16th ANNUAL SYMPOSIUM ON SUSTAINABILITY AND THE ENVIRONMENT

"Systems Design for Sustainable Futures"

BRIDGEWATER STATE UNIVERSITY
RONDILEAU CAMPUS CENTER BALLROOM

Saturday, November 18, 2017
9:30 AM - 2:30 PM

SYMPOSIUM PROGRAM

16th ANNUAL SYMPOSIUM ON SUSTAINABILITY AND THE ENVIRONMENT

Saturday, November 18, 2017
Bridgewater State University Rondileau Campus Center Ballroom

The 16th Annual Symposium on Sustainability and the Environment will focus on student research posters (including completed, in progress, and proposed research) in all environmental disciplines from colleges, universities and high schools in the Northeastern U.S. Since its inception in November 2001, the Symposium has averaged 100 attendees and over 40 student poster presentations. This Symposium provides an annual forum for discussion of issues related to environmental research and education specific to the New England region, and has opened doors to collaborations in research and education among the participants.

Our guest speaker is: **Dr. Linda Booth Sweeney**, Ed. D., author, consultant and educator dedicated to helping people of all ages integrate an understanding of living systems into learning, decision making and design. Dr. Booth Sweeney supports systems change on complex issues such as sustainable production/consumption, food system resilience, childhood obesity, sectarian conflict and climate change. She has worked with Outward Bound, M.I.T. Sloan School, City of Somerville, PBS Learning Media, Tufts Friedman School of Nutrition, Kimberly Clark and Cargill. As a visiting faculty member, Dr. Booth Sweeney has taught at both the undergraduate and graduate levels for Babson College, University of Nebraska, Indiana University at Pennsylvania and OSR/Bainbridge masters program in Seattle.

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Saturday, November 18, 2017
Bridgewater State University Rondileau Campus Center Ballroom

PROGRAM

8:00 – 11:30 AM: Registration and light snacks

9:30 AM: Welcoming Remarks in the Rondileau Campus Center Ballroom:
Dr. Kristen Porter-Utley, Dean of the Bartlett College of Science & Mathematics

9:45 – 10:45 AM: Guest Speaker:

Dr. Linda Booth Sweeney
Author, consultant and educator dedicated to helping people of all ages integrate an understanding of living systems into learning, decision making and design

"Connect the Dots, Change the Game - Systems Design for Sustainable Futures"

10:45 – 12:00 PM – Poster Session I: Boards 1-17, Rondileau Campus Center Ballroom

12:00 – 12:45 PM – Lunch in the Ballroom; take down posters from Session I, set up Session II posters

12:45 – 2:00 PM – Poster Session II: Boards 18-33, Rondileau Campus Center Ballroom

Poster Session I Titles and Abstracts: Boards 1-17
Rondileau Campus Center Ballroom (10:45 AM to 12:0 PM)

Board #1: "Rapid SPE in field HPLC detection of complexed thiocyanate by aqueous soluble metalloporphyrins from saline waters", Kelsey Letson and Stephen O'Shea, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

The rapid detection of in situ thiocyanate from cyanide harvested ornamental fish is of great importance to address the detrimental impact this type of fishing is having on reefs and ecosystem. Thiocyanate is the primary metabolic byproduct of cyanide exposure by a fish released in situ. A rapid and accurate field test has been developed to address the presence of this thiocyanate which will be of great asset to marine law enforcement to curb this practice. This research has developed protocols to complex SCN- in situ from contaminated sea-water by aqueous soluble metalloporphyrins. (Co, Mn, Zn and Cu dications of 5,10,15,20-tetrakis(p-sulfonatophenyl) porphyrin). The aqueous complexed-porphyrins are concentrated by SPE (ODS C18), released into methanol, which is directly injected onto the HPLC. An isocratic solvent mix of Acetone-Acetonitrile (40:60) flows through a HPLC column (Prevail C18 5μ) with in-line fluorescence detection (λex 416 nm, λem 650 nm). With a retention time of 7 minutes the presence or absence of the thiocyanate-metalloporphyrin complex can be assessed. The metalloporphyrin complexed species obtained from field samples were characterized and calibrated to authentic external standards by both UV/Vis and fluorescence spectroscopy.

Board #2: "Development of an In-Field Seawater Back Extraction and HPLC-Fluorescence Detection of Thiocyanate to Combat Illegal Cyanide Fishing", Holly Eberlin and Stephen O'Shea, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

Harvesting of tropical ornamental fish by dispersing sodium cyanide into the environment to render fish unconscious, making them more easily collected, is an illegal practice. Upon ingestion by the fish, the primary excretory metabolite is the thiocyanate ion (SCN-). To address whether cyanide has been unlawfully used, a field instrument has to be developed that will have a rapid response to a low detection limit of SCN- in water containing the harvested fish. This research developed a HPLC UV/Vis and fluorescence detection of co-solvent back extraction of metalloporphyrin SCN- complex from sea water. Simple free metal SCN- coordination using Fe (III) was successful but not sensitive enough to low (ppb) SCN- concentrations as well as being susceptible to hydrolysis. To circumvent hydrolysis, Co (II) metalloporphyrins were successfully analyzed in co-solvent (Saltwater:DMF) coordination of SCN- that can be characterized by UV-Vis and the more sensitive fluorescence spectroscopy. To enhance analysis of the low concentrated coordinated metalloporphyrin from field study samples, a simple SPE (C18 ODS) concentration allows for characterization of both non-coordinated and coordinated metalloporphyrins via HPLC fluorescence detection.

