ACS Local Section
Midland

Programming Booklet

ACS Midland Section
The 80th Fall Scientific Meeting

October 25, 2024

Central Michigan University

Mt. Pleasant, Michigan

Additional meeting details can be found at:

https://midlandfsm.org/

ACS Local Section Midland

Guests Park in Lot 33

CMU Campus Map

https://www.cmich.edu/docs/default-source/finance-and-administrative-services-division/cmu-police/parking-services/cmu-campus-map.pdf

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2024 Fall Scientific Meeting Schedule

Friday, October 25, 2024

Time	Location	Event
9:00 AM – 3:30 PM	BIOSCI Atrium (East End)	**Registration**
10:00 AM - Noon	BIOSCI 1015	**Career Expo**
Noon – 12:30 PM	BIOSCI Atrium	**Coffee Break**
12:30 – 1:30 PM	BIOSCI 1015	**Meeting Welcome and Keynote Address** **Keynote Speaker: LaShanda Korley** **"Tackling the Plastics Waste Challenge via Catalytic Innovations, Macromolecular Chemistry, and Sustainable Feedstocks"**
1:40 – 3:00 PM	BIOSCI 1015	**Speed Oral Presentations (Contributed)** -Shalin Patil, "Supramolecular structures and dynamics of a class of hydrogen bonding liquids: monohydroxy alcohols" -Zachary Henderson, "A Network-Based SEIR Model for COVID-like Infectious Diseases via U.S. Air Transportation" -Sujith Reddy Ganta, "Effect of surfactant on a lipid Bilayer using DPD" -Sabrina Curley, "Photopolymerization Induced Phase Separation as An Elegant Approach for Designing Surfaces for Water Collection" -Mohamed Hamza, "Removing arsenate from water with molecularly imprinted membranes" - Nadia Allahyarzadeh Khiabani, "Non-Invasive Intranasal Administration of G4 70/30 PAMAM Dendrimer in the C57BL/6 Mouse Model" - Mayank Singh, "Site Specific Delivery of Cancer Nano-therapies using Receptor Targeted Poly(amidoamine) (PAMAM) Dendrimers as Nano-vectors"
3:00 – 3:30 PM	BIOSCI Atrium	**Coffee Break**
3:30 – 5:45 PM	BIOSCI Atrium	**Poster Session**
5:45 – 6:00 PM	BIOSCI 1015	**Poster Awards and End of Conference**

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Keynote Address

"Tackling the Plastics Waste Challenge via Catalytic Innovations, Macromolecular Chemistry, and Sustainable Feedstocks"

Speaker: Prof. LaShanda Korley

12:30 – 1:30 PM, BIOSCI 1015

Abstract: Polymers are ubiquitous in the modern world, and the demand for and production of plastic products continues to rise. Alternative approaches are critical in the transition from a dependence on petroleum feedstocks to the utilization of biomass building blocks towards the development of robust polymeric materials with exceptional mechanical function and thermal properties. I will share innovations designed to establish a life cycle management framework for polymer design, focusing on biomass building blocks derivable from lignin sources. Examples of performance-advantaged polymer materials, including thermoplastics and thermosets, will be described, with the potential to address health impacts of petroleum-derived analogs, to promote sustainable manufacturing, and to serve as functional matrices for composite design. To tackle the global problem of plastics pollution, I also will overview deconstruction and upgrading strategies to tackle plastics waste complexity, including architectural variations and additives/contaminants.

Bio: Prof. LaShanda T. J. Korley is a Distinguished Professor in the Departments of Materials Science & Engineering and Chemical & Biomolecular Engineering at the University of Delaware (UD). Previously, she held the Climo Associate Professorship of Macromolecular Science and Engineering at Case Western Reserve University, where she started her

independent career in 2007. Prof. Korley is the Director of an Energy Frontier Research Center – Center for Plastics Innovation (CPI) funded by the Department of Energy and also the Co-Director of a Materials Research Science and Center – UD Center for Hybrid, Active, and Responsive Materials (UD CHARM). She is also the Principal Investigator for the National Science Foundation Partnerships for International Research and Education (PIRE): Bio-inspired Materials and Systems and the codirector of the Center for Research in Soft matter & Polymers (CRiSP) at the University of Delaware. She received a B.S. in both Chemistry & Engineering from Clark Atlanta University as well as a B.S. in Chemical Engineering from the Georgia Institute of Technology in 1999. Prof. Korley completed her doctoral studies at MIT in Chemical Engineering and the Program in Polymer Science and Technology in 2005, and she was the recipient of the Provost's Academic Diversity Postdoctoral Fellowship at Cornell University in 2005. She was named a DuPont Young Professor in 2011, received a 3M Nontenured Faculty Grant in 2010, and was selected for the National Academy of Engineering Frontiers of Engineering symposium. She is a Kavli Fellow as part of the Japanese/American Frontiers of Science Symposium. Prof. Korley is a Fellow of the American Institute for Medical and Biological Engineering (AIMBE), American Physical Society (APS), and the American Chemical Society (ACS) Polymeric Materials: Science and Engineering (PMSE) Division. She also was awarded the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) Lloyd N. Ferguson Young Scientist Award for Excellence in Research and the American Institute for Chemical Engineers (AIChE) Minority Affairs Committee Gerry Lessells Award. Most recently, Prof. Korley was appointed a U.S. Science Envoy by the U.S. State Department. Her research focuses on bio-inspired polymeric materials, film and fiber manufacturing, plastics recycling and upcycling strategies, stimuliresponsive composites, peptide-polymer hybrids, fiber-reinforced hydrogels, and renewable materials derived from biomass.

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Science Career Expo

12:30 – 1:30 PM, BIOSCI 1015

The intent of this event is to provide a unique networking opportunity. This includes professionals working at different companies and students interested in a career in the chemical industry. The room we reserved is used for breakout college classes and so is perfect for this type of event. Companies will each be given a six-seater conference table with a TV and can set up as much or as little company information, show-and-tell, and/or swag as they prefer. Students from colleges and universities across mid-Michigan will be encouraged to visit the tables and talk to the professionals about their perspectives on a career in industry. Visitors will come-and-go throughout the two hours as their schedules allow. Last year this event naturally played out like a micro-mentoring opportunity, and the feedback was unanimously positive. This is not a job fair, which removes a lot of pressure on all participants.

