2017); Khalighi, Mehdi*

Department of Applied Engineering, Safety & Technology, Millersville University, Millersville, PA 17551

The effects of Bisphenol A (BPA) on human health and the environment were examined. Research findings indicated that Bisphenol A is a chemical found in polycarbonate plastics and epoxy resins. BPA is commonly found in food and beverage packaging along with various other consumer products. Studies, including an expert panel consensus supported by the National Institutes of Health, have found that BPA can negatively affect the endocrine system in humans and animals. Based on these findings, a study will be conducted to determine the prevalence of BPA in the plastic food and beverage containers offered to Millersville University students by the on-campus dining service. The study will record the number of containers with a resin code of 7 and calculate the percentage of containers that contain BPA. The research will conclude the extent of exposure to BPA on campus.
3. Traffic Pollution: A Study of Congested Areas on Route 30 of Lancaster, Pennsylvania

Darrah, Morgan (MU 2017); Mancini, Nick (MU 2017); Khalighi, Mehdi*
Department of Applied Engineering, Safety & Technology, Millersville University, Millersville, PA 17551

In August 2016, the Environmental Protection Agency declared Lancaster County, Pennsylvania a maintenance area in regards to air quality. Parts of Lancaster’s air pollution levels fail to meet the NAAQS standards, specifically for exposure to PM. Fine particles emitted from motor vehicles on major highways pose enormous health risks to humans exposed and can lead to short and long-term respiratory health effects. Due to the number of trucks that travel on Route 30 in Lancaster daily, the most congested areas surrounding Tanger and Rockvale Outlets are likely to be strong areas of concern. Real-time air sampling at fixed locations will be taken from 2090 Lincoln Hwy East to 35 S Willowdale Drive and the results will be compared to the NAAQS Standards. The research will assist city and public health officials to consider control measures of reducing traffic-induced PM air pollution and adverse health effects to the population exposed.

Biology

4. Migration of Trunk Neural Crest Cells in *Trachemys scripta*

Dougherty, Moira; Cadavid, Veronica (MU 2017); Smith, Matthew (MU 2014); Cebra-Thomas, Judith*
Department of Biology, Millersville University, Millersville, Pa 17551

Turtles plastron bones develop through intramembranous ossification, suggesting they are neural crest derived, similar to some craniofacial bones. *Trachemys scripta* turtle embryos (G16-17) undergo a second migration of late-emerging skeletogenic trunk neural crest cells (NCCs) which migrate ventrally and aggregate in the region of the forming plastron. Whether this late-migrating subpopulation of NCCs results from premigratory NCCs which remain dormant in the neural tube or if a new induction event is required to produce NCCs is unknown. Through in situ hybridization and immunostaining, the expression of premigratory neural crest specifiers during and between the two waves of migration in *T. scripta* embryos is being investigated. Transcription factors Sox9, Sox10 and FoxD3 are neural crest specifiers and are expressed in premigratory and migratory NCCs. They are expressed in the dorsal neural tube of chicken embryos until the cessation of trunk NCC migration. If the expression of these premigratory markers persists in turtle embryos after the first wave of NCC migration, it would suggest that a premigratory NCC population is maintained in stage G12-14 turtle embryos. The lack of NCC
migration in vivo may be due to the lack of a supportive environment, or to other factors regulating the epithelial-to-mesenchymal transition.

