2011 Fall Research Symposium (Friday, September 16, 2011)
Abstracts

Nick Alverson: Sediment Fingerprinting: The Le Sueur River Basin
Laura Triplett, Nick Alverson, Jennifer Hanson

The Minnesota River contains an abnormally high amount of sediment in its waters. This sediment is the cause of the Minnesota River's high turbidity levels, and is also the main contributor of sediment that is filling and impairing Lake Pepin. In order to create an effective plan to restore the Minnesota River, the primary source of the sediment must be identified. A study by Schottler and Engstrom (personal communication, 2009) has shown top soil is only a minor contributor to the sediment load of the river by using atmospherically-deposited radioisotope trace found in top soil. With soil ruled out, the search for the source can be narrowed to bluffs, ravines, and stream banks.

This study compares the geochemistry of bluffs, ravines, stream banks, and top soil. Multiple sediment samples of each above category were taken from the Le Sueur River watershed. This River is a tributary to the Minnesota River, and also contains a very high amount of sediment. Samples were then processed and analyzed through the ICP-MS. The goal with this data is to determine if there is a difference in trace-element concentrations between bluffs, ravines, top soil, and stream banks.

Noel Amborn: Changes in Reproductive and Metabolic Phenotypes in Response to Excess Androgen in Utero
Sue Mentor,* Laura Burger,* Beth Wangemaker,* Noel Amborn
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An endocrine abnormality seen in women known as Poly Cystic Ovary Syndrome has been recently identified a common cause of infertility. As a result of high androgen levels in the body, Poly Cystic Ovary Syndrome manifests itself among many avenues in the body. The reproductive manifestations of this syndrome begin at the level of the Hypothamalo-Pituitary-Gonadal axis. A persistently high frequency pulse of GnRH maintains the high levels of androgen in the body and is the root cause of the hormonal changes that affect reproductive cycling. Although PCOS is seen in families, a gene has yet to be identified. Therefore it has been hypothesized that PCOS could be a result of an epigenetic change. Subjection to androgen in-Utero has allowed us to develop a PCOS phenotype in model organisms from which we have been able to study whether epigenetics are playing a role in the increased prevalence of PCOS in women.

Jake Bruihler, Tara Selly, Todd Kremmin: Geology of Nicollet County, MN
Jake Bruihler, Tara Selly, Todd Kremmin, and Julie Bartley

How do you create an exhibit that conveys its message in a meaningful way to all audiences? We created an exhibit about the geology of Nicollet County, MN for the sesquicentennial anniversary celebration at Gustavus Adolphus College. In doing so, we had to find ways of answering tough

questions with easy to understand answers. We started with a basic exhibit and surveyed non-geology students about their understanding of it. We used this input and came up with more creative ways to express our ideas. Throughout the process, it was discovered that different people understand the same information in many different ways. This forced us to create many elements within the exhibit which displayed information in different ways, such as images, captions, and samples. The final exhibit combined a three-dimensional representation of the Minnesota River Valley with two dimensional representations of both space (maps) and time (cross-sections). With the varying types of information displayed, viewers understand a wider range of geologic information. In our research, we discovered how people view and learn from exhibits. With this knowledge, we attempted to incorporate all possible elements to create an exhibit that conveyed its message in a meaningful way to all audiences.

Spencer Bonnerup: Characterization of Reversed-Phase Liquid Chromatography Columns using the Hydrophobic Subtraction Model

Spencer Bonnerup, Dwight Stoll

In this work we aimed to characterize different reverse-phase liquid chromatography (RP-LC) columns for identification of column characteristics and how they vary from column to column. To this end, we followed the Snyder, Dolan and Carr methodology for the determination of said characteristics: column hydrophobicity, column steric interactions, column Hydrogen bond acidity, column Hydrogen bond basicity, and column cation-exchange activity. To do this work, we first had to calibrate the instruments to assure that our settings would produce results similar to those of Dolan, Snyder, and coworkers (you need a reference here) for each of the columns studied. First, we determined a linear calibration curve for the oven temperature of each of the instruments. Secondly, we determine what composition needed to be entered into the instrument to get the same retention factor for selected probe analytes as a mobile phase mixed off-line. Lastly, we assessed the accuracy of the flow rate delivered by the instrument. In each case, we discovered significant, but reproducible differences between the observed parameters, and those specified by the method. Measurement of these differences will be critical to subsequent characterization of new RPLC phases.