List of companies and organizations

- **Agilent**
- **Dow**
- **IFF**
- **DuPont**
- **BASF**
- **Montrose Environmental**
- **Cayman Chemical Company**
- **DuPont WNN**
- **QuadSil Inc.**
- **Central Michigan University**
- **Haviland Products Company**
- **SK siltron**
- **Corteva**
- **Hemlock Semiconductor**
- **University of Michigan**

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Science Career Expo

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Engage with Industry Professionals and Experienced Chemists

Friday October 25
10:00 am -12:30 pm
CMU Bioscience 1015

Talk to Employees from:

Pharmaceutical Research & Development
Environmental Chemisrty & Sustainability
Materials Science and Engineering
Forensic Chemistry
Chemical Engineering in Manufacturing
Data Science in Chemical Industries
Biotechnology and Biochemistry
Academic Research & Teaching
Government and Regulatory Roles in Chemistry

Free Event - All Welcome
Explore your options
& find your career path
FREE lunch with registration:

Part of the ACS Fall Scientific Meeting
for more info: midlandfsm.org

Speed Oral Presentations (Contributed)

1:40 PM – 3:00 PM, BIOSCI 1015

This interactive approach utilizes CMU's active learning classrooms, featuring table configurations conducive to small group engagement. Each table, accommodating up to eight individuals, includes a convenient viewing screen.

Speakers deliver concise presentations (5 ~ 6 min), followed by a brisk Q&A session (2 min). Upon time's expiration, audience groups transition to the next table (2 min), repeating the process until exposed to all presentations.

#	Presenter, Affiliation, Presentation title
1	Shalin Patil, Central Michigan University “Supramolecular structures and dynamics of a class of hydrogen bonding liquids: monohydroxy alcohols”
2	Zachary Henderson, Central Michigan University “A Network-Based SEIR Model for COVID-like Infectious Diseases via U.S. Air Transportation”
3	Sujith Reddy Ganta, Central Michigan University Effect of surfactant on a lipid Bilayer using DPD
4	Sabrina Curley, Michigan State University Photopolymerization Induced Phase Separation as An Elegant Approach for Designing Surfaces for Water Collection
5	Mohamed Hamza, Central Michigan University Removing arsenate from water with molecularly imprinted membranes
6	Nadia Allahyarzadeh Khiabani, Central Michigan University Non-Invasive Intranasal Administration of G4 70/30 PAMAM Dendrimer in the C57BL/6 Mouse Model
7	Mayank Singh, The National Dendrimer and Nanotechnology Center Site Specific Delivery of Cancer Nano-therapies using Receptor Targeted Poly(amidoamine) (PAMAM) Dendrimers as Nano-vectors

1. Supramolecular structures and dynamics of a class of hydrogen bonding liquids: monohydroxy alcohols

Shalin Patil
Michigan State University, East Lansing, 48823

Monohydroxy alcohols (MAs) form supramolecular structures due to the hydrogen bonding association, which makes them a fascinating class of materials. A typical dielectric response of MAs reveals the presence of the two processes namely the Debye process, and the structural relaxation process. Broadband dielectric spectroscopy, light scattering and rheology have been actively applied in the past to study the characteristics of these supramolecular Debye relaxation processes. However, the molecular origin of the Debye relaxation and its connection with the hydrogen bonding association/dissociation dynamics remains a topic of active debating. In this talk, we combine broadband dielectric spectroscopy and rheology, i.e. the Rheo-dielectric spectroscopy, to investigate the molecular dynamics of monohydroxy alcohols. We find that shear can significantly modify the dielectric spectra, resulting in a reduction in both Debye-like relaxation time, t_D and structural relaxation time, t_α, of monohydroxy alcohols. Detailed analyses show an interesting relationship between the external shear and t_D^2/t_α that can be rationalized through considering explicitly the hydrogen bonding association/dissociation dynamics. All these observations help us in the development of theoretical understanding on the dynamics of MAs i.e. the living polymer model (LPM) which allows us to obtain relationships consistent with the experimental observations, ultimately leading to us develop a molecular mechanism of the Debye relaxation process. We will discuss these findings and the details of the theoretical development in the presentation.

2. A Network-Based SEIR Model for COVID-like Infectious Diseases via U.S. Air Transportation

Zachary Henderson and Leela Rakesh
Center for Applied Mathematics and Polymer Fluid Dynamics, Department of Mathematics,
Central Michigan University, Mt. Pleasant, MI 48859

This project develops a network-based SEIR model to simulate the spread of infectious diseases across the U.S., with states represented as nodes connected by weighted edges based on daily flight data from the USDOT Air Carriers dataset. To represent the population, two state matrices are employed to track the progression of individuals through disease stages: a "true state matrix" models the disease state of citizens of each location while a "current state matrix" models the disease state of individuals currently present in each location, which is a mixture of citizens of surrounding locations. The differential equations governing the system are derived and presented in a matrix equation for efficient coding, and simulations are conducted in R using COVID-19 parameters to produce spatial and temporal maps of disease spread, revealing how infections propagate through interconnected regions. In addition to infectious disease modeling, network analysis and compartmental models are applicable to various industrial contexts, such as monitoring supply chain disruptions. In the chemical industry, these can be used to track process disruptions, such as a reactor malfunction affecting interconnected units due to shared resources. Furthermore, future integration of AI with the SEIR framework can enhance predictive capabilities by allowing for real-time parameter adjustments. This synergy can enable proactive interventions in public health and industrial settings, leading to quicker responses to emerging threats and fostering more resilient systems through improved understanding of complex network interactions.

3. Effect of surfactant on a lipid Bilayer using DPD

Sujith Reddy Ganta
Central Michigan University, Mount Pleasant, 48858

This study investigates the impact of surfactants, specifically sodium dodecyl sulfate (SDS), on lipid bilayers through Dissipative Particle Dynamics (DPD) simulations. SDS, as an amphiphilic molecule, significantly influences the stability and properties of lipid membranes, affecting biological functions and drug delivery systems. Our findings reveal that varying concentrations of SDS disrupt lipid organization and enhance membrane permeability, leading to increased fluidity and notable changes in bilayer morphology. This research highlights the potential of surfactant-modified lipid bilayers in filtration applications, as these membranes can effectively remove contaminants for water purification and selectively filter biological molecules, such as proteins or nucleic acids, which is valuable in biotechnology. Additionally, lipid bilayers can be engineered to encapsulate drugs, with surfactants facilitating controlled release in drug delivery systems, while also enhancing the efficiency of chemical separation processes in industrial contexts. Although lipid bilayers show promise for filtration, practical applications must address factors such as stability, mechanical strength, and resistance to fouling. Further research is needed to optimize these membranes for real-world scenarios, potentially leading to significant advancements in filtration technologies across various fields.

