

2013 Sigma Xi Symposium Abstracts

Gustavus Adolphus College

May 3, 2013

Session 1: Oral Papers

Nobel 201 and Nobel 222

Session 1A: Nobel 201	
2:30 pm	<p>The Effect of Color Contrast on Perception of Portion Size predators Amanda Feeks Advisor: Lauren Hecht</p> <p>Larger portion sizes, packages and dinnerware suggest that serving and consuming more food is acceptable and proper. However, this has led to the United States' obesity rates increasing by over 50%. Sedentary work and inert pastimes may account for a large portion of the problem, but increased portion sizes and eating frequency at restaurants and buffets are the driving force behind weight gain. In response to these increases, health behavior research has gradually begun to study the distortion of people's food perceptions. Recently, researchers suggested that environmental factors, such as plate size and color, form a visual illusion, (i.e., the Delboeuf Illusion) and affect perception of portion sizes. In low contrast conditions (e.g., light colored food on a light background), it may be more difficult to perceive the amount of food on a plate accurately. Furthermore high contrast conditions (e.g., a dark colored food on a light background) may allow for more accurate perception because food can stand out more drastically. Thus, the current study assessed the influence of the color and lightness of elements in the food environment (i.e., food, plate, tablecloth) on perception and administration of portion sizes.</p>
2:45 pm	<p>Nucleophilic Reactions of Potassium Phthaloylphosphide Tuan Tran Advisor: Brian O'Brien</p> <p>Solid potassium phthaloylphosphide [<i>o</i>-C₆H₄(C=O)₂PK, abbreviated henceforth as KPhth] was prepared by reaction of diethyl phthalate, phosphine, and potassium <i>t</i>-butoxide in a Schlenk vessel designed for gas/liquid reactions. The product was then isolated by Schlenk filtration and stored under nitrogen.</p> <p>The phosphorus atom in KPhth is nucleophilic, and reacts readily in traditional S_N2 reactions. In this study, KPhth was first reacted with various alkylating agents, including one fluoros ponytail iodide, to provide P-alkylated products. A second study, reactions of KPhth and KPPH₂ with thiazyl trifluoride (NSF₃) was also pursued. Expectations were that the phosphide nucleophiles would displace fluoride from NSF₃ to provide P-substituted derivatives such as NSF₂Phth. Preliminary ¹⁹F and ³¹P NMR analysis seems to indicate, however, that NSF₃ acts as an oxidative fluorinating agent rather than as a simple electrophile. Experimental details and spectroscopic analyses from both studies will be discussed.</p>

3:00 pm	<p>Evaluating Trace Metal Contamination in an Abandoned Shooting Range Jeffrey Allen Advisor: Laura Triplett</p> <p>Abandoned shooting ranges are areas of potential concern for heavy metal contamination because some of the metals may be bioavailable and possibly enter ecosystems, water sources, and humans. This study is a preliminary investigation of potential contamination in soil at a former National Guard shooting range. We collected soil samples and used acid digestion to release metals that are environmentally available and analyzed through the ICP-MS. Higher concentrations of trace metals were found in the target area and increased with depth in the soil. The average concentrations for Pb exceed 10 ppm with over 6,000 ppm. Cr exceeded 100 ppm with over 3,500 ppm. Nickel beats 50 ppm by over 900 ppm. These concentrations are high enough to surpass the United States Environmental Protection Agency (USEPA). Out of eleven elements detected, nine exceeded the USEPA averages. A complete survey and cleanup of the site is required.</p>
3:15 pm	<p>Towards a Novel Switchable Aromatic Hemiporphyrzine Ligand Dasha Grishina Advisor: Tom Gardner</p> <p>Hemiporphyrzines are a well-known class of non-aromatic 20 π e- tetraaza rings. The recent report of a novel dicarbahemiporphyrzine ring system that is 18/20 π e- switchable to aromaticity (J. Am. Chem. Soc. 2012, 134, 190-193) has inspired us to pursue the synthesis of an analogous hemiporphyrzine ring that can serve as a novel switchable aromatic ligand for metal complexes. This presentation reports on the synthesis of this hemiporphyrzine, and its use as a switchable ligand.</p>
3:30 pm	<p>Origins of a Terrace Feature in Seven Mile Creek Park, MN Jake Bruihler Advisors: Julie Bartley, Laura Triplett, James Welsh</p> <p>This research is an investigation of the formation of a terrace feature sitting 3-5 meters above the current floodplain of Seven Mile Creek. It is important because it improves understanding of the geologic history of Seven Mile Creek Park following glacial retreat ~11ka. The terrace strata carry the record of the creek's depositional response to a sudden drop in local base level. Based on sedimentary analysis of samples taken from these strata, the terrace is interpreted to be intermittent deposition of fluvial and alluvial materials. Optically Stimulated Luminescence dating attempted to constrain age of deposition; though unsuccessful, the data results indicate that following glacial deposition, sediment transport distances were short. These interpretations correspond with sedimentology and geomorphology, based on knowledge of local geology.</p>