Board #3: "Assessing legacy pollution by shell surface XRF analysis of sedentary shellfish", Shayne Green, Deanna Rackie, Kimberly Kardas and Stephen O'Shea, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

The release and leaching of metal pollutants into coastal and estuarine environments has been greatly curtailed, capped deposits however, can still reenter the ecosystem by natural perturbation or human activity. To assess the potential of legacy pollution sites, this research investigated the ability of the native bivalve *Mercenaria mercenaria* (Quahogs) as a natural bioindicator within infield XRF analysis. The quahog exhibiting a sedentary borrowing habitat and long lifespan (>10yrs) make them ideal in-situ biomonitors. Quahogs have the ability to bioconcentrate heavy metals into their shells and to exchange/adsorb them on their outer shell surface from the benthic media. Quahogs harvested from sites in Narragansett Bay, RI had their shells assessed by XRF and correlated with ICP analysis for their heavy metal content to that of their surroundings. The cation exchange capacity and adsorption of the shell's outer surface – at various buffered pHs (2.5, 4, 5 and 8) along with varying concentrations of Cu, Pb and Cd ions reflecting the change in sediment as quahogs borrow themselves in sediment – were also determined to access potential metal rerelease into the water column.

Board #4: "Field XRF monitoring of heavy metal Pb^{2+}, Cd^{2+} , Cu^{2+} and Zn^{2+} immobilization by fragmented and powdered shell beds from contaminated waters", Kimberly Kardas, Deanna Rackie and Stephen O'Shea, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

The potential use of shellfish shells as an ecofriendly and sustainable heavy metal biosorbent was investigated in conjunction with the development of an in-field XRF analysis protocol. The primary composition of marine mollusk shells are the polymorphs of $CaCO_3$ (aragonite and calcite). The powders of these biogenic carbonates were assessed in their ability to remove Pb^{2+}, Cd^{2+}, Cu^{2+}, and Zn^{2+} ions from contaminated water. Surface reflectance XRF, FTIR and Raman spectroscopies, in correlation with free in situ metal dissolution by ICP analysis, demonstrated that the biogenic sorbents displayed very high sorption capacities for these metal cations. Batch experiments were performed to determine the effects of exposure time, initial pH, and biosorbent grain size with relationship to biosorbative efficiency. Further use of XRF revealed that the shell bed must be recharged in order to be an effective treatment for surface biosorption capacity.

Board #5: "Characterization of In-Situ Marine Core Sediment and Pore Water Degradation of CFCs", Colby Masse, Natalie Gambrell and Stephen O'Shea, Department of Chemistry, Roger Williams University, Bristol, RI 02809

Understanding microbial metabolic and abiotic degradation pathways of natural halo-carbons (HCs) is important not only from a climate perspective but also for what it tells us about the overall balance of HCs biogeochemical cycling and their release into the ecosystem. This research was conducted in order to further understand the in-situ transformations of HCs in core ocean sediment and wet terrestrial samples under various oxidation/reduction potential conditions. The analysis inoculated core sectioned samples under inert atmosphere and Rhizon filtered pore water by ion chromatography elucidate the potentially primary micro organismal metabolic catabolic and/or abiotic oxidant degradation pathways. Headspace GC/MS analyses give evidence of organic HC degradation byproducts. Development of a new technique, ^{9}F NMR in situ determination metabolites and the release of fluoride ion were used to further investigate degradation of alkyl fluorocarbons, the replacement of HCs.

Board #6: "Sediment Core Depth Profile Enhanced Degradation of CFCs by Biotic and Abiotic In-situ Stimulation", Natalie Gambrell, Colby Masse and Stephen O'Shea, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

Though there has been a dramatic decrease in anthropogenic CFCs, they are still having a significant effect on global warming by further compounding the feedback release from their aquatic environment sink. Core samples from marine and terrestrial sites were assessed for the pore water composition and their microbial metabolic in situ enhanced oxidant spiked bioremediation of halo hydrocarbons (HCs) in an anaerobic chamber with oxygen and carbon dioxide gas sensors. The headspace gases were elucidated by GC/MS. The mechanistic HCs degradation pathway can be eluded to by oxidation-reduction potential (ORP) of the environment and its pH, shedding light on in situ metal oxidation states' and the potential microbial communities principle. Catabolic oxidants and the bacterial succession order, following submergence of a sediment, directly matches the order of decreasing potential for the corresponding redox couples: O_2 /H_2O, NO_3^-/ N_2, $MnO_2(s)$ / Mn^{2+}, $Fe(OH)_3(s)$ /Fe^{2+}, SO_4^{2-}/HS^- and CH_2O/CH_4. This succession allows the selected spiking of sectioned core sediment microbial oxidant to illicit enhanced microbial activity towards HCs. Release of the halide ion from HCs monitored by HPLC-IC and ^{9}F NMR and GC/MS following the volatile organic degradation by products.

Board #7: "Synthesis and analysis of pyrazoline derivatives as alcohol dehydrogenase inhibitors", Meagan Hackey and Lauren Rossi, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

Alcohol dehydrogenase (ADH) inhibitors are commonly employed for the treatment of parasitic infection in humans. A series of substituted pyrazoline derivatives were synthesized to probe the inhibition of ADH. Structural modifications were done to study the electronic and steric interactions associated with the enzyme active site. The identification of pharmacophoric regions will allow for the methodological modification of these compounds to improve enzyme affinity and targeted inhibition.