4. Photopolymerization Induced Phase Separation as An Elegant Approach for Designing Surfaces for Water Collection

Sabrina Curley
Michigan State University, East Lansing, 48824

Several approaches in water-harvesting technology take inspiration from nature to address scarcity. Numerous animals and plants have developed over time unique surface interactions with water to aid their survival. One example is the Namib desert beetle which has a carapace decorated with hydrophilic macroscale bumps and hydrophobic channels with microscale bumps which promote fog condensation and collection. This and other natural designs can be translated into engineering solutions via lithography, machining, or 3D printing, however these approaches can require multiple-step processing conditions, associated excess time and energy, while also producing wasteful byproducts. As an alternative, we present how utilizing photopolymerization induced phase separation (PIPS) can enable complex chemical and physical surface patterning in a single UV curing process. Vinyl acetate/1,6-hexanediol diacrylate comonomer resins with poly(dimethyl siloxane) were cast as 10cm x 10cm coatings and cured at low UV intensity (0.001 W/cm^2) to promote slow reaction kinetics. At the beginning of UV exposure, resin/water interfaces were introduced to the system, driving macroscale domain coalescence based on surface energy. The array of surfaces was characterized by roughness, contact angle behavior, and ability to harvest water from humidity. PIPS surfaces demonstrated higher volumes of water collection compared to controls, and chemically heterogeneous surfaces collected the most water of all conditions. This study highlights the interplay of phase separation, surface wrinkling, and wettability, showing how these oft isolated phenomena can be used in conjunction with one another to realize unique solutions in terms of complex surface design.

5. Removing arsenate from water with molecularly imprinted membranes.

Mohamed Hamza
Central Michigan University, Mount Pleasant, 48858

The presence of toxic chemicals in drinking, industrial, and wastewater is still a serious concern, with pollutants like arsenate being particularly hard to remove. While current water treatment methods work well for many contaminants, they are less effective for this specific chemical. This project aims to use molecularly imprinted polymers (MIPs) and graphitic carbon nitride to fabricate membranes to remove arsenate from water. MIPs provide a specific site for arsenate to be removes, while graphitic carbon nitride provides porosity to the membranes. To fabricate the membranes we are using electrospinning, a technique that allows us to control the pore size of the membrane. This research presentation provides initial data on creating imprinted membranes through this process. We created the membranes by adjusting various parameters of the polymer and the electrospinning instrument, then examined the effects of these changes on the membrane quality.
We started by adjusting the viscosity of the polymerization solution, then added pre-polymerizing the solution before electrospinning. We also left the polymer under UV light to get rid of the monomer, which was effective, which was shown by Infrared Spectroscopy analysis. From the results of our experiment, we concluded that pre-polymerizing the solution was the most effective and gave the most consistent results. We are currently working on improving the strength of the membrane.

6. Non-Invasive Intranasal Administration of G4 70/30 PAMAM Dendrimer in the C57BL/6 Mouse Model

Nadia Allahyarzadeh Khiabani
1 Field Neurosciences Institute Laboratory for Restorative Neurology, Central Michigan University, Mount Pleasant, MI 48859 USA
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Various methods of drug administration to the brain have been investigated, but the blood-brain barrier (BBB) remains a major obstacle for neurological disorders. Nanocarriers have emerged as a promising strategy to overcome this barrier. Among these, intranasal administration offers a direct route to the brain, bypassing the BBB. Dendrimers are highly branched, tree-like macromolecules consisting of a central core, inner layers, and terminal functional groups. PAMAM (Polyamidoamine) dendrimers are comprised of repeating amide (R-C(=O)-NH2) and amine (R-NH2) units, giving them a flexible, biocompatible structure. In vivo studies using G4 PAMAM dendrimers administered intranasally show no significant toxicity, underscoring their promise as a safe and effective approach for CNS drug delivery.

This study involved male and female C57BL/6 mice. The treatment group received daily intranasal doses of CY5.5-labeled G4 70/30 PAMAM dendrimers, while the control group received HBSS. The In Vivo Imaging System (IVIS) was used weekly for three weeks to track fluorescence. After this period, fresh organ samples (brain, lung, liver, kidney) were collected from all mice, frozen, and sectioned for analysis. Fluorescence microscopy of the sections revealed a higher accumulation of G4 70/30 PAMAM dendrimers in the brain, liver, and kidney of the treatment group compared to the control group, which showed no significant differences when treated with HBSS. In conclusion, our findings demonstrate that G4 70/30 PAMAM dendrimers can be successfully delivered intranasally to the C57 mouse brain, indicating the effectiveness of intranasal delivery for neurological diseases.

7. Site Specific Delivery of Cancer Nano-therapies using Receptor Targeted Poly(amidoamine) (PAMAM) Dendrimers as Nano-vectors

Mayank Singh
The National Dendrimer and Nanotechnology Center, Mt. Pleasant, Michigan 48858, USA &
Central Michigan University-College of Medicine, Mt. Pleasant, Michigan 48859, USA

Since the discovery of dendrons, dendrimers and the “dendritic state” in the early 1980s [1,2], substantial progress has occurred with this fourth major architectural class of precise, structure controlled soft nano-polymers [3]. Historically, the first commercially available poly(amidoamine) PAMAM dendrimers have emerged as very promising candidates for many nanomedicine applications [4-7].

Receptor mediated, targeting of docosahexaenoic acid (DHA) conjugated dendrimers has been shown to facilitate the delivery of therapeutics in a site-specific manner. Omega-3 fatty acid (DHA), has been shown to exhibit a high affinity for fatty acid receptors (FFA1/GPR40), ubiquitously expressed in various regions of the human brain (i.e., olfactory bulb, midbrain, medulla oblongata, hippocampus, hypothalamus, cerebral cortex, cerebellum and in the spinal cord) and is a potent inhibitor of breast cancer and colon cancer. As such, we report the synthesis, characterization, as well as in-vitro and in-vivo evaluations of DHA-dendrimer conjugates as nano-vectors for site-specific targeting and delivery of nanotherapeutics. The DHA carboxylate group was covalently coupled (i.e., carbodiimide reaction) to amine terminated PAMAM dendrimers and confirmed by various spectroscopy techniques (i.e., NMR, FT-IR, DLS etc.). The in-vitro cellular uptake studies displayed higher fluorescence uptake in neuroblastoma cells (IMR-32), compared to breast cancer (MDA-MB-231) and colon cancer (HCT-29) cell lines. Furthermore, this targeted delivery system has exhibited improved targeting efficiency in preclinical (living animal) studies using a non-invasive imaging system.

In summary, our DHA targeted dendrimer vectors have exhibited very high biocompatibility as well as excellent in-vitro & in-vivo profiles indicating great promise for targeted therapeutic applications in the treatment of cancer and other diseases.

References:

[1] Tomalia, D.A., Baker, H., Dewald, J., Hall, M., Kallos, G., Martin, S., Roeck, J., Ryder, J. and Smith, P. A new class of polymers: starburst-dendritic macromolecules. Polymer journal 1985. 17(1), 117-132.

[2] Tomalia, D.A., and Jean M. J. FrÃ©chet. Discovery of dendrimers and dendritic polymers: A brief historical perspective. J Polym Sci Part A: Polym Chem 2002. 40: 2719â€“2728.

[3] Tomalia, D.A. Dendrons/dendrimers: quantized, nano-element like building blocks for soft-soft and soft-hard nano-compound synthesis. Soft Matter 2010. 6, 456-474.