3:45 pm	<p>Analyzing and Presenting Resistivity Data from Emerald Mound Archeological Site in Attempt to Discover a Mississippian Trail Michael DeLucia Advisor: Laura Triplett</p> <p>The Emerald Mound archeology site consists of a few man made mounds and, in a 1940's areal image, two linear features resembling paths. These features were quite extensive, but no longer visible in modern areal images. Understanding travel techniques can give us a better understanding of the culture that produced them, but many were lost due to modern agriculture and urbanization. Years of travel on a road would compress the soil beneath the theorized path. Higher resistivity values are correlated with more compressed soil, but there are quite a few other variables that affect resistance. A series of 10 linear resistivity profiles were set up perpendicular to the feature in question. These profiles, in both maps and graphs, showed a pattern of higher resistivity that was located between 40 to 50 meters and 110 to 120 meters along the profiles from the south end. This pattern was consistent through multiple different profiles and depths, but was not present in all as the resistivity data is very noisy and variable. The continuity of high resistivity values concludes that the linear feature was likely produced by this ancient civilization and is not a by-product of modern agriculture.</p>
4:00 pm	<p>Mapping Depth to Bedrock in a Tropical Pre-Montane Wet Forest Rachel Oien Advisor: Laura Triplett</p> <p>Measuring the depth to bedrock in tropical montane environments is complicated by aspect, elevation, slope, landslides, slumping and other mass wasting events. As part of a larger study, Texas A& M Costa Rica REU aimed to close the water budget for a tropical pre-montane forest, the focus of this study is to generate a map of the depth to saprolitic tuff and topographical information for the purpose of estimating the volume of soil water storage in the Howler Monkey Watershed at Texas A&M Soltis Center, San Isidro de Peñas Blancas, Costa Rica. A map of the depth to saprolitic tuff was created using 101 hand-augured holes (over 2.63 ha) spatially distributed throughout the watershed. The 22 soil samples were collected and ranged from 50-73% water content. The slopes across the watershed vary from 12-65 degrees but only have a 24% correlation with the depth to saprolitic tuff. Results suggest that the depth of the saprolitic tuff is quite sensitive to small scale topographic variability. Depth to bedrock provides necessary data to estimate the total volume of soil within the watershed and ultimately the hydrology of the area.</p>

4:15 pm	<p>A comparison of biogenic silica analysis using UV Vis and ICP-MS methods Zachary Wagner Advisor: Laura Triplett</p> <p>Silicate (SiO₂) is naturally present in many forms at earth's surface and is studied across many disciplines. Despite this, biogeochemical cycling of silica is less understood than cycles of other common elements like carbon. One of the difficult aspects of studying silica fluxes from one part of the environment to another is that it is difficult to accurately and precisely measure biogenic silica, or silica particles formed by biota. In this study, we examined two methods for analyzing biogenic silica, ultra-violet visible spectrophotometry (UV-Vis) and inductively coupled plasma mass spectrometry (ICP-MS), with the goal of finding the most accurate and precise method for measuring silica in aqueous solution. Biogenic silica was extracted from sediments from the Platte River, then the solutions were split and analyzed by the two methods. We found that the UV-Vis method yielded concentrations about twice as high as those reported by the ICP-MS for identical samples. We also found that both methods had about 20% deviation from the mean, and was higher at lower concentrations when samples were compared in triplicate. We conclude that standard analysis methods of calculating silica concentrations do not show significant difference in ability to precisely measure silica but both are still lacking in accuracy due to the large difference between the ICP-MS and UV-Vis results.</p>
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Session 1B: Nobel 222	
2:30 pm	<p>Identifying an mRNA Directly Degraded by the Exosome in <i>Saccharomyces cerevisiae</i> Carl Schiltz Advisor: Jeff Dahlseid</p> <p>Protein levels in organisms are regulated partly by changes in abundance of mRNAs, the levels of which are determined by the opposing forces of mRNA synthesis and degradation. In baker's yeast a protein complex called the exosome is partly responsible for mRNA degradation. Most mRNA species targeted by the exosome are "aberrant" or abnormal; however, the exosome has also been reported to act on at least one mRNA. We have successfully identified SOK2 as a candidate. To test if SOK2 mRNA is regulated by the exosome, we have begun to analyze the total RNA from wild-type yeast and yeast with impaired exosome function. If SOK2 mRNA is directly degraded by the exosome, we will isolate the regions of SOK2 RNA responsible for exosome recognition. Characterizing the recognition region will allow the identification of more wild-type mRNA species degraded by the exosome and confirm this novel function of the exosome.</p>