Board #8: "Comparative study aimed at improving dye-sensitized solar cells", Hiba Wakidi and Cliff J. Timpson, Department of Chemistry, Roger Williams University, 1 Old Ferry Road, Bristol, RI 02809

Dye-sensitized solar cells (DSSCs) are liquid-based photovoltaics that convert light into electrical energy. The photo-conversion efficiency of these devices has increased over the last two decades but DSSCs have yet to establish themselves as an economically viable alternative to conventional sources of energy production. In order to make DSSCs more economically attractive, one is faced with increasing the photoconversion efficiency of the cells, lowering the overall cost of producing the cells, or both. This work seeks to compare the functionality of a series of DSSCs fabricated with two different light absorbing, ruthenium-based, dye complexes operating with two different redox mediators and two different types of cathodes in an effort to evaluate ways to reduce the overall cost of DSSCs while attempting to improve their overall efficiencies.

Board #9: "Synthesis of a Photocatalytic Hydrogen Production System", Alexander Brown and Sarah Soltau, Department of Chemical Sciences, Bridgewater State University, Bridgewater, MA 02325

Global warming is one of the most pressing challenges facing us today. It is scientifically established that the production of copious amounts of greenhouse gases such as carbon dioxide (CO_2) is the primary cause of global warming. Many of these greenhouse gases are produced from the combustion of carbon based fuels and researchers are investigating alternate fuel sources such as hydrogen gas. Hydrogen gas is a clean burning fuel that stores a significant amount of chemical potential energy. The goal of this project is to synthesize a new protein based photocatalytic hydrogen production system and to study the effect of modification on said system. This will be done through the synthesis and connection of a three-part system including, a photosensitizer, a protein, and a hydrogen evolution catalyst. Synthesis and characterization of the photosensitizer and expression of the wild type protein has been completed and substantial progress has been made on expressing the mutated protein, purification of the mutated protein, and connection of the hybrid complex. Completion of this project will give insight into the effect component positioning has on hydrogen production as well as provide a fundamental structure for future protein based hydrogen production experimentation.

Board #10: "Survey of microplastic pollution in surface and drinking water using FTIR spectroscopy", Nicholas Blackmon and Cielito King, Department of Chemistry, Bridgewater State University, Bridgewater, MA 02325

Microplastics are tiny plastic particles less than 5 mm in length that are either manufactured for use in consumer products or produced from the deterioration of plastics. They can enter aquatic ecosystems through wastewater discharge and have been detected in fish and shellfish in multiple studies. Microplastic pollution is troubling due to its potential to negatively affect human health. Microplastics can act as a vehicle for several organic pollutants and hydrophobic toxins. Microfibers, also known as lint, belong to a class of microplastics produced from the breakdown of fibers used in textiles. Like microplastics, microfibers could have negative impacts on human health. The purpose of this research was to determine the extent and nature of microfiber pollution in Massachusetts freshwaters. To survey microfiber pollution in local freshwater ecosystems, water samples from selected rivers and lakes were collected and filtered through a stack of fine-sized sieves. Visual identification of microfibers against other types of microplastics was done using a microscope. Preliminary microfiber like particles were analyzed using Fourier-transform infrared spectroscopy (FTIR) to determine the chemical composition by comparison with known fibers. Results showed that there are low incidents of microfiber pollution in local rivers and lakes. Most of the synthetic microfibers found were identified as polyester and cotton/polyester blends. Future directions include examining microfibers using the FTIR microscope spotlight 400 to prevent loss of samples from transferring between the microscope and the IR. In addition, sampling will be extended to several brands of bottled water for the presence of microplastic contaminants.

Board #11: "A preliminary investigation into the unintended consequences of caffeine exposure on children", Joyce Kinyu, Edward Brush and Cielito (Tammy) DeRamos King, Department of Chemistry, Bridgewater State University, Bridgewater, MA 02325

Products targeting humans as consumers are usually meant to improve their living standards and to make life easier. Nevertheless, some of the negative effects experienced are unintended. This raises concerns and calls for intervention for the sake of those who are negatively impacted. Caffeine is meant to serve as a stimulant in adults but it has had some unintended negative impacts on children. This area has been understudied for children below the age of 15 years, thus inspiring the research question: are foods and beverages that target children as consumers enriched with caffeine? The goal of this research project was to determine the extent to which foods and beverages that target children as consumers are enriched with caffeine and consider hidden sources of caffeine. This was successfully done using High Performance Liquid Chromatography (HPLC) for qualitative and quantitative analysis of food and beverage samples. High purity caffeine was used to prepare calibration standards to quantify caffeine in food and beverage samples. Among the samples analyzed, jelly beans of different colors especially black had approximately 16 mg/l of caffeine in four jelly beans. Some chocolate flavored candies such as Junior Mints showed chromatograms consistent with caffeine. Further analysis will be done in the future with the incorporation of an internal standard which will help improve the accuracy and precision of identification and quantification of caffeine in food and beverages. This research was supported by the BSU Department of Chemistry, and by a summer 2017 grant from the Adrian Tinsley Program.

Board #12: "The Behavior of Sulfamethoxazole in Various Conditions", Stephanie Preval and Rachael Kipp, Department of Chemistry & Biochemistry, Suffolk University, Boston, MA 02111

Pharmaceuticals compounds, such as sulfa antibiotics, are emerging environmental contaminants. Sulfa antibiotics have a 50-90% chance of entering the environment via feces or urine. Sulfamethoxazole (SMX) is one of the most prescribed sulfonamides in the world, and thus is often found in surface waters. Its amines are protonated and deprotonated at various pH values, establishing pH as a significant parameter. As such, this experiment focused on the study of SMX solutions with pH of 2 – 11, which include the environmentally relevant range of 4 - 10. SMX has demonstrated stability in aqueous solutions of pH 2, 5, and 11 for 28 days with negligible variances in its fluorescence intensity at 343 nm. As surface waters run off into the soil, it is important to understand SMX's interactions with the components in soil as well. However, soil composition is quite complex. Therefore, a soil model was introduced in which the 1% potting soil and 99% sand was chosen to be the optimal controlled soil system. Since 1% has a lower percentage of soil composition than other combinations tested (3% and 5% potting soil), the 1% mixture had fewer water soluble compounds. The water soluble components of the potting soil have an overlapping fluorescence peak at 450 nm. Since fluorescence peaks are additive, there is some interference with the SMX fluorescence peak. Due to the spectral overlap, 335 nm was chosen as the best wavelength to monitor change in SMX concentration. As the pH decreased from 9 to 2, the percent of SMX bound to soil increased, confirming that pH influences SMX binding to soil. At pH 11, almost 99% of SMX is bound. Consequently, SMX binding is increased at the two extreme ends of the pH range.