[4] Singh, M.K., Singh, S., Patil, U.K., and Chauhan, A.S. Poly(amidoamine) dendrimers a â€˜soft polymerâ€™ for topical application of resveratrol: Ex-vivo & in-vivo study. Journal of Drug Delivery Science and Technology 2024. 97, 10579.

[5] https://www.sigmaaldrich.com

[6] https://starpharma.com

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Poster Presentation Abstracts

3:30 – 5:45 PM BIOSCI Atrium

1. Structural Insights into Adaptive Remodeling of Fungal Cell Wall via Solid-State NMR Analysis

Isha Gautam, Michigan State University, East Lansing, Michigan

Life-threatening fungal infections have become a major threat to human health, with high mortality even after treatment. To counter emerging drug resistance, efforts have been devoted to developing novel antifungal agents targeting components in fungal cell walls. However, we face a technical challenge in characterizing the polymorphic structure and assembly of polysaccharides in native fungal cell walls. Here, we will discuss some recent advances using solid-state nuclear magnetic resonance (ssNMR) to understand the structural dynamics of cell walls in Aspergillus species. First, high-field ssNMR spectroscopy on living fungal cells has updated our view of the molecular-level organization of cell wall polymers. The cell wall of A. fumigatus was found to contain hydrophobic scaffolds of chitin and α-glucans, surrounded by a hydrated matrix of β-glucans and capped by a dynamic layer containing mannan and galactan-based polymers as well as glycoproteins. Second, ssNMR results from carbohydrate-deficient mutants revealed how gene deletion induces significant changes in the composition and water accessibility of biopolymers. Third, we identified the structural mechanisms employed by the fungus to remodel their cell walls in response to environmental stresses and antifungal drugs. These studies collectively provide the structural foundation for understanding the adaptive strategies used by the fungus to survive unfavorable conditions and provide structural insights to guide the design of better antifungal medications targeting the structure and biosynthesis of cell wall components. The biophysical method is also being extended to other major pathogenic fungal species.

2. TBA

Ankur Ankur
Michigan State University, Michigan

Cryptococcus is the etiological agent of cryptococcosis, a systematic fungal infection with dissemination to the central nervous system causing meningoencephalitis. Understanding the cell wall structure, dynamics, and mechanisms of adaptations is essential for developing cell wall-targeted drugs to treat fatal fungal infections such as meningoencephalitis. The polysaccharide capsules anchored by the cell wall make C. neoformans different from other fungal species and act as a virulence factor. Glucuronoxylomannan (GXM) and glucuronoxylomannogalactan (GXMGal) are the capsular components with the former being a major component. This study aims to explore the polysaccharides in intact and living C. neoformans fungal cells utilizing solid-state NMR spectroscopy. To this end, we used ssNMR to identify the functionality of cell wall carbohydrates in wild-type C. grubbii (Serotype A), C. neoformans H99 (Serotype D) and their mutants. It divulged a rigid core formed by β-1,6-glucan, β-1,3-glucan, α-1,3-glucan, GXM polymer, chitin, and chitosan with GXMGal polymers, as well as β-1,6-glucan, and β-1,3-glucan in the mobile phase.

3. An in-silico pipeline for the rational directed evolution of light-sensitive transcription factor EL222

Ashley Slaviero, Central Michigan University, 48859

Directed evolution is a powerful technique for improving protein activity for use in translational and basic research. Two approaches exist: random and rational. With random evolution, libraries of hundreds of thousands of variants are produced with procedures like error-prone PCR. Conversely, rational mutagenesis takes advantage of well understood amino acid sequences and/or three-dimensional structures of target proteins to generate variants without large stability disruptions, forming smaller libraries. To this end and to improve ease of screening in mammalian cells, we developed an in-silico pipeline for rational mutagenesis dependent on multiple sequence alignment (MSA) of homologous proteins, identification of functionally significant residues, and back-to-consensus mutagenesis. We applied this pipeline to the light-sensitive transcription factor EL222 to produce variants capable of higher levels of transcription when stimulated with light. Homologous proteins were first aligned to form a consensus sequence. The MSA was then used to identify functionally significant residues in EL222 with Max Likelihood statistics of conservation of residues at each position. Functionally significant residues differing from the consensus sequence were then mutated to match the consensus at the same location. By making one amino acid conversion per variant, we developed a library of 93 mutants. Four different variants were identified with better transcription than wildtype EL222. Next, a additional library will test combination mutations, pairing high signal and low background variants. The top EL222 variant will be incorporated into transcriptional systems in mammalian cells and in vivo. These systems will be tuned for activation by both bioluminescent and LED light sources.

4. Synthesis, characterization, and electrochemical analysis of synthetic biomolecule models containing ruthenium interacting with hydroxamate and/or nitrosyl

Alexis Glumm, Saginaw Valley State University, University Center, 48710

Previous studies have examined the interactions between biological models and nitric oxide (NO), though there is still research to be done on molecules capable of generating NO within model biological systems. Thus, this research has worked to synthesize model heme units using d8-metal base, attaching a known NO-donating compound, hydroxamic acid, and studying interactions. Using electrochemical and spectroelectrochemical techniques, the redox behavior of the compound interactions will be analyzed. It is hypothesized that the synthetic heme-hydroxamate model will be redox active. Cyclic voltammetry will provide more data for the redox behavior, allowing an understanding of the ability of hydroxamate to donate NO when attached to the model biological ligand. This research therein provides insight into the potential side effects of pharmaceutical drugs containing NO-donors which may be currently unknown.

5. The Effect of Calendering on the Performance of Lithium-Sulfur Batteries

Ben Seltin and Brad Fahlman, Central Michigan University, Mount Pleasant 48879

Lithium-sulfur (Li-S) batteries face rapid capacity loss over time making them not viable for most battery applications. The ability to control and mitigate this rapid capacity fading would allow for Li-S batteries to be viable in many applications. Herein, we describe the use of electrode calendering to combat rapid capacity loss through altering the porosity of the electrode materials. The calendering of cathodes did reduce the porosity of the battery leading to positive benefits in battery performance, with the average capacity of calendered cells being 15% higher over the first 100 cycles of the batteries. We will show that the calendering of lithium-sulfur cathodes was shown to have greater battery performance, which was achieved through a reduction in overall porosity of the cathode.