2:45 pm	<p>The Impact of Innovation on Medical Education Dawn Comstock Advisor: Sanjive Qazi</p> <p>The Mayo Clinic is consistently recognized as a worldwide leader in healthcare research, patient care and medical education. Beginning from its humble roots in Rochester, MN, the Mayo Clinic has achieved this status as a result of its strong vision and emphasis on its mission statement and core values throughout its history. It has also been shaped by a willingness to incorporate teaching and research innovations into practice. A systematic historical review highlighted how the system developed and continues to respond and lend direction in the rapidly changing healthcare industry with respect to delivering patient care and education. This is exemplified by the use of medical simulation in improving medical training, incorporating team building, and critical review of practices. In completing analysis of simulation data from students and medical professionals, we identified improvements in communication and clinical skills. This research supported the possibilities that would result from achieving an institution-wide integration of simulation and simulation analysis at the systems level to enable this technology to inform better medical practice and research.</p>
3:00 pm	<p>Identifying and Targeting Progenitors of Cancer Cells through Data-mining Cell Sorting Data Sarah Lucht Advisor: Sanjive Qazi</p> <p>Cancer stem cells can arise from molecular transformations of small sub-population progenitors and targeting these sub-clones early in development is expected to more effectively prevent large heterogenous cancer cell populations. Multi-channel fluorescence-activated cell sorting (FACS) methods enable detection of molecular sub-types of cancer stem cells which can be targeted using nano-particles to inhibit growth and development. Raw nano-medicine and FACS data are being deposited in open databases to facilitate data-mining efforts and the generation of new hypotheses for more targeted approaches to cancer inhibition. However, analysis of FACS data requires a high degree of manual labor and familiarity with gating techniques to identify sub-populations of cells. We present here a normal mixtures model to analyze FACS and identify rare sub-populations of cells using molecular parameters. This clustering method will be applied to interrogate patient databases for identified markers and to counter the proliferation of B-precursor leukemic stem cells in infants.</p>

3:15 pm	<p>Instituting the Concept of Well-being in Clients with Mental and Physical Instability and Disability Daniel Sinda Advisor: Sanjive Qazi</p> <p>We developed a research study with Shiloh’s Hope Inc., a small non-profit organization, whom is committed to providing a holistic, person-centered approach to support the physical, intellectual, emotional, and spiritual needs of their mentally ill and vulnerable adult clients. Our goal was to increase commitment to well-being practices in clients through participation in a scientific investigation of skin conductance changes and cortisol responses as surrogate markers for stress responses. Emotive surveys were taken before and after each session to monitor their conscious perception of the experience. Eight trials were conducted over a period of 3 months involving 5 participants per session and 2 sessions per trial. Skin conductance responses were taken from one individual per session and the responses were later discussed. Cortisol measurements were taken 4 out of the 8 trials to monitor long-term changes in the response. Each session included activities, discussions and meditation. Cortisol had significant decreases for paired responses before and after each session (Paired T-test, $P < 0.01$) which indicated a strong trend of increasing response over the 3 month period. Skin conductance responses exhibited marked variation between individuals. The emotive survey responses compared to the cortisol levels related that a change in cortisol is negatively correlated with the response to Q2 (“I feel at ease”). The clients were highly motivated to discuss and participate in this scientific investigation. We presented our findings to the group and we are planning future trials in which the previous participants will help aid in sessions for new clients.</p>
3:30 pm	<p>Oxygen Isotopic Analysis of Belemnites: Implications for Water Temperature and Life Habits in the Jurassic Sundance Sea Amanda Adams Advisors: Julie Bartley</p> <p>Stretching across much of the west-central United States, the Jurassic-aged (164 million years ago) Sundance Formation is all that remains of the largest continental seaway in the past 250 million years. Despite its wide extent and excellent exposure, little is known about the temperature or chemistry of this ancient inland sea, making it an ideal choice for studying the geochemistry of the now dry sea. The Sundance Formation preserves a diverse array of well-preserved marine fossils, including belemnites, an extinct relative of today’s squid. Analysis of oxygen isotopic composition of belemnites permits calculation of paleotemperatures for this seaway. In this study, subsamples of 36 well-preserved adult belemnites yielded average paleotemperatures of 13-18°C for the Sundance Seaway. Comparisons between adult and juvenile belemnites also suggest that these cephalopods occupied distinct habitats during different life stages.</p>