Board #13: "The Use of Solid Phase Extraction as a Method for Determining Sulfamethoxazole in Soil", Andrew Scott and Rachael Kipp, Chemistry and Biochemistry Department, Suffolk University, Boston, MA 02108

Sulfamethaxozole (SMX) is a commonly used antimicrobial in veterinary medicine. Excess SMX is excreted through urine and feces to become present in the environment. Increasing amounts of this emerging contaminant can have negative impacts on the environment and the organisms that live in the environment. The purpose of this research is to optimize a solid phase extraction (SPE) method in order to determine the amount of SMX present. A SPE method is useful due to the potential to minimize matrix effects, and pre-concentrate the sample. Absorbance and fluorescence will be used to detect the SMX and determine the concentration in the samples. Ultimately, SPE is tested for efficiency and accuracy that in turn gives an effective technique for determining pharmaceuticals that exist in our environment as well as determine other components that are present in our environment too. Once the SPE method is optimized, the technique will be used to determine antimicrobials that exist in our actual environment to determine toxicity of pharmaceuticals that exist in the real world.

Board #14: "Method Development for GC-MS Detection of Dimethylsulfone", Chaim Wigder and Denyce Wicht, Department of Chemistry & Biochemistry, Suffolk University, Boston, MA 02111

A rise of the total organic content (TOC) in the water recovery system on the International Space Station (ISS) has been detected. The increase poses a contaminant risk for the potable water used by the crew on-board the module. Among the compounds contributing to the increase in the TOC is dimethylsulfone ($DMSO_2$). Evidence exists for the natural breakdown of $DMSO_2$ to methanesulfinate via cleavage of the S-C bond by the enzyme SfnG. This presents the possibility of transporting enzymes or bioengineered microbes to the ISS to be used for onboard water treatment. In order to verify the conversion of $DMSO_2$ to methanesulfinate, the analytical technique of gas chromatography–mass spectrometry (GC-MS) can be used to analyze aqueous samples of $DMSO_2$ in the presence of SfnG. An analytical method must be developed with the proper parameters needed to detect the compounds of interest.

Board #15: "Ouriço Water Monitoring System: Addressing Water Scarcity in Santiago, Cabo Verde", Brianna Love, Kate Hansen, Alcides Andrade Jr., Amy Banzaert, and Sónia Semedo (University of Cabo Verde), Department of Engineering Studies, Wellesley College, Wellesley, MA 02481

Ouriço is a device that monitors the water level and quality and an associated website created through a collaboration between students and faculty at the University of Cabo Verde and Wellesley College. It is designed to be installed on water reservoirs in Cabo Verde as there is currently no system in place to provide live data of water level and quality data to Aguas de Santiago (ADS), the water company for the Island of Santiago, remotely. This absence causes frequent water shortages throughout the island as the wells feeding the reservoirs are turned off to prevent overfilling but are not turned back on as soon as they run dry; instead they are only turned on when citizens notify ADS leaving citizens without water for days. Ouriço is our approach to resolve this issue by working with ADS and citizens through a collaborative relationship between two universities. The preliminary data collected by Ouriço shows that the device has merit and requires refinements and additional testing. The ultimate goal for the project is to create both commercial and residential versions of the device.

Board #16: "Greater Boston Area Community Gardens: Helping Sustainable Urban Agriculture Minimize Resuspended Respirable Soil Particles", Jacqueline Gong and Kari Brabander, Marjot Foundation Scholars, Newton North High School, Newton, MA 02460, and Daniel Brabander, Department of Geosciences, Wellesley College, Wellesley, MA 02481

Urban community gardening is generally seen as a positive addition to an urban area resulting in increased access to local produce and providing opportunities for community engagement. However, legacy lead in urban soils had been linked with elevated lead blood levels in urban children. Our research examines if urban agricultural practices in Boston contribute to increased levels of respirable lead in the airsheds around community gardens. Gaining a better understanding of how much lead is in the air that gardeners may be breathing can help implement best practices to minimize risk of lead exposure.

We use an AirBeam by Habit Map, a portable air quality sensor that records the abundance of Particulate Matter (PM) that the EPA regulates. We have collected data from 11 community gardens across the City of Boston. While the amount of particles in the air is monitored in real time with the sensor, we also collect particles with conductive double-sided adhesive carbon tape to determine the elemental composition of the collected PM using scanning electron microscopy (SEM). In our work so far, we have seen particulate matter in our sample gardens range from 1$\mu g/m^3$ to 22 $\mu g/m^3$, compared to an urban wild site with an average of 12 $\mu g/m^3$. After this initial collection of ambient conditions at the site, we also record a second, shorter session with the AirBeam in which we agitate a plot's soil to simulate garden activity. In these simulated gardening experiments we have observed a rapid increase in PM reaching a value of 129 $\mu g/m^3$ in less than one minute. This demonstrates that urban soil can be resuspended and that, depending on our results of elemental composition, new practices may need to be put in place to protect against the dangers of resuspended particles.
After collecting our data using the AirBeam we plan to use a SPECTRO XEPOS X-ray fluorescence spectrometer to analyze our soil samples for traces of lead and SEM to analyze our air particle samples. By combining data from multiple

sites, we plan to create a map with corresponding air lead levels in order to provide a visual model of our data across the city. Community garden airsheds will be compared with regional urban wild background location.
As community gardening becomes more common it will become increasingly important for gardeners in all different locations to consider best practices that protect against any potential lead exposure pathways.