6. Understanding of the Reaction of Lignin with Formaldehyde by Solid-State NMR

Debkumar Debnath, Michigan State University

As resin is obtained through addition and condensation reactions between phenol and formaldehyde under alkaline conditions, methylene linkages were obtained after the condensation of methylolphenols. Due to the low solubility of cured resin in organic solvents, solid-state NMR (ssNMR) is employed to investigate the methylene bridges which is a crucial factor behind adhesive properties of the cured resins. 1D 13C and 2D 13C-13C correlation spectra were measured on phenol-formaldehyde (PF), lignin monomers-formaldehyde (HF and GF), and crude lignin-formaldehyde (LF) resins. By comparing 1D liquid NMR and ssNMR of cured and uncured resins, the discernment of formation of methylene linkages originating from hydroxymethyl groups is achieved. The identification of methanol and formic acid during LF resin formation, attributed to the intricate structure of crude lignin, underscores the divergent reaction pathways involved. Additionally, the presence of methylene linkages is confirmed through cross peaks observed in 2D correlation spectra between methylene and hydroxymethyl groups. Furthermore, the formation of various linkages, such as ethers and esters, is elucidated by 2D correlation spectra. Complementing these findings, both ssNMR and Fourier Transform Infrared (FTIR) analyses support the qualitative assessment of methylene linkages and the integration of hydroxymethyl groups into crude lignin, thus tracking the reaction's progression. This foundational knowledge of lignin-formaldehyde reactions contributes to the advancement of environmentally friendly, bio-based adhesive development.

7. Development of monosaccharide chemical reporters to probe lipoglycan synthesis and transport in mycobacteria

Caleb Mensah, Central Michigan University, Mt. Pleasant, 48859

Bacterial cell surface glycolipids are critical in the adaptation of bacteria to their surroundings and pathogenesis. Understanding and elucidating bacterial glycolipid biosynthesis and transport is of great importance. Mycobacteria are characterized by a dual-membrane cell envelope of unique composition and structure. The mycobacterial cell envelope consists of four layers: mycomembrane (outer membrane), arabinogalactan, peptidoglycan, and plasma membrane (inner membrane). The cell envelope is highly populated with inositol- and mannose-containing lipoglycans called phosphatidylinositol mannosides (PIMs) and their multi-glycosylated derivatives, lipomannan (LM) and lipoarabinomannan (LAM). The biosynthesis and transport pathways of these essential glycolipids remain undercharacterized. Metabolic labeling in combination with click chemistry is a powerful approach to probing glycan-synthesizing pathways in bacteria. We recently reported that 5-azido inositol (5-InoAz) metabolically labels PIMs in a Mycobacterium smegmatis inositol auxotroph strain, a function that was leveraged to discover the first inositol importer in mycobacteria, InoABC. However, 5-InoAz incorporated into lower PIM species (Ac1PIM1) encountered a metabolic bottleneck that prevented elaboration to higher azide-labeled PIMs. New tools are required to access higher labeled PIMs, LM, and LAM to facilitate their study by click chemistry. Here, we describe the synthesis of additional azido monosaccharide chemical reporters based on inositol and mannose, as well as their preliminary evaluation for labeling mycobacterial lipoglycans.

8. Assessing synaptic connections with Interluminescence using TRAP2 mice

Elaheh Emamgholi Zadeh, Alexander D. Silvagnoli, Maya O. Tree, Ute Hochgeschwender, College of Medicine, Central Michigan University, Mount Pleasant, MI

Almost no methods exist for selectively modulating communication between defined cells at the synaptic level, which is key to understanding how functional connectivity creates percepts, engrams and actions. Here, we advance a novel strategy for selectively modulating synaptic transmission, Interluminescence. This approach uses bioluminescent light from a presynaptic axon terminal, generated by a luciferase, to modulate an opsin in its postsynaptic target under experimenter-controlled introduction of a small molecule (luciferin).

We developed two separate methods that target the luciferase to the synaptic cleft, each offering distinct features for experimenter needs. To provide sustained and synapse-specific regulation, the 'Persist-Int' strategy places a luciferase in the synaptic cleft tethered to the presynaptic terminal, and an opsin in the opposing postsynaptic membrane. In this configuration, light generation creates sustained and activity-independent modulation. In the complementary 'Act-Int' strategy, luciferase is released into the synaptic cleft in response to presynaptic activity, a synapse-specific form of activity-dependent modulation.

For the presynaptic membrane-tethered light emitter, we fused mNeonGreen-SSLuc to the transmembrane and cytoplasmic domains of neurexin (Nrxn3b) via a spacer consisting of the extracellular domain of the human CD4 (mNeonGreen-SSLuc-linker-CD4-Nrxn3b). For the postsynaptic opsin we selected the highly light-sensitive step function opsin ChR2(C128S). AAV2/9 preparations of these constructs were injected into the lateral hypothalamus and the locus coeruleus, respectively, of double transgenic TRAP2::lox-stop-lox-EYFP mice. Intraperitoneal injection of tamoxifen was followed by injection of the luciferin fluorofurimazine or vehicle. Activation of opsin-expressing neurons by bioluminescence from synoptically connected luciferase-expressing neurons was assessed by Fos2A-Cre-mediated EYFP fluorescence.

Our data demonstrates robust effects of Persist-Int Interluminescence in vivo and show a facile way to assess synaptic connections in different parts of the brain.

9. Effect of Cold Deformation on the Microstructures and Mechanical Performance of Semicrystalline Polymers

Juncheng Zheng, Michigan State University

As environmental pollution from plastic waste escalates, polymer recycling has garnered increasing attention. However, the multicomponent nature of packaging materials, which comprises multiple layers with diverse functionalities, poses significant challenges to recycling efforts. In this work, we extend the application of cold rolling to amorphous polymers. By changing chain packing through cold deformation followed by crystallization, we successfully fabricate thin films with optical transparency and enhanced mechanical performance, paving the way for the design of sustainable packaging solutions.

10. Modeling the moving front in heated stable glasses

Koksal Karakus, Central Michigan University, Mt Pleasant, 48859

In our study, we model the moving front phenomenon in stable glasses. Heating regular glasses above the glass transition temperature causes a sharp change in the relaxation time of the material and this change happens homogeneously throughout. However, for stable glasses which are prepared by vapor deposition, this change starts at the free surface and a moving front of mobility propagates towards the interior with a constant velocity. This velocity seems to depend on the thermal stability of the glass as well as the annealing temperature. We attempt to describe this moving front as a solution to a nonlinear partial differential equation that minimizes the free energy functional of the system. A modified form of the KPP-Fischer equation, which allows traveling wave solutions, is being investigated.

11. Synthesis of g-C3N4 polymer membranes by electrospinning and UV light polymerization

Maame Esi Amissah
ACS Seed Program, Central Michigan University, Mt. Pleasant, MI 48858

The presence of toxic chemicals continues to be a relevant concern in drinking, industrial, and wastewater treatment. In particular, certain contaminants and heavy metals, such as ammonia and arsenate, prove difficult to remove. Current water treatment methods can remove most, but not all, of these harmful chemicals.Our project aims to remove ammonia and arsenate from water through adsorption with Molecularly Imprinted Polymers (MIPs). To create these polymers, we developed membranes composed of graphitic carbon nitride and polymeric materials employing the technique of electrospinning. We also utilized ultraviolet lights to facilitate faster polymerization within the membranes. We created our membranes by adjusting different parameters of both the polymer and the electrospinner and monitoring their effects. Infrared Spectroscopy analysis found several carbonyls from the monomer still present in the final polymer. The membranes also were not completely homogenous and developed cracks. We will continue working to improve the polymerization yield and stability of the membranes.