3:45 pm	<p>Qualitative and Quantitative Assessment of Taphonomic Patterns in Modern Algae and Cyanobacteria: Implications for Identifying Precambrian Microfossils Tara Selly Advisor: Julie Bartley</p> <p>Precambrian microfossils are notoriously difficult to assign to major taxonomic groups. Presently, no single set of characters can be used to identify the earliest eukaryotes or to securely place silicified microfossils or compressed acritarchs into domain-level clades. Cell size, cell wall ultrastructure, ornamentation, and biogeochemical characteristics are used separately or in combination to evaluate the systematics of these microfossils. Understanding characteristic taphonomic pattern in diverse groups can aid in recognizing eukaryotes in the Precambrian fossil record. Previous work has evaluated decomposition of algae and cyanobacteria separately; this project aims to make a direct comparison between photosynthetic prokaryotes and eukaryotes through qualitative description of taphonomic trends and through quantitative analysis of decomposition. Preliminary results indicated that there are characteristic differences between taxa. Based on these initial findings, taphonomic characters may be useful, when combined with traditional taxonomic characters, in inferring phylogenetic placement of Precambrian microfossils.</p>
4:00 pm	<p>Using Condonts to Determine Depositional Variability within the Decorah Formation of Eastern Minnesota and Iowa Matt Illies Advisor: Julie Bartley</p> <p>The Decorah Formation is a well-known fossiliferous rock unit throughout the central United States. Ordovician in age, it contains an abundance of shallow marine fossils. The purpose of this study is to examine any depositional differences in the Decorah Formation, across three localities in the Upper Midwest. Samples were taken from Rochester, Decorah and Minneapolis outcrops; at each site a sample was taken from the top and bottom contacts of the formation. Conodont biostratigraphy and species richness was used to determine if the samples were significantly different in terms of which species were found and how many of each species were found at a location. All the locations had a P value of .698 for the T test and .903 for the One Way tests. Across the samples 2/5 to 1/2 of the conodont species were the same. A statistical comparison of the top and bottom samples of the Decorah at the three localities showed that there was not significant evidence to refute the hypothesis that this section of the Decorah was deposited in the same general environment. The same was true for the One Way data analysis test done across the top and bottom of the localities.</p>

Part 2: Poster Papers
In association with the *Celebration of Creative Inquiry*
5:00 pm – 7:00 pm; Jackson Campus Center

The Effect of Scopolamine Bromide on Spatial Learning By Rats

Eli Benz, Kat Dahl

Advisor: Mike Ferragamo

Behavioral experiments give exceptional insight on psychological processes and the neural mechanisms of spatial learning and memory. The intent of this study was to test the effect of scopolamine on spatial learning and memory of rats by using the Morris Water Maze (MWM). The MWM is a tool commonly used in behavioral experiments that requires the rat to learn quickly while attempting to locate a hidden platform in a pool of water. The induction of hippocampal long-term potentiation, a physiological correlate of learning, can be induced by activation of the cholinergic input from the medial septum. Pre-training administration of the drug scopolamine, a muscarinic cholinergic antagonist, induced strong amnesia in rats. The control rats and the rats injected with scopolamine both exhibited learning, but the control group learned more quickly than the rats injected with scopolamine. When the rats were required to recall previously learned information, the control rats did so much more effectively. The results suggest that cholinergic inputs to the hippocampus are involved in spatial learning.