Board #17: "Geohealth: Understanding human and natural system interactions to identify sustainable management practices", Amanda Hernandez, Kimberly Chia Yan Mi, Emma Jackman, Charli Klein, Brianna Love, Melanie T. Passaretti, Sarah Smith-Tripp and Daniel Brabander, Geosciences Department, Wellesley College, Wellesley MA 02481

Geohealth is an emerging discipline at the boundary between natural sciences, public policy and stakeholders, recognizing that research is often applied and can inform local decision-making. We are a transdisciplinary research group comprised of undergraduate researchers from across the liberal arts, exploring biogeochemical systems through the lens of stakeholders. In particular, we investigate biogeochemical cycles to examine ecosystem and community and public health implications. The range of current projects includes: remediation of contaminated urban soils by amending with compost, understanding the connections between herbicides and human health through studies focused on detecting herbicides in commercial tampons, and sustainable management of complex landscape systems.

Our analytical tools vary across projects and include pED-XRF, CHNS, VP-SEM-EDS, and GIS mapping and analysis. For several projects we employ participatory action research frameworks based on partnerships with citizen scientists and Greater Boston community organizations including the Food Project. Our latest collaboration is with the newly funded Paulson Initiative on the Wellesley College campus aimed at understanding the importance of ecology of place. These partnerships inform how we generate research questions that often result in the development of best practices to minimize exposure risk and inform ecologically based management practices at many scales. Blending scientific inquiry with sustainable management practices, our work demonstrates a holistic approach with the potential to transform a community's engagement with landscape sustainability.

Poster Session II Titles and Abstracts: Boards 18-33
Rondileau Campus Center Ballroom (12:45 to 2:00 PM)

Board #18: "Reducing Solvent Use in Tufts University's Chemistry Research Labs", Jonathan Ng and Jonathan Kenny, Department of Chemistry, Tufts University, Medford, MA 02155

Although many chemistry research labs require the use of solvent to carry out their research, it is beneficial for the environment, universities, and lab researchers to keep solvent use at a minimum. This is due to the fact that solvent use contributes to carbon emissions, its costs (for both purchase and disposal) are expensive, and prolonged exposure can lead to health risks for researchers. This project aimed to reduce solvent use at Tufts University by purchasing an automated flash chromatography system that would optimize solvent use for compound purification and minimize waste disposal. The proposed solvent reduction plan is estimated to reduce departmental solvent use by 45%, saving the university $29,000 to $43,000 per year in purchase and disposal costs, while also reducing the environmental and health impacts associated with solvent use.

Board #19: "Examining Heating and Cooling Energy Use in the Pearson-Michael Chemistry Complex", Patrick Milne and Jonathan Kenny, Chemistry and Environmental Studies Departments, Tufts University, Medford, MA 02155

This project studied the energy being used to heat and cool the labs in Tufts University's chemistry building. Laboratories, especially chemistry labs, use several times more energy than buildings of similar size, primarily because fume hoods extract and exhaust a large volume of air, requiring a great deal of energy to heat or cool replacement air from outside. A model was created to track the past energy use of the building in relation to weather using differences between indoor and outdoor air temperatures to quantify heat transfer. Then as an example of how this project could be implemented

practically, several options for the renovation of the introductory chemistry laboratory were compared. Since most general chemistry experiments do not require a fume hood for safety, the first option was to turn off the fume hoods and use the surfaces as open benchtops, which would save the university $39,700 each year and reduce our annual carbon footprint by 180 tons with almost no up-front cost. The second option, to replace the fume hoods with smaller, adjustable extraction arms, resulted in annual savings of $39,200 and 178 tons of carbon dioxide, and repaid the initial investment in 1.03 years. Finally, newer fume hoods could be installed with the ability to turn them off when the lab is not in use, a project which would save $37,500 and 170 tons of carbon per year and pay for itself in 2.16 years. The savings from these renovations are all fairly similar because they eliminate the high ventilation rate when the lab is not in use, indicating the possibility of significant improvements in sustainability simply by reducing waste.

Board #20: "Simmons College Sustainability Survey, Preliminary Results", Charlotte Rivard (Department of Biology) and Michael Berger (Department of Physics and Chemistry), Simmons College, Boston, MA 02115

While our federal government continues to ignore the climate crisis and take funds away from environmental agencies, private institutions like colleges & universities must step up as leaders in sustainability. To poll priorities of potential sustainable changes on campus, the Simmons College Sustainability Club recently sent out a survey to the student body, faculty, and staff. So far 110 students and 72 faculty & staff have ranked the importance of the following issues:
1) Better signs to inform recycling, 2) Composting at the Fens, 3) Reducing excessive watering with the sprinklers, 4) More accessible recycling around campus, 5) Less plastic waste at the Fens and 6) Reducing excessive heating in dorms. The students and the faculty & staff have both shown particular interest in the plastic waste at the Fens and excessive heating/cooling on campus, and have contributed insightful comments for further improvement.