Anthony J. Cesnik: Evaluation of phosphinic and phosphonic fluorosurfactant mixtures as possible PFOA replacements in PTFE emulsion polymerization

Anthony J. Cesnik, Todd S. Sayler,* Richard E. Fernandez,* and Joseph S. Thrasher*
*University of Alabama

The emulsification capabilities of the fluorosurfactant mixture MAFS-010, produced by Merck (Darmstadt, Germany), was evaluated and applied to fine-grained PTFE polymerization. An effective analysis procedure was developed for polymerization mixtures, including polymer sample preparation by drying and washing the latex. The stability and efficacy of MAFS-010 components in PTFE emulsion polymerizations will be discussed.

31P and 19F NMR spectroscopies were used to determine the component structures and percent composition of MAFS-010: 85% ammonium bis(perfluorobutyl)phosphinate (1), 5% ammonium hydrogen perfluorophosphonate (2), and 10% co-products. An effective CMC determination for non-binary solutions was developed, and the mixed, micellular composition of these solutions was demonstrated. The CMC of MAFS-010 was calculated to be 65 ± 2 mM and 6.3 ± 0.4 mM using concentrations of (1) and (2), respectively. Using total surfactant concentrations, the CMC was calculated to be 70 ± 4 mM. Five PTFE polymerizations were performed using a TFE administration facility. A polymerization using PFOA demonstrated the capacity to produce fine-grained PTFE particles 1 to 8 µm in diameter and agglomerates around 20 µm in diameter. A polymerization using MAFS-010 demonstrated the capacity to produce similarly sized PTFE particles. Chain transfer reactions of MAFS-010 components occurred in polymerizations that utilized the initiator APS at 85˚C. Eight MAFS-010 stability tests were performed under various conditions, including 85˚C without initiator and 85˚C with APS, and were analyzed via 31P and 19F NMR. The fluorosurfactant mixture changed only in the trial at 85˚C with APS.

Alex Chubick: The Difference in Charge Between CRY1 and CRY2 and Its Effects on CRY Function
Alex Chubick, Kimberley Sukhum, Yhew Pongsawakul, and Karla Marz

Circadian rhythms are 24-hour rhythms that help regulate biological processes. The core mechanism driving circadian rhythms is a negative feedback system found within the cell. Within this system the protein known as Cryptochrome (CRY) plays an important role, and in mammals there are two types of CRY, CRY1 and CRY2. These two CRYs have opposite effects on the lengths of circadian rhythms. In an effort to understand which structural differences between them are important, CRY1/2 hybrid mutants were developed in which CRY1 contained different CRY2 residues substituted for its own. It was found that these mutations reduce CRY's overall activity and specifically its ability to localize to the nucleus. To see if the mutations had any other effects, the mutant CRYs were given nuclear localization sequences (NLS) to allow the protein to enter the nucleus. Preliminary data suggest that adding a nuclear localization sequence to one of the hybrid mutants restored at least some of its repression activity. Before any conclusions can be made about these results, further tests must be performed.

Megan Crow: Photodegradation of the Herbicide Imazethapyr on Corn and Soybean Wax
Megan Crow, Maja Johnson, and Amanda Nienow

Imazethapyr is an herbicide commonly used in the Midwestern U.S. on corn and soybean crops. Previous studies have observed photolysis as one of the major pathways of environmental degradation. The goal of this study was to determine the rate of degradation of imazethapyr on plant waxes, considering that the herbicide is applied directly to crops in the field. Imazethapyr solutions were irradiated on glass, aqueous, corn wax, and soybean wax surfaces under simulated UV light and analyzed using HPLC. The imazethapyr degraded the fastest on the aqueous and glass surfaces. The soybean wax was notably slower, and the corn wax showed little degradation. This suggests that the composition of the plant wax

has a significant slowing effect on the degradation rate of imazethapyr. Future work will include further characterization of the waxes to understand the reason wax affects degradation, as well as studying degradation of imazethapyr on plant leaves.

Brandon Furey: Comparing SEBAL and METRIC: Evapotranspiration models applied to Paramount Farms almond orchards

Brandon Furey, Shawn Kefauver,* and Susan Ustin*
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The overarching goal of the land research group in the NASA Student Airborne Research Program was to develop tools to better monitor crop water status of farms to avoid over-watering so that irrigation can be more efficient. Water is a scarce and expensive resource in California and so efficient irrigation in farming is practically mandatory. Two evapotranspiration models were applied to almond and pistachio orchards in California. The SEBAL model, developed by W.G.M. Bastiaanssen, was programmed in MatLab for direct comparison to the METRIC model, developed by R.G. Allen and the IDWR. Remote sensing data from the NASA SARP 2011 Airborne Research Program was used in the application of these models. An evaluation of the models showed that they both followed the same pattern in evapotranspiration (ET) rates for different types of ground cover. The models exhibited a slightly different range of values and appeared to be related (non-linearly). The models both underestimated the actual ET at the CIMIS weather station. However, SEBAL overestimated the ET of the almond orchards by 0.16 mm/hr when applying its crop coefficient to the reference ET. This is compared to METRIC, which underestimated the ET of the almond orchards by only 0.10 mm/hr. Other types of ground cover were similarly compared. Temporal variability in ET rates between the morning and afternoon were also observed.