Relationship Between Salicylate Induced Tinnitus And Circadian Rhythm

Kendra Braegelman

Advisor: Jan Wotton

Tinnitus is characterized by hearing an uncontrollable, phantom noise and affects the quality of life of approximately 30 million people in the United States. This condition is most commonly found in individuals over 60 who have been exposed to loud noises throughout their lifetime. The goal of this experiment was to create a model system of tinnitus in rats to enable investigation of the relationship between tinnitus and circadian rhythm, as reports indicate human symptoms worsen at night. Tinnitus was induced in rats by an injection of salicylate. The presence of tinnitus was detected through the gap startle paradigm. A startle, characterized as eyelid closure and flexing of facial and skeletal muscles, is an instinctual response upon hearing a sudden sound. The startle response is attenuated if the animal hears a prior signal in the background noise, such as a gap of silence. However, if the subject is experiencing tinnitus it will not be able to easily detect the short gap in background noise and therefore, there should not be a reduction in startle response. Through the use of this framework, we detected an increased gap startle response in a salicylate-injected rat compared to the same rat's response without salicylate injection. Successful replication of this methodology will provide the groundwork to investigate whether a connection between tinnitus and circadian rhythm exists, which may further elucidate the neural tinnitus pathway.

Synthesis of the Bifacial Ligand, 1,6,7,12-Tetraazaperylene: A New Approach

Nora Christensen, Michael Howe

Advisor: Thomas Gardner

1,6,7,12-Tetraazaperylene is a conceptually useful ligand for constructing coordination polymers with potentially interesting electronic and magnetic properties. However, the synthesis of this compound has been elusive to synthesize, and has only been reported recently through an inconvenient starting material that is not easily customizable. Our initial approach was to mimic the reported synthesis of the similar compound, sampangine, which is itself prepared in two steps beginning with a hetero Diels-Alder reaction of crotonaldehyde dimethylhydrazone and a bromoquinone to yield the intermediate compound cleistopholine. Unfortunately, our attempts to

reproduce the reported synthesis of the analogous intermediate, 4,8-dimethyl-1,5-diazaanthraquinone, yielded a complex mixture of products, with only a trace suggested to be the desired intermediate. We have therefore undertaken a new, four-step synthetic approach to this compound, one designed to include on the heterocycle ring the peripheral leaving groups necessary for construction of the desired polymers.

Mapping Tree Growth and Survivorship in Monteverde, Costa Rica

Grant Cooper

Advisor: Laura Triplett

Since 2002, the Fundacion Conservacionista Costarricense (FCC) has been working to create a biological corridor on the Pacific slope of Costa Rica to restore habitat for the Three-wattled Bellbird. This effort is being done through reforestation of pasture and farm fields from Monteverde all the way down to the Gulf of Nicoya. The challenge is that there are many unique life zones within the corridor, each with a unique assemblage of different tree species. Also, other factors might affect the success of reforestation within these life zones such as maintenance regime and slope. One area where reforestation success with native tree species is currently being studied is an FCC site in Monteverde called Nacimiento y Vida. At this site, the growth and survivorship of four tree species was studied in two plots with different slopes, one relatively flat with a 10 degree slope and the other more steep with a 34 degree slope. Observations in the field were conducted in order to determine the location of trees on a map and take basic measurements of their overall health. The four species studied were; *Casimiroa edulis*, *Myrsine coriacea*, *Nectandra salicina*, and *Roupala glaberrima*. Using the GIS software ArcMap the individual trees were plotted and information about them joined to those points. The final products were maps of the two plots showing where the trees are located, which trees survived, and the monthly growth rate for each tree. In the future, these maps can make other reforestation projects more successful because of the information learned about each of the species.