12. SYNTHESIS OF 3,4-DIHYDROXYBENZAlDEHYDE BASED GENERATION 3 ANTIOXIDANT DENDRONS

Nanzhu Li, Central Michigan University, Mount Pleasant, 48859

Antioxidants neutralize harmful free radicals produced by metabolism, lifestyle, and many other environmental factors. Antioxidant dendrimers carrying multiple hindered phenolic groups on the surface are shown to have high antioxidant capabilities, particularly when stabilized by nearby electron-donating groups. Dendrimers, molecules with branching structures, are of particular significance due to their customizability and ability to have multiple functions. Many antioxidants have poor water solubility, which is an important criterion for clinical applications and function in the body. This research aims to develop 3,4-dihydroxybenzaldehyde-based G3 dendrons (a pie-shaped segment of dendron) with an aldehyde focal point that can be attached to other dendrons in the future to form various dendrimers that have clinically applicable solubility and high antioxidant activities, and low pro-oxidant activity. The surface of antioxidant dendrons consists of syringaldehyde (hydrophobic), Vitamin B6 (water-soluble) molecules, and Vitamin B6 and syringaldehyde (amphiphilic) molecules.

13. Synthesis of Graphitic Carbon Nitride Functionalized with Imprinted Polymers for the Removal of Arsenate and Ammonia in Water

Joe Likavec, Project SEED - CMU, Mt. Pleasant, 48858

Imprinted polymers incorporating graphitic carbon nitride (g-C3N4) have emerged as a promising approach for the selective removal of heavy metal ions and other contaminants that are difficult to remove from contaminated water. This study presents the synthesis and application of molecularly imprinted polymers (MIPs) functionalized with g-C_3N_4. The imprinted cavities within the polymer matrices are tailored to specifically recognize and bind heavy metal ions such as AsO4^-3, as well as ammonia (NH3). The performance of the imprinted polymers is evaluated under various conditions, including different contaminant concentrations, and in the presence of competing ions. Results demonstrate high selectivity, and rapid adsorption kinetics, making g-C3N4-based MIPs a highly effective material for the removal of toxic heavy metal ions. This highlights the potential of these advanced polymers for use in sustainable and efficient water treatment technologies aimed at addressing the growing challenge of heavy metal pollution in our water.

14. Characterization of Lab-Generated Plastic Particles for Removal Studies

Marissa Walker, Dow Chemical, Central Michigan University

The removal of small (less than 5 mm) synthetic particles is a part of the effort to reduce environmental pollution. The size of these particles poses significant challenges for their removal. Dow is currently exploring technologies to remove plastic particles. It is crucial for these studies to utilize a standard sample with a known particle size distribution. Such standard samples can be generated in the laboratory and must be characterized for particle size, shape, and chemical composition of the particles. In this study, we have generated a collection of small particles from a generic high-density polyethylene (HDPE) sample and analyzed the particles for size, shape, and chemical composition. Here, we will discuss the challenges associated with sample preparation for optical microscopy and Raman microspectroscopy, provide the details of optical microscopy and Raman microspectroscopy methods, and discuss the results of image and spectral analysis. The optical micrographs of the dispersed plastic particles were analyzed using ImageJ software to extract size and shape from the captured optical microscopy images. Raman microspectroscopy was utilized to certify chemical composition of the generated samples when compared to the bulk generic HDPE sample. The results of analytical characterization and identification of the particles suggest that the method of generating plastic particles can be utilized to create a sample with known particle distribution. These promising results are an important step forward to develop technology for the removal of plastic particles from different media.

15. Optimizing the Immune Targeting of Mycobacteria via Surface Glycan Engineering

Phoenix Knipe, Central Michigan University, Mount Pleasant, 48858

Mycobacteria cause human diseases such as leprosy, tuberculosis, and non- tuberculosis mycobacterial (NTM) disease. Treatment of these diseases is becoming increasingly difficult due to their unique cell envelope's ability to tolerate antibiotic treatment and drive drug resistance. Recently, a new immune targeting of mycobacteria strategy was developed utilizing cell surface glycan engineering via modified trehalose derivatives. This strategy modifies the mycobacterial cell surface with antibody-recruiting molecules (ARMs), which bind to human-endogenous antibodies and increase macrophage uptake and killing of mycobacteria. The present study investigates new strategies to efficiently deliver ARMs to mycobacteria.

16. Synthesis of Azido-Inositol Analogues as Tools to Study Mycobacterial Glycolipids

Carson Bush, Central Michigan University, Mount Pleasant, 48858

Tuberculosis, caused by Mycobacterium tuberculosis (Mtb), is responsible for over 1 million deaths annually, making it one of the world's deadliest infectious diseases. Mtb is particularly tolerant to drugs that could lead to its eradication due to its complex cell envelope. This envelope is partially composed of virulence-associated glycolipids called phosphatidyl inositol mannosides (PIMs) which contain the sugar inositol. PIMs and similar glycolipids have immunomodulatory effects during mycobacterial infection, yet their associated biosynthetic and transporter proteins, and the means by which they exert their immunoactivity in the host, remain largely unknown. To help address these questions, we propose to develop new chemical probe compounds that allow labeling and analysis of PIMs in live mycobacteria. Inositol can serve as a target for developing probes that metabolically incorporate into, and facilitate the study of, PIMs within live mycobacterial cells. Here, we report synthetic studies of inositol analogues modified at the 4- and 5-positions with different functional groups including azido and fluorine groups, which allow for the metabolic labeling and analysis of PIMs in intact mycobacteria. In the future, these probes can be employed in experiments aimed at better understanding PIM biosynthesis, transport, and host interactions, which may provide insights for drug development.

17. Design and Characterization of 3D-Printed Capsule Inserts using HPMC filaments incorporating ibuprofen for controlled drug release

Kennedy Holt, ACS Project SEED, Midland 48640

Three-dimensional (3D) printing has revolutionized the production of lattice structures tailored for controlled-release drug systems. This study explores the application of 3D printing technology in fabricating Triply Periodic Minimal Surface (TPMS) structures using Hydroxypropyl Methylcellulose 15LV (HPMC) as a matrix for Ibuprofen (IBP). HPMC, known for its versatility and biocompatibility, served as an adaptable foundation for drug delivery systems. The fabricated lattice structures exhibit precision in the control of pore size and geometry which is crucial for modulating the release kinetics of Ibuprofen. This research investigates the methodology and characterization of TPMS lattice structures, highlighting their potential application in personalized medicine and targeted drug delivery. Key parameters such as filament extrusion, Ibuprofen content (HPMC with 0%, 10%, and 20% w/w ibuprofen), printing resolution, and Ibuprofen release profiles are discussed to demonstrate the feasibility and effectiveness of 3D printed HPMC lattice structures in pharmaceutical sciences.