Board #21: "Testing for the Leaching of BPS in Dr. Brown and Gerber Life Baby Bottles", Lilia Hall, Eliana Ruben, Blue Ware, Shannon Sullivan and Michael Berger, Chemistry and Physics Department, Simmons College, Boston MA 02215

With the removal of BPA in most everyday plastics, many people feel safer. However, although BPA is no longer widely used, other bisphenols such as BPS or BPF, with harmful properties similar to BPA have been reported as substitutes in plastics. We will be looking for the presence of BPS in baby bottles to see if this vulnerable population is still being exposed to the harmful effects of bisphenols. In order to determine whether bisphenols can leach from the baby bottles during typical heating and cleaning methods, samples of water and milk in the bottles will be analyzed for BPS using gas chromatography and mass spectrometry.

Board #22: "Using *Phragmites australis* for the Remediation of Contaminated Drinking Water", Madeline Karod, Bianca Boschetti, Emily Robinson and Michael Berger, Department of Chemistry, Simmons College, Boston, MA 02215

The use of readily available waste biomass has been widely proposed for the remediation of contaminated waters. *Phragmites australis* is an invasive aquatic plant in Boston's Muddy River close in proximity to Simmons College, making it an accessible and sustainable source of biomass for this project. This work explores the possibility of using this invasive species as a biomass source for the reduction of excessive manganese (II) from drinking water supplies. The effectiveness of both the dried *Phragmites* stems and char derived from these stems was tested in removing manganese from aqueous solution. Preliminary results showed that a sustainable biomass treatment could remove the manganese contamination. The goal of this continued research project is to investigate treatment parameters of the invasive biomass to optimize its effectiveness in removing contaminants from drinking water. Recent work has shown that *Phragmites* may be effective in removing zinc (II) from contaminated water as well. Expected scientific outcomes include Langmuir isotherms and maximum absorption capacity determinations for different treatments.

Board #23: "Colleges of the Fenway Collaborative Examination of Chemical and Biological Aspects of the Muddy River, Boston, MA", Stephanie Enderson, Annie Chen, Jason Erichsen, Roxanne Lee, Hannah Malatsky, Sheen McCaig, Abigail PinterParsons and Lisa Lobel, Social Work and Environmental Studies and Math and Science Department, Wheelock College, Boston, MA 02215

Abiotic and biotic parameters within Boston's Muddy River were measured and shared between introductory classes in chemistry and environmental science at two neighboring Institutions in the Colleges of the Fenway during the fall semester of the past three years. Environmental science students at Wheelock and Simmons Colleges participated in the Charles River Watershed Association's biological monitoring program assessing habitat and water quality using benthic macroinvertebrates (BMIs) as bioindicators. During this project sediment samples were also collected for metals analysis by a Simmons College chemistry course. Chemical and biological data were collected from two sites within the Muddy River watershed. The Babbling Brook (MRBB) site was surrounded by parkland and was hypothesized to be a "better quality" habitat containing a diverse assemblage of BMIs as compared to the second site (MRRW), which was in a more urban setting downstream from the Babbling Brook. Students assessed the quality of the habitat using the EPA rapid bioassessment protocol. BMIs are classified based on their tolerance of poor or contaminated water and can be classified as sensitive, intermediate or tolerant of poor water quality. Abundance of BMIs in these three classes was used to calculate a water quality index. Metal concentrations in sediments were measured by x-ray fluorescence (XRF) while solvent extracted PAHs were analyzed with gas chromatography/mass spectrometry. Both PAH and metal concentrations were compared to threshold and probable effects sediment screening guidelines. Combining the data from the two classes can give students from each, new insight into the important interactions between the abiotic factors and resulting biota found within the ecosystem.

Board #24: "Storm Event Nutrient Dynamics in BSU Storm Water Bioretention System", Leon Edwards and Kevin D. Curry, Department of Biological Sciences, Bridgewater State University, Bridgewater, MA

Bioretention systems used for stormwater management have been investigated for their capacity to reduce nitrate and phosphorus concentrations which can impact aquatic life by eutrophication. (Davis et al. 2001) The BSU stormwater bioretention system is a low impact design intended to improve water quality of stormwater runoff. This study examined samples from the BSU stormwater bioretention systems from Spring and Fall 2017 for levels of nitrate-nitrogen (NO_3^-N), soluble reactive-phosphorus (SRP), and conductivity.

In Spring 2017, monitoring chambers 2 and 3 were often 6x to 30x greater in conductivity and paralleled peaks in phosphorus. Levels of SRP in MC4 indicate that the bioretention system is able to reduce phosphorus despite the elevated amounts of phosphorus in chambers 2 and 3. Dramatic increases in conductivity and phosphorus in the bottom of these chambers may be due to road salt added to the parking lot. In September 2017, levels of Nitrate peaked early in rain events and diluted over time. SRP levels dramatically peaked at 0.041 mg/L late in the rain event at MC1, while all other chambers fluctuated between 0.008 - 0.017 mg/L. Conductivity levels were dramatically lower than Spring 2017 levels. Up to 5% of road salt weight is often from phosphorus (New Hampshire Department of Environmental Services 2006). Timing and volume of rainfall also influences levels of nutrients and conductivity. Regulating the amount of road salt being put into the parking lots can help decrease phosphorus and improve removal in the bioretention system as well as decrease conductivity.