5. Multipotency of Trunk Neural Crest Cells in *Trachemys scripta*

*Martin, Seth, and Cebra-Thomas, Judith*

Department of Biology, Millersville University, Millersville, Pa 17551

The bony plates that comprise the ventral part of the turtle shell (the plastron) are formed by intramembranous ossification, the same process that produces many of the bones of the skull. Several anterior skull bones and facial structures are produced by a population of migrating, multipotent cells originating from the developing central nervous system, known as neural crest cells (NCCs). Previous research has demonstrated that trunk NCCs, arising from the developing spinal cord instead of the brain, migrate in two distinct waves in turtle embryos. This experiment tested the hypothesis that the second wave of trunk NCCs in turtle embryos is capable of differentiating into bone. Turtle (*T. scripta*) NCCs were isolated and allowed to differentiate, and the resulting cell types were analyzed by antibody staining and fluorescent microscopy. The fraction that produced typical NCC-derived cells (i.e. pigment cells) was compared to the fraction that produced osteoblasts. Our results suggest that the late trunk NCCs are predisposed to differentiate into osteoblasts, and thus provide good candidates for the cells that form the plastron. Craniosynostosis is a common human developmental deformity involving premature fusion of the calvarial sutures. A better understanding of intramembranous ossification, and analysis of an enriched population of osteogenic NCCs, could result in improved treatment options.

6. Microbiome Analysis of Parasitic Louse Flies on Migrating Raptors and the Potential for Pathogen Dispersal

*Thomas, Kayli; McCabe, Rebecca (MU 2013); Benbow, M. Eric; Pechal, Jennifer; Receveur, Joseph; Wallace, John*

Department of Biology, Millersville University, Millersville, PA 17551

Avian species often experience many pathogenic, ecological, and behavioral effects from the ectoparasites to which they are highly susceptible; parasites can affect long-term survival of raptors by reducing reproductive success and negatively affecting their ability to compete for resources and avoid predation. Migrating birds have played a role in the spread of several known human pathogens, e.g., *Borrelia burgdorferi*, the causative agent of Lyme Disease and West Nile virus. The aim of this project is to characterize the abundance of louse flies (Order: Diptera; Family: Hippoboscidae) on different migrating raptors over time as well as the microbial communities found within blood feeding hipposboscids to gain a better understanding of
potential avian pathogens and the potential dispersal of these pathogens during migration. A field survey of hippoboscids and analysis of the microbiomes within these ectoparasites throughout the migration period may provide baseline information on the possible movement and dispersal of avian pathogens via migrating ectoparasites and the role, if any, raptor diversity plays on ectoparasite abundance and microbial community diversity and dispersal. Birds were trapped by mist or bow net by banders at the Little Gap Banding Station in Northampton, PA as part of an annual effort to monitor migrating raptor populations. Collection of hippoboscids from the dorsal and ventral portions of six different raptor species was carried out, resulting in a cumulative total of 113 louse flies between 2015 and 2016. Louse fly samples for microbiome analysis (n = 3 flies/bird) were used for metagenomic analyses of bacterial communities. Abundance of occurring taxa was determined using QIIME software. More than half of all raptors surveyed in this study were found to be hosts to hippoboscid louse flies. A better understanding of the relationships between louse flies and their microbiomes may potentially elucidate valuable information useful in the conservation of raptors via reducing the effects of ectoparasites on migrating raptors.

7. Lab Validation of a Container Oviposition Sticky Trap for Collection of *Aedes aegypti* Mosquitoes

*Hutchinson, Phil; Thomas, Kayli; Wallace, John*
Department of Biology, Millersville University, Millersville, Pa 17551