18. Synthesis of 5-Chloromethylfurfural from renewable resources

Jonathan Ameh, Midland ACS SEED

5-Chloromethylfurfural (CMF) is a bio-renewable intermediate compound used in the production of various carbon-based chemicals and materials. The synthesis of 5-CMF involves a series of acid-catalyzed chemical reactions. In this project, CMF is produced from biomass-derived carbohydrates in a biphasic reaction using aqueous HCl and toluene. Being hydrophobic, CMF can be isolated from the aqueous phase by a solvent-solvent extraction. Monosaccharides such as fructose and glucose, and disaccharides such as sucrose were successfully converted to CMF in satisfactory yields. This understanding led to the expansion of the project by testing biomaterials containing these sugars, such as sawdust, corn products, and other starchy compounds. Experiments were run to test efficiency of different reaction conditions to support the highest yield of 5-CMF. Overall, the optimized bi-phasic system helps to determine a simple, cost-effective method to synthesize 5-CMF from renewable resources.

19. Synthesis of Methy gallate- and Gallic aldehyde- Antioxidant Dendrons

Skylar Medes and Ashlyn Lapratt
Central Michigan University, 48859

Antioxidants play a key role in reducing the amount of oxidative damage to cellular materials, which is caused by reactive, radical species. Shielding cells and tissues from radical damage is key to reducing oxidative stress and inflammation in the body. Our research focuses on making antioxidants, carrying multiple phenolic antioxidant units, which can take on multiple different reactive radical species. In this presentation, we will present two antioxidant dendrons with various solubilities—gallic aldehyde-based and methyl gallate-based—that are highly suitable for clinical applications. We will showcase syntheses of the dendrons as well as our findings on their antioxidant activities.

20. Effects of Rainfall on E. Coli levels in Bay County Beaches

Serena Lin, Project SEED, Saginaw, 48603

This study investigates the effects of rainfall on E. coli levels in recreational water sources in Bay County. Our findings indicate that E. coli levels rise significantly following rainfall, primarily due to gull droppings washing into the beaches. We employed two analytical methods: Quantitative polymerase chain reaction (qPCR)--which was done instead by the graduate students, and provides rapid results by amplifying E. coli DNA, and Colilert-18, a standard method for monitoring total bacteria levels with an incubation time of 18 hours. We utilized both in order to minimize any error. Additionally, we applied microbial source tracking (MST) to form our hypothesis that gull feces are a major contamination source. This idea can be supported by previous years' results. By implementing this approach, it helps in our understanding of bacterial dynamics in relation to weather patterns.

21. Enhancing PAMAM dendrimers for targeted delivery of YWHAB siRNA as a promising therapeutic approach for Glioblastoma treatment

Osheen Dubey
Central Michigan University, Mt. Pleasant, MI 48858

Glioblastoma (GB) is a primary brain tumor arising from central nervous system malignancies. Current treatment options, which include radiotherapy, temozolomide chemotherapy, and surgery, offer limited success due to the lack of precision medicine and high tumor recurrence, leading to a low survival rate. Small interfering RNAs (siRNAs), known for their simple design, high target specificity, and effectiveness at low doses, present a promising therapeutic approach. This study explored using YWHAB siRNA to target the 14-3-3β protein, which is overexpressed in glioblastoma and enhances its malignancy. Prior research from our lab demonstrated that knockdown of 14-3-3β significantly reduces U87MG cell proliferation and spheroid formation.

A key challenge in glioblastoma treatment is crossing the blood-brain barrier (BBB). Polyamidoamine (PAMAM) dendrimers, known for their small size and ability to cross the BBB, offer advantages such as enhanced siRNA stability, protection from enzymatic degradation, and high solubility. We optimized a dendriplex formulation using generation 4 (G4) 70/30 PAMAM dendrimers with a cystamine core and YWHAB siRNA in HEK293 cells. The G4 70/30 dendrimers, composed of 70% hydroxyl and 30% amine groups, showed low toxicity and high transfection efficiency. Our experiments achieved a 70% knockdown of the YWHAB gene, with the maximum knockdown occurring at a 1x concentration, and reaching peak efficiency 120 hours post-transfection. This study highlights PAMAM dendrimers as a potential delivery system for YWHAB siRNA in glioblastoma therapy.

22. Optimizing the Scaled-up Synthesis of 6-Azido-Trehalose and 6,6'-Diazido-Trehalose Hexaacetate

Ekene Osiri, Central Michigan University, Mount Pleasant, 48858

Trehalose, a disaccharide absent from humans but crucial to microbial metabolism and structure, has been widely studied as an access point to combating the pathogenicity of some microbes, particularly Mycobacterium tuberculosis. Successful modification of trehalose has been achieved in the past using chemical and chemoenzymatic methods to access azide-modified trehalose analogues, which are useful as probes, inhibitors, and synthetic intermediates. Our lab has sought to access large quantities of azido trehalose compounds to support in vivo experimentation. In this work, we used a chemical synthesis route to generate quantities of 6-azido-trehalose and 6,6'-diazido-trehalose hexaacetate. Both target compounds were synthesized on multi-gram scale and their structures confirmed by NMR spectroscopy, setting the stage for subsequent synthetic transformations or testing in animal models.

23. Analysis of Duckweed Growth in Dow Gardens and Whiting Forest

Megan Wilson Project SEED, Midland, 48640

This experiment investigated why different ponds in Dow Gardens and Whiting Forest grow duckweed better than other ponds and what factors affect the growth of this duckweed. In the main DOE of the experiment 11 water sources were analyzed under different levels of shade and fertilizer. The collected data was then put into JMP to produce graphs and charts. The water source was the dominant factor for duckweed growth, but shade and sunlight were also significant. Water source, color difference, and algae all produced highly significant models. These results led to further research on the water itself. It was analyzed for phosphate, nitrate, pH, and total dissolved solids. Although, these results were significant, they weren't nearly as significant as using the water source ID. Further research would have to be conducted to discover exactly what in the water sources impacts duckweed growth.

24. Synthesis of Trehalose Glycolipids and Evaluation of their Binding to Trehalose Dimycolate Hydrolase from Mycobacterium tuberculosis

Casey Papson, Central Michigan University, Mount Pleasant, 48859

There are significant challenges with the diagnosis and treatment of tuberculosis (TB) due to the cell wall makeup of the causative agent, Mycobacterium tuberculosis (Mtb). Much of the virulence and difficulty of treating Mtb is attributed to the protection and adaptability of the outer membrane layer of the cell wall. This mycobacterial outer membrane, referred to as the "mycomembrane," is rich in a cell surface-exposed glycolipid called trehalose dimycolate (TDM), which consists of a trehalose sugar core modified by long hydrophobic mycolic fatty acid chains. TDM is essential for Mtb survival and virulence, and it is unique to Mtb and other mycobacterial species, making it an attractive target for diagnostic and drug development. TDM hydrolase (Tdmh) is an enzyme involved in the breakdown of the mycomembrane under certain conditions. Currently, it is known that Tdmh breaks down TDM to release free mycolic acid, however, there are knowledge gaps with regards to the precise substrate preference and physiological importance of Tdmh. Due to this, we synthesized several trehalose glycolipids and measured their binding affinities with a catalytically inactive Tdmh mutant utilizing biolayer interferometry. The results from this study may have implications for understanding mycomembrane construction and maintenance and could provide insights for the development of novel reagents to detect mycobacterial surface components.