Board #25: "Discovery and conservation of amphibians and reptiles in Tidmarsh reserve, MA", Josh West, Victoria Schneider, Amanda Deguire and Thilina Surasinghe, Department of Biology Bridgewater State University, Bridgewater 02325

The Massachusetts Audubon Society purchased a large plot of mixed wetlands and forest that contain many different types of habitats, known as Tidmarsh Farms. Tidmarsh farms consist of a mosaic of habitats including ponds of different seizes, cold-water streams, red maple and Atlantic white cedar swamps, grasslands, and pine-oak forest. Tidmarsh farms was formerly a cranberry farm, but has been restored to its natural state, and is very likely the largest freshwater restoration project ever undertaken in Massachusetts. In this research project, our overall objective is to find out what

communities and species of reptiles and amphibians inhabit these ecosystems so that conservation efforts can be focused to protect the species present. In this project, one of my principle responsibilities was to deploy and bait different types of traps in the optimal locations. In addition during our travels through the terrain we cataloged every type of reptile and amphibian we saw along the way. When we captured one we identified it, photographed it and took the following water measurements at the locations where we captured it: temperature, dissolved oxygen content, conductivity, and PH. A large number of Pickerel, Green, Leopard, Bull, and Gray Tree frogs have been cataloged along with painted and Eastern Musk/Stinkpot turtles. An unusually large number of Pickerel frogs were found in a relatively small area. Large amounts of tadpoles from all the listed species except Gray Tree frogs were also observed. The PH, water temperature, dissolved oxygen levels, and conductivity of the water all fell within normal levels typical for these kind of environments. The large abundance of amphibians and reptiles observed indicates that this restored ecosystem is recovering very well, and cranberry bogs can be successfully transformed into healthy wetland ecosystems under the right conversational management. Future directions for research will be to perform statistical analyses on the population densities of these species and the correlations to the recorded water conditions to find out what microhabitats were preferred.

Board #26: "Phase Effects III: Ensemble Effects", Reginald O. Sarpong, Alexander Steacy, Joshua Muzyk, Ryan Hamelin and Steven L. Fiedler, Biology and Health Science Departments, Fitchburg State University, Fitchburg, MA 01420

This computational study employs molecular dynamics to: i) extract a first-order rate constant on the passage of a prototypical carbonaceous particle through a representative cellular membrane, and ii) construct a system of equations within the inhomogeneous solubility diffusion model to extract the effect(s) of the adjacent stagnant water layer. Concurrently, the calculated free energy profile with respect permeant position along the bilayer norm, allows us to better visualize the permeation process. This profile is leveraged to determine thermo-dynamic and kinetic-based properties associated with the permeation process. These properties, in turn, succinctly summarize the underlying chemistry on the interactions between the membrane and molecular permeants.

Board #27: "St. John, USVI, Tropical Ecology Course", Megan Laurie, Matthew Hall, Heather Burton and Megan Laurie, Marine Safety and Environmental Protection, Massachusetts Maritime Academy, Buzzards Bay, MA 02532

In the winter of 2017, fifty-four Massachusetts Maritime Academy freshman participated in a twelve-day field course at the Virgin Island Environmental Resource Station (VIERS) on St. John, USVI. The purpose of this course was to introduce students to fieldwork and integrative problem solving as well as to study the complexity of ecosystems through an immersive experience. Freshman were engaged in first-hand sustainability problems such as limited resources and conservation of an island nation. Students collected data in a variety of ecosystems such as mangroves, reefs, and dry tropical forests while working in teams of four to five to create a detailed field guide. This field guide included exercises such as shoreline profiling, the history of St. John, the geography of St. John, analysis of invasive species, environmental conditions, local botanical medicinal purposes, and an evaluation of biodiversity in Lameshur Bay via calculated diversity index. This course provided students with the knowledge, tools, and appreciation of environmental conservation necessary to pursue careers in protecting the environment.

Board #28: "The Impact of Sustainable Land-use Practices on Bee Nesting Guild Diversity", Austin Schofield, Daiana Moniz, Prisca Sanon, Adam Germaine, Andrew Oguma, Folusho Ajayi and Michael Bankson, Division of Math and Science, Massasoit Community College, Brockton, MA 02302

Native Bees are the largest contributors to animal pollination, and reports of their decline have prompted studies of bee communities and the implementation of land-use practices that are assumed to benefit bee abundance and diversity. This study focuses on nesting guild diversity and tested the following hypothesis: urban sites where sustainable land-use practices are implemented will have higher nesting guild diversities than other urban sites and be comparable to rural sites with expected high nesting guild diversities. Sustainable land use practices were employed at two of the six test sites and include large native plantings, no-mow areas, and limited use of chemicals.

Bees were collected using pan traps and sweep netting over two seasons (2016 and 2017). Bees were preserved and identified to genus and nesting guild. Sites were classified as urban or rural based on percent impervious land cover using ArcGIS.

Urban sites employing sustainable land-use practices had nesting guild diversities comparable to those of the rural sites, while the urban site with no sustainable land-use practices exhibited poor diversity. These data suggest that sustainable land-use may support bee community functional diversity. Bee communities at all sites were dominated by ground-nesting bees, indicating that southeastern Massachusetts supports a large community of ground-nesters. Two sites displayed low relative abundance while still measuring relatively high guild diversities, indicating that land-use practices affect total abundance and diversity differently.

Board #29: "Effects of Land-Use on *Bombus* Abundance", Isabelle Ruesch, Rachel Patten, Adam Germaine, Prisca Sanon, Andrew Oguma, Folusho Ajayi, Micheal Bankson, Division of Math and Science, Massasoit Community College, Brockton 02302

Bees pollinate the majority of agricultural crops and provide critical pollination services. Bees of the genus *Bombus* are especially effective pollinators due to their morphological features, generalist foraging preferences, and ability to sonicate (vibrate to release pollen from plants). *Bombus* loss is thought to lead to declines in local plant diversity, suggesting the presence of this genus may indicate a healthy ecosystem. As such, *Bombus* abundance was analyzed to determine if differing land-use practices, as defined by land management and percent impermeability (percent paved), had an effect on the *Bombus* abundance. Unexpectedly, the highest abundance of *Bombus* was found among urban sites, with this abundance being five times more than that of any rural sites. This suggests *Bombus* may be well suited for urban environments; however, future work is needed to determine the exact environmental factors that promote *Bombus* abundance.