Mosquito transmitted pathogens such as the Zika and Dengue viruses that are primarily vectored by *Aedes aegypti* mosquitoes has become a major worldwide focus for mosquito and disease. Container breeding mosquitoes such as *Ae. aegypti* and *Aedes albopictus* utilize both natural (e.g., treeholes and plant axils) and anthropogenic containers (such as tires, cans, and buckets) to breed. These ovipositional habitats have been neglected in control methods until recent years. To date, all traps developed (n = 2-3) utilized some form of chemical control for adults or larvae. We have partnered up with a local company interested in testing the efficacy of a unique design for an *Aedes* ovi- sticky trap that is organic in nature, i.e., does not use any toxic chemical to trap or kill mosquitoes. The objectives for this study included: 1) determine if this novel trap will collect mosquitoes; and 2) compare how various attractants utilized in the trap fare in collecting mosquitoes. Adult *Ae. aegypti* mosquitoes were obtained from a breeding supply company and blood fed using bovine calf blood and sausage casing. Mosquitoes were inserted into 61 X 61cm cages with container traps placed at random locations inside the cage (n = 6 replicate cages per trial). There were two trials conducted per experiment. Approximately 100 (7-8 day old) gravid female mosquitoes were used in each cage and maintained at 14:10 (L:D ratio) and at 26°C. We tested three different attractants; yeast pellets, a biofill additive whose purpose is to increase glue coverage on the trap, and caproic acid. Yeast attractant was included within the water of each container whereas, biofill and caproic acid were incorporated into the sticky grid of the trap.
Cages were monitored for 48 hours and removed for counting of trapped mosquitoes. Preliminary results have shown water without yeast attractant combined with a single grid trap to be the most effective at luring adults, the biofill additive is effective in increasing ensnarement, and caproic acid at 1.0ppm concentration is the most effective at attracting mosquitoes to oviposit. With design changes resulting from this data, it will be possible to bring to market an inexpensive, non-toxic mosquito trap aimed at tropical and subtropical countries where Zika and Dengue viruses represent serious threats.

8. Quantifying Threats to Endangered Species to Improve Conservation Efforts

Costante, Delaney1; Sandercock, Alexander1; Thomas, Kayli1; Evans, Jessica2; Treakle, Tyler2; Ritrovato, Isabel2; Hollingsworth, Maggie2; Check, Courtney2; Rydberg, Ann Marie2; Caron, Rachel2; Leu, Matthias2*; Haines, Aaron1*
1-Department of Biology, Millersville University, Millersville, PA 17551
2-Biology Department, College of William and Mary, Williamsburg, VA 23185

The purpose of this study was to quantify threats facing U.S. species listed as ‘Threatened’ or ‘Endangered’ (n = 1356) under the Endangered Species Act. Federal Register Documents were reviewed to identify threats that impacted species at their time of listing and how they have changed over time. Threats were separated into six broad categories: habitat modification, overutilization, pollution, species-species interactions, demographic stochasticity, and environmental stochasticity. The results show that habitat modification has been the most pervasive threat, and is increasing in frequency. Overutilization is a less common threat, and has been consistently declining. Species-species interactions and environmental stochasticity have drastically increased in frequency since the beginning of the act. Today species are facing more threats at their time of listing in comparison to when the ESA began. Based on these trends, we provide recommendations on how to improve the recovery process for endangered species.

9. Evaluation of Non-invasive Hair Dyes in Marking Small Mammal in Field Studies

Bridgehouse, Tyler and Haines, Aaron*
Department of Biology, Millersville University, Millersville, PA 17551

Mark-recapture is used in wildlife research to provide estimates of population density, survival, recruitment and movement to help guide management decisions. For small mammal research, ear-tagging has been successfully used to mark individuals, however ear-tags can inhibit grooming and promote infection. The use of Passive Integrated Transponder (PIT) tags have also been used to mark small mammals, but PIT tags are prone to falling out of the body and causing infection. Hair dyes are favored for short term mark-recapture studies because they are relatively low cost, can be applied easily and are less stressful and damaging to marked
individuals. Our objective was to test the effectiveness of Clairol hair-dye and The Muromachi Kikai hair-dye marker on *Peromyscus leucopus* and *Blarina brevicauda*. Our study was conducted within Millersville University and consisted of two transect lines, each with ten Sherman traps checked three times a week over three months. We captured 33 individuals and marked each of them once with both hair-dyes. These individuals were then monitored based on recapture events (n=116). All captured individuals were photo recorded to validate the effectiveness of the hair-dye marks. Results showed that the Muromachi Kikai hair-dye marker outlasted the Clairol hair-dye and can be used to distinguish most individuals after 7 weeks in the field. We concluded that the Muromachi Kikai hair-dye marker could be used in short-term (< 3 months) studies of small mammals.