25. SYNTHESIS AND EVALUATION OF D-MANNITOL-BASED ANTIOXIDANT DENDRIMERS

Blessed Agbemade, Central Michigan University, Mount Pleasant, 48858

Free radicals start the chain reactions. If not neutralized, they can damage cellular materials and cause oxidative stress in the human body, which can ultimately contribute to the pathogenesis of numerous diseases. Antioxidants are known for their ability to protect cells against oxidative stress by scavenging free radicals. The solubility of antioxidants in aqueous media is vital for their bioavailability and functionality. In this presentation, we will report biocompatible antioxidant dendrimers, synthesized using D-mannitol as the scaffold, which was attached to various antioxidant building blocks (4-hydroxybenzaldehyde, syringaldehyde, pyridoxal, and/or pyridoxal-5-phosphate) via copper-catalyzed azide-alkyne cycloaddition click chemistry reactions. Additionally, we will present their DPPH radical scavenging activities, DNA protective effects against free radicals, and pro-oxidant potentials.

26. Evaluation of Phase Transfer Catalyst in the Preparation of Benzo-15-Crown-5 Ether

Emily propp, Acs project seed, Michigan State University 48706

The crown ether Benzo-15-Crown-5 (B15C5) is usefull for the separation of lithium-6 and lithium-7 isotopes. Lithium-7 finds use in the nuclear power industry and a simple, high yielding synthesis of B15C5 is desirable to meet this need. Phase transfer Catalyst (PTCs) have been used in the chemical industry to increase reaction rates, yields and selectivity. The current study evaluated the effectiveness of PTCs on the synthesis of B15C5. Two PTCs were used in the study along with, several solvents and bases. The two PTCs evaluated were tetrabutylammonium hydrogen sulfate (TBAHS) andbenzyltributylammonium chloride (BTAC). These reagents were used to carry out a synthesis of B15C5 and the results of the synthesis were quantified by gas chromatography (GC). Sodium hydroxide used with polar protic solvents like isopropyl and ethanol gave best results. PTCs did not appear to have significant effect on the yeild of B15C5 in these reactions. However, they did increase the yeild when used with polar and nonpolar protic solvents, but not enough for the solvents to be useful. Overall preliminary results suggest that PTCs provide no practical benefits to the synthesis of B15C5.

27. Monica C. Holmes Clean Water Initiative for H2O Q Stewardship

Madi Boerger and Emma Buschlen, CMU College of Science and Engineering, H2O Q, Mt Pleasant

The Monica C. Holmes Fund, established in 2010 for the betterment of water quality, is expanding its initiative to leverage its College of Business Administration (CBA) origins with the program. H2O Q is a water quality stewardship project in collaboration with 7-12th grade teachers and classrooms (se.cmich.edu/H2OQ). The combined program has CMU student support teams adopt a teacher/classroom for their tenure at CMU, typically 3-4 years. During this time, each classroom of 7-12th grade students experience the H2O Q curriculum. Each year, the CMU students volunteer in the classroom, identify projects, and help the teacher seek financial support for project continuation. Annually, a new team is assembled, and the cycle continues with a College of Science and Engineering and CBA student team adopting a teacher/classroom.

28. Empowering Student Scientists: Development of a Mobile Spectroscopic Analysis Tool for Environmental Nitrate Testing in H2O Q Programs

Ashley Brown, CMU, Mount Pleasant 48858

The H2O Q program, originally designed by the ACS Midland Local Section and housed at Central Michigan University (CMU), equips middle and high school classrooms with environmental water quality testing kits. These kits include nitrate testing tools that utilize an enzyme reduction process, offering a safer alternative to traditional cadmium-based methods. While the program provides handheld spectrometers and visual color comparison cards, many schools find the spectrometers cost-prohibitive, and the comparison cards lack accuracy. To address this, our research focuses on developing a mobile application as a cost-effective and accurate spectroscopic analysis tool for nitrate testing. This study validates the accuracy of a mobile application for measuring nitrate levels in water samples, comparing it to a standard photodiode method. Using a 3d printed custom cuvette holder for optimal for data collection, there is a positive correlation between absorbance and saturation, supporting the app's efficacy in determining nitrate levels. A two-point calibration method based on the app's saturation values closely matches the expected concentrations measured by the photodiode across multiple trials. This innovative approach aligns with H2O Q's mission to foster authentic scientific experiences in classrooms while promoting environmental stewardship. Our work validates the relationship between saturation, hue, and absorbance to potentially enhance the method accuracy. The research advances the capabilities of the H2O Q program and contributes to the broader field of environmental monitoring and citizen science, further supporting the ACS's commitment to chemistry education and environmental sustainability.

29. Effects of Rainfall on E. Coli Levels

Serena Lin, Project SEED/ACS

This study investigates the effects of rainfall on E. coli levels in recreational water sources in Bay County. Our findings indicate that E. coli levels rise significantly following rainfall, primarily due to gull droppings washing into the beaches. We employed two analytical methods: Quantitative polymerase chain reaction (qPCR)--which was done instead by the graduate students, and provides rapid results by amplifying E. coli DNA, and Colilert-18, a standard method for monitoring total bacteria levels with an incubation time of 18 hours. We utilized both in order to minimize any error. Additionally, we applied previous years' data of microbial source tracking (MST) to form our hypothesis that gull feces are a major contamination source. By implementing this approach, it helps in our understanding of bacterial dynamics in relation to weather patterns.

30. Microplastics and Fluorescence in Natural Water Samples

Nora Jannenga, Central Michigan University, Mt. Pleasant MI, 48858

The H2O-Q project, developed by the Midland Section of the American Chemical Society, engages 7-12 grade students in active water quality research, including a focus on microplastics detection. This project involves the continued development and testing of a prototype method for microplastics screening. Inspired by "Yooperliteâ€ hunting, the search for florescent granite rich with sodalite on the shores of Lake Superior, the particles left behind after running through the H2O-Q water filter apparatus were examined under different light sources. Analysis under ultraviolet light revealed man-made microfibers and microplastics in much greater quantities than identified with visible light and the naked eye. This research seeks to advance educational resources in the classroom and contribute to the understanding and ongoing analysis of environmental microplastic contamination in various natural bodies of water.

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Thanks to all the participants and presenters as well as to their affiliated organizations which supported their participation in this event!