Release Rates Of The Steroid Dexamethasone Phosphate (DSP) From Silicon Rods Used In Implantable Medical Devices

John Danforth, Chris Harmes, and James Arps (ProMed)

Advisor: Dwight Stoll

The purpose of this research was to determine release rates of the steroid dexamethasone phosphate (DSP) from silicon rods used in implantable medical devices such as pacemakers. The elution of DSP from the silicone rods into phosphate buffer solution at 37°C was monitored over a four-week period using high performance liquid chromatography (HPLC). Three different preparations of the silicone rods were studied to understand the factors affecting the rate of release of the DSP to the buffer solution: 1) low temperature cure with no polymer sheath; 2) low temperature cure with polymer sheath; and 3) high temperature cure with no polymer sheath. All silicon rods contained 25% DSP by mass. A set of standards with known quantities of DSP were analyzed by HPLC to prepare a calibration curve for quantitation. Samples of the phosphate buffer were collected at 1, 3, 6, and 12 hours, 1, 3, and 7 days, and 2, 3, and 4 weeks, and analyzed by HPLC. From these data, the cumulative release of DSP was plotted as a function of time, and the elution rate constants for the three experimental conditions were determined. From these data, the cumulative release of DSP was plotted as a function of time, and the elution rate constants for the three experimental conditions were determined. It was found that the rods cured at lower temperature released DSP at slower rates compared to those cured at higher temperature, and that the polymer sheath had the largest impact of slowing elution of the drug from the rods. These results will inform subsequent design and manufacturing of these rods for application in implantable devices.

Towards a Novel Switchable Aromatic Hemiporphyrzine Ligand

Daria Grishina

Advisor: Thomas Gardner

Hemiporphyrzines are a well-known class of non-aromatic $20 \pi e^-$ tetraaza rings. The recent report of a novel dicarbahemiporphyrzine ring system that is $18/20 \pi e^-$ switchable to aromaticity (J. Am. Chem. Soc. 2012, 134, 190-193) has inspired us to pursue the synthesis of an analogous hemiporphyrzine ring that can serve as a novel switchable aromatic ligand for metal complexes. This presentation reports on the synthesis of this hemiporphyrzine, and its use as a switchable ligand.

Mapping the Period (PER) Binding Surface of the Circadian Clock Protein Cryptochrome (CRY)

Mariecus Jarvis, Audrey Messelt

Advisor: Karla Marz

Circadian clocks control many rhythms in organisms, often by telling them to produce different proteins at different times. These biological clocks function through feedback loops that are completed every twenty-four hours. In one negative feedback loop, genes for the clock proteins Cryptochrome (CRY) and Period (PER) are transcribed in the nucleus and translated in the cytoplasm. CRY and PER proteins subsequently bind each other and travel back to the nucleus, where they inhibit their own transcription, closing the loop. Eventually the protein complex degrades and transcription of these circadian clock proteins can occur again, with the pattern repeating each twenty-four hours. To better understand the clock mechanism, we studied the binding behavior of CRY and PER in isolation using HEK-293 cells, which do not have clocks but will make CRY and PER if given DNA coding for them. By itself, PER is found in both these cells' nucleus and cytoplasm, but if wild-type CRY is present it binds PER and pulls it into the nucleus. We can see this shift in location via immunocytochemistry and fluorescence microscopy. Using this approach, we examined PER binding by a panel of site-directed CRY mutants, and identified a set of amino acids that are important for binding to PER.

Diels-Alder Reactions of Prochiral 1,5-Disubstituted Anthracenes Towards the Creation of Chiral Auxiliaries and Ligands

Danielle Mangine

Advisor: Thomas Gardner

Diels-Alder reactions of prochiral 1,5-disubstituted anthracenes have received surprisingly little attention, not to mention their further development into chiral auxiliaries and ligands for possible use in chiral catalysis. This presentation reports on the study of the Diels-Alder chemistry of principally two 1,5-disubstituted anthracenes, 1,5-diphenylanthracene and 1,5-bis(phenylmethoxy)anthracene, with dienophiles such as dimethyl fumarate, fumaronitrile, and dimethyl acetylenedicarboxylate, and their subsequent development into useful chiral auxiliaries and ligands.

Optical Imaging By Reflection Through Random Media

Briana Mork

Advisor: Steve Mellema

The objective of this experiment is to observe and measure images produced by a beam of light that follows a designated pathway, a specific setup called a Mach-Zender interferometer. The measurement and observation of the images as well as the control of the lasers takes place using computer software. In order to control very minute movements of the lasers- to increase and decrease distances that the beam of light will travel- stepper motors are used. A USB I/O is able

to control the stepper motors and observe and measure data received from the experiment using computer software already existing for the experiment. The planned presentation will talk about future goals and intentions as well as the focus of the semester: integrating software and tools to be able to run the experiment solely from computer input.