**Chemistry**

10. **Synthetic Studies Toward Altersolanol P and Derivatives**
*Bentzel, Tobias C.; Frey, Brandon L.; Kennedy, Steven Merwin*<sup>*</sup>
Department of Chemistry, Millersville University, Millersville, Pa 17551

Altersolanol P (AP), a new member of the altersolanol family of compounds, is the inspiration for multiple synthetic studies in our laboratory. Previously, we synthesized an intermediate, containing the complete carbon framework of AP, via Lewis acid-mediated Diels-Alder cycloaddition on multi-gram scale (in 80% yield and 8:1 regioselectivity). Current synthetic efforts are focused on epoxidations, anti-diol formations, and syn-dihydroxylations of Diels-Alder adducts based on the work of Krohn et al. The biological activities of derivatives can be further studied.

11. **Imine Library Synthesis via Solvent-Free Reactions**
*Gillis, Samantha K.; Thames, Joy E.; Kennedy, Steven Merwin*<sup>*</sup>
Department of Chemistry, Millersville University, Millersville, Pa 17551

We have initiated studies to expand the scope of Touchette’s solvent-free imine formation reaction between ortho-vanillin and para-toluidine. These reactions are cost efficient and exhibit green chemistry properties. The primary goal of this project is to synthesize and characterize a variety of imines. We are taking two related approaches to this study: imine synthesis via para-toluidine and a library of substituted salicylaldehydes or imine synthesis via ortho-vanillin and a library of substituted anilines. Previous studies on structurally similar imine ligands—and their bidentate metal complexes—have revealed multiple biological activities for this class of
molecules, including bactericidal properties. We hope to further explore the antibacterial properties of new all compounds produced from our synthetic work. Future studies also include reductive amination of the synthesized imines.

12. Exploring the Regioselective Diels-Alder Reaction Scope of 1,4-Naphthoquinones

Good, Gillian N.; Ma, Weihao ‘Howard’; Kennedy, Steven Merwin*
Department of Chemistry, Millersville University, Millersville, Pa 17551

Altersolanol P (AP), a new member of the altersolanol family of compounds, is the inspiration for multiple synthetic studies in our laboratory. The altersolanols, and structurally similar compounds, exhibit antibacterial activity. Recently, we reported our work toward the regioselective synthesis of intermediates en route to altersolanol derivatives via lewis acid catalyzed Diels-Alder reactions of the natural products isoprene and Juglone (5-hydroxy-1,4-naphthalenedione). Epoxidation or dihydroxylation of the resulting adducts is expected to provide a small library of altersolanol derivatives for antibacterial testing. To further expand the molecular diversity of our library, in this study, we will explore the reactivity of 1,4-Naphthoquinone dienophiles with dienes, such as (2E,4E)-2,4-Hexadienyl acetate and 2,4-Hexadien-1-ol. We eventually hope to substitute Juglone (5-hydroxy-1,4-naphthalenedione) for 1,4-Naphtoquinone to explore regioselectivity of the Diels-Alder reaction. New compounds will be tested for antibacterial activity.

13. Expanding the Green Scope of Pentaerythritol Acetal Formation

Marrazzo, John-Paul R.; Simon, Samantha N.; Kennedy, Steven Merwin*
Department of Chemistry, Millersville University, Millersville, PA 17551

Acetals are germinal diether derivatives of aldehydes formed by the reaction of an aldehyde with two alcohols. Collard et al. have shown that by utilizing temperature control, benzaldehyde and pentaerythritol, when mixed in water with catalytic acid, can selectively form monoacetal derivatives. The goal of our project is to expand the substrate scope of this monoacetal selective reaction to synthesize new monoacetals and to define their structure using 2D NMR techniques. Acetals similar to our target monoacetal products are used in a variety of synthetic applications. They have served as alcohol protecting groups in route to polymer-based adhesives and synthetic glycodendrimers for nanomedicine applications in drug delivery and vaccines. Our work should help to broaden the synthetic utility of this user-friendly and environmentally benign reaction. It is also hoped that this work will produce starting material for multistep synthesis routes optimized for use in advanced-level undergraduate teaching laboratories. Preliminary results based on studies using the NMR internal standard dimethyl sulfoxide indicate that many
substituted benzaldehydes will provide a level of selective monoacetal formation.