Board #30: "The Impact of Land-Use Practices on Native Bee Diversity in Southeastern Massachusetts", Elizabeth Apiche, Kelechi Oriaku and Michael Bankson, Division of Math and Science, Massasoit Community College, Brockton 02302

Bees are keystone species that fundamentally contribute to pollination of both wild plants and food crops worldwide. Biodiversity is the bedrock of a healthy ecosystem, and a decline in native bee diversity may have a particularly bad effect on local ecosystems. The present study used pan traps and sweep netting to monitor native bee diversity across a range of land uses at six sites in Southeastern Massachusetts. Bees were sampled biweekly, pinned and identified to genus. The Shannon Diversity Index was used to assess the diversity at the different sites for 2016 and 2017. The test sites are designated as urban or rural based on GIS-analysis of percent impervious surface area within a 300-meter buffer zone around each native bee collection site. Two sites located on the urban campus of Massasoit Community College have been managed with more sustainable land-use practices that include large areas of native plantings, the installation of no-mow zones, and reduction of chemical use. Native bee diversity, as expected, was higher at rural sites compared to urban sites ($p<0.05$), and did not exhibit significant change from 2016 to 2017. Two sites on the urban campus of Massasoit Community College showed diversity that was higher compared to the other urban site and similar in diversity to the more rural sites. These results suggest that sustainable land use practices like those implemented on the Massasoit Community College campus may benefit local bee communities, even in an urban setting.

Board #31: "Does abundance of non-native *Apis* correlate with abundance within individual native bee nesting guilds?", Rachel Patten, Mariella McEachern, Adam Germaine, Prisca Sanon, Felusho Ajayi, Andrew Oguma and Michael Bankson, Division of Science and Mathematics, Massasoit Community College, Brockton 02302

Imported honeybees (*Apis*) provide key pollination services in many agricultural settings. As colony collapse disorder continues to lower the survivability of domestic honeybee hives, many food crops may increasingly depend on the services of native bee pollinators. Native bees are also essential for the healthy functioning of local ecosystems, and a

decline in native bee communities would have deleterious effects on the environment. Previous studies have not conclusively determined if resource overlap between *Apis* and native bees leads to competition. The present study extends this line of inquiry by asking if specific native bee nesting guilds experience competition with *Apis*, as indicated by negative correlations of their local abundances. Bees were sampled by pan-trapping and sweep-netting at six locations in southeastern Massachusetts from April-October 2016 and April-July 2017. Correlations between abundance of *Apis* and abundance of four locally dominant nesting guilds were calculated. There was no negative correlation between abundances of *Apis* and any of the guilds, suggesting a lack of significant competition. The native guild abundances positively correlated with each other, indicating that the studied nesting guilds thrive in similar settings. The lack of any correlation between *Apis* and native bee abundances may be due to the dependence of *Apis* abundance on human intervention, rather than environmental conditions.

Board #32: "Population Changes of *Lasioglossum* Over Time", Ana Estabrooks, Charmi Patel, Folusho Ajayi, Prisca Sanon, Adam Germaine, Michael Bankson and Andrew Oguma, Division of Science and Mathematics, Massasoit Community College, Brockton 02302

Lasioglossum is the most diverse and widely distributed bee genus worldwide, and it spans a wide variety of ecological niches including pollination roles ranging from highly specialized to generalist. As colony collapse disorder continues to reduce populations of anthropogenically introduced honeybees, native *Lasioglossum* species may be particularly important pollinators in both natural and agricultural ecosystems. Understanding the impacts of different land use practices on this genus, especially in areas of high human population density, would aid in its conservation. We examined the relationship between differing land use practices in southeastern Massachusetts and *Lasioglossum* abundance over two years (2016 – 2017). We sampled bee communities at six sites including urban sites with and without sustainable land-use practices, and rural areas with and without commercial agriculture. We based urban and rural designations on percent impervious surface within 300-m of each study site (assessed using geographic information system software, ArcGIS). Bi-weekly sampling employed pan traps and sweep netting, and continued April – July each year. While *Lasioglossum* abundance declined from 2016 to 2017 at all sites, the most rural site, one without commercial agriculture, had significantly higher average *Lasioglossum* abundance than all other sites. This suggests that particular resource(s) may be present at that site and lacking at the others, even those with sustainable land-use practices in place. Additionally, while *Lasioglossum* abundance decreased from 2016 to 2017, continued monitoring is needed to assess whether this is indicative of a longer term trend.

Board #33: "Effect of Distance From Power Line Cut and percent Imperviousness on Bee Abundance", Cynthia Oyatta, Daiana Moniz, Prisca Sanon, Folusho Ajayi, Adam Germaine, Michael Bankson and Andrew Oguma, Division of Science and Mathematics, Massasoit Community College, Brockton 02302

Pollination by native bees is critical to global crop production and essential to local ecosystem health. Studies showing declines in bee abundance have generated interest in finding methods to support native bee communities. Some studies suggest that power-line right-of-ways may serve as sanctuaries for bees due to their regular, but infrequent clearing and abundant edge regions. The present study evaluated the relationship between bee abundance and proximity to a power line cut. The relationship between percent impervious surface area and bee abundance was also determined for comparison. Bees were collected biweekly via pan trap and sweep net in 2016 and 2017. Distance from the nearest power line cut to each study site was measured using Google maps. ArcGIS software was used to calculate percent impervious within a 300-meter buffer around each study site. There was a modest positive correlation but between power line cut proximity and bee abundance, but no significant correlation between percent impervious land surface and bee abundance. Selective adoption of some management practices used to maintain power line cuts may lead to an increase in native bee abundance on other areas.