Construction of Two-Fold Symmetric Phthalocyanines for the Purpose of Creating Linear Coordination Phthalocyanine Polymers

Emma Motl, Xi Wang, Bryan Miles, Kelly O'Neill, Kendyl Greimann, Kayla Hanninen
Advisor: Thomas Gardner

Our project involves building coordinatively bound polymers that contain phthalocyanine units that are also well-soluble in organic solvents. To do this, we needed to reduce the four-fold symmetry of phthalocyanine down to two-fold, which we are achieving through steric blocking using tetraphenylphthalonitrile. The parts of the polymer that bridge the phthalocyanine rings are coordinative in nature, and we are using existing ligands such as 1,10-phenanthroline and 1,3-bis(2-pyridylimino)isoindoline, and are also exploring a new type of chelating ligand, 1,3-bis(2-imidazolylimino)isoindoline that can adopt various charge states, and therefore accommodate various metal oxidation states. It is hoped that polymers such as these might someday exhibit interesting electronic, magnetic, or chemical sensing properties.

Mapping Depth To Bedrock In A Tropical Pre-Montane Wet Forest In Costa Rica

Rachel Oien
Advisor: Laura Triplett

Measuring the depth to bedrock in tropical montane environments is complicated by aspect, elevation, slope, landslides, slumping and other mass wasting events. As part of a larger study, Texas A& M Costa Rica REU aimed to close the water budget for a tropical pre-montane forest, the focus of this study is to generate a map of the depth to saprolitic tuff and topographical information for the purpose of estimating the volume of soil water storage in the Howler Monkey Watershed at Texas A&M Soltis Center, San Isidro de Peñas Blancas, Costa Rica. A map of the depth to saprolitic tuff was created using 101 hand-augured holes (over 2.63 ha) spatially distributed throughout the watershed. The 22 soil samples were collected and ranged from 50-73% water content. The slopes across the watershed vary from 12-65 degrees but only have a 24% correlation with the depth to saprolitic tuff. Results suggest that the depth of the saprolitic tuff is quite sensitive to small scale topographic variability. Depth to bedrock provides necessary data to estimate the total volume of soil within the watershed and ultimately the hydrology of the area.

Reduced-Symmetry ABAC Metallophthalocyanine Complexes From a Tethered Phthalonitrile Trimer

Josie Steinmetz, Anna Ayers Looby, Kacy Lorber, Kayla Hanninen, Kendyl Greimann
Advisor: Thomas Gardner

Reduced-symmetry ABAC metallophthalocyanines, with two opposing corners from one type of phthalonitrile and the second and fourth corners from two other, mutually dissimilar phthalonitriles, are notoriously difficult to deliberately synthesize, other than as one component within a statistical mixture of products. Our recent synthesis of a novel tethered phthalonitrile trimer offers a synthetic gateway specifically to ABAC metallophthalocyanines. This presentation discusses the ABAC metallophthalocyanines prepared from this trimer using a variety of metals and "fourth corner" phthalonitrile components.

Characterization Of Carbon-Modified Silicas For Use In Analytical Liquid Chromatography

Tuan Tran, Ian Gibbs-Hall, Paul Young, Doug Fryer (United Science, LLC), Conor Smith

(United Science, LLC), Jon Thompson (United Science, LLC), Bill Barber (Agilent Technologies); Advisor: Dwight Stoll

We have recently developed a series of novel carbon-modified porous silica materials for use in analytical and preparative separations, and as solid-phase extraction media. The analytical materials exhibit unique characteristics compared to other commercially available carbon phases and are substantially more stable at high pressures. Users of carbon-based phases are aware that some compounds are very difficult to elute from existing commercial carbon-based materials. The new materials described here significantly address this problem through both the ability to adjust the carbon loading on the underlying substrate, and the use of a relatively inert substrate. We will report on the basic characterization of a suite of materials that cover a wide range of carbon loading, including: retention of non-polar and polar compounds, chromatographic selectivity, and mass transfer characteristics.

Characterization of Diffuse Media with Laser Speckle

James Trevathan

Advisor: Paul Saulnier

The intensity distribution of light scattered by an optically diffuse material can be used to determine the scattering properties of the material. The speckle contrast ratio is an important property which can be calculated from the statistical properties of the intensity distribution and is related to the degree of scattering in a material. We explore a method for measuring the intensity distribution and calculate the speckle contrast ratio for single as well as stratified polycarbonate membrane filters; spanning the weak to highly scattering regimes.