Earth Sciences

14. Cross-Frontal Exchange of Water Masses Across the New England Shelf Break Front Observed Using the Coastal Pioneer Array

Egbert, MarieClaire E.; Alexander, Cassandra; Parkes, Robert (2016); Vaillancourt, Robert D.*

Department of Earth Science, Millersville University, Millersville, Pa 17551

We studied the physical characteristics of the water column near the New England Shelf Break Front in the North Atlantic Ocean over seasonal time scales using the Coastal Pioneer Array. The purpose of our study was to observe and explain the seasonal changes in the physical characteristics of the water column and to detect cross-frontal exchanges of shelf and oceanic waters. There was an unusual water mass that intruded on the study site beginning in late May and extending into June, of 2014. This event appeared as an abrupt warming from ca. 15°C to ca. 25°C, accompanied by an abrupt increase in salinity from ca. 35 psu to ca. 36.5 psu. The intrusion extended initially to ca. 200 m depth and increased to ca. 400 m depth, and was accompanied by sudden decreases in in-vivo chlorophyll a fluorescence, indicating oligotrophy. We hypothesize that this intrusion was from a warm core ring or current meander shed from the north side of the Gulf Stream, whose main axis is located to the south of the study site. MODIS sea surface temperature data for this time period does not support this hypothesis, however, as it appears that the warmer oceanic water is not intruding on the study site location. It is possible that the sea surface temperature data from the satellite does not see deep enough into the water column to show the intrusion, however. We will also present evidence for additional cross-frontal intrusions for the years 2015 through 2017, but these analyses were not yet complete by the meeting abstract due date.
15. An $A_\infty$-Coalgebra Structure on a Polygon

Minnich, Quinn; Umble, Ronald*
Department of Mathematics, Millersville University, Millersville, PA 17551

Let $P$ be a polygon with $n$ vertices, let $V$ be the graded vector space generated by the vertices, edges, and region of $P$, and let $\partial: V \to V$ be the map induced by the boundary. There is a homotopy coassociative coproduct $\Delta_2: V \to V \otimes V$, a coassociator $\Delta_3: V \to V \otimes V \otimes V$, and non-vanishing higher order operations $\Delta_k: V \to V \otimes^k$ for all $k < n$. The vector space $V$, together with the boundary map $\partial$, coproduct $\Delta_2$, and higher order operations $\Delta_k$, $k \geq 2$, is called an $A_\infty$-coalgebra. To our knowledge, no such family of $A_\infty$-coalgebras has appeared in the literature.

16. Analyzing the nanostructure of a peacock feather using spectroscopy and microscopy

Huska, Dylan; Dushkina, Natalia*
Department of Physics, Millersville University, Millersville, PA 17551

Humans have been interested in colors since the dawn of time, and that is no different now. Our understanding of color has increased from learning how to harvest colors, to understanding how pigments work, and how to create them. The next step is to move in to structural colors, colors produced by light interacting with bio nanostructures. The blue and green iridescent colors with metallic sheen that are found in nature, are all products of structural coloration. One of the most beautiful displays of color is found in the eye of the feather of the Pavo cristatus, more commonly known as the Peacock. This project will analyze the eye of the peacock feather using techniques in spectroscopy and microscopy. The spectrum reflected by the eye will be tested through multiple angles and multiple lighting scenarios. The eye of the feather will also be observed under a polarizing microscope to investigate the polarizing effects. In addition, the eye will be observed under a scanning electron microscope (SEM) to determine the shape and nature of the nanostructures that generate the magnificent color of the feather.
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An asterisk (*) denotes the SCTE faculty mentor for the student research