Renee Guittar: Excess: a creative research project responding to visual art with movement.

Renee Guittar, Melissa Rolnick

This summer Dance Professor Melissa Rolnick and Renee Guittar '12 worked on creating a modern dance piece that Guittar will perform in the Hillstrom Museum September 12 at 7:30pm and October 4 at 6:30pm. The solo, entitled Excess, was created collaboratively between Rolnick and Guittar in response to Kris Lowe's charcoal and chalk drawings ""Comfort Me, Said He,"" on display September 12 through November 6, 2011.

Rolnick and I created the solo while thinking about the vulnerability and vastness displayed in ""Comfort Me, Said He."" We played with recreating the imagery but most importantly we focused on responding to the emotions we felt when viewing the work. The solo went through many revisions because it began as a duet, turned into a solo, and then was altered once we were able to see how the museum was curated. This piece is a site-specific work because as choreographers, we took into consideration that

the performance space is not a proscenium stage. We altered the piece once we were in the museum because we wanted to work with the space and respond directly to Kris' work.

Jennifer Hanson: Multi-Elemental Fingerprinting of Modern and Ancient Carbonates
Jennifer Hanson, Julie Bartley

Calcium carbonates (aragonite, high-Mg calcite, and low-Mg calcite) are a family of precipitated minerals that form within the ocean. The chemistry of the world's oceans has fluctuated through time, producing carbonates composed dominantly of aragonite + high Mg calcite or dominantly of low Mg calcite. These times of "aragonite seas" and "calcite seas" correspond to major shifts in Earth's climate and global sea level that can be traced as far back as the early Phanerozoic Eon (~540 million years ago). During the Proterozoic Eon (prior to 540 million years ago), it is unknown whether ocean chemistry oscillated in this way.

After deposition, the carbonates undergo a process of recrystallization to the more stable low-Mg calcite or dolomite (a secondary mineral). To determine primary mineralogy of ancient rocks, we look for relict features of the original minerals. Previous work suggests that, during stabilization, carbonates may retain their original trace element composition. If the original composition of a stabilized carbonate can be determined and matched with primary polymorphs, one could reconstruct the chemistry of Proterozoic oceans. To begin this process, we analyzed the trace element composition of modern high-Mg calcite, low-Mg calcite, and aragonite using mass spectroscopy. Using a multivariate mathematical analysis, we evaluated the data for elemental concentration clusters that distinguished calcium carbonate polymorphs chemically. A Discriminant Function Analysis successfully for distinguishes among aragonite, high-Mg calcite, and low-Mg calcite. Future analyses will examine ancient, stabilized carbonates to determine whether elemental clustering is effective in determining original mineralogy.

Zainab .O. Jaji: Assessing the Role of Iron-Sulfur Cluster Synthesis Defects in Mitochondrial Diseases
Zainab .O. Jaji, Oleksandr Gakh,* and Grazia Isaya*
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The role of Iron-Sulfur cluster (ISC) biosynthesis defects was studied using Friedreich Ataxia (FRDA) as the disease model. FRDA is an autosomal recessive neurodegenerative disease caused by the transcriptional silencing of the gene that codes for frataxin (FXN) resulting in its inadequate expression. FXN is a mitochondrial protein involved in iron homeostasis in the cell through the formation of ISC. Iron homeostasis is necessary because $^{Fe2+}$ is involved in the production of reactive oxygen species that damage the cell. The major aim of this project is to determine whether the relative levels of the three major ISC biosynthesis proteins (FXN, NFS1 and ISCU) can serve as a biomarker in the diagnosis of the FRDA. Based on preliminary results and the similarity in the primary sequence of ISCU homologs, it was hypothesized that an increase in ISCU would be observed in human cells. Lymphoblast cells from normal, carrier and patient individuals were cultured. Also, post-mortem tissues from the cerebellum

and heart of patient and normal individuals were isolated. The various proteins in the cell lysates and tissue homogenates were resolved using SDS-PAGE and identified via western blotting. The results from the experiments showed an increase in ISCU in FRDA patients compared to normal in unstressed lymphoblast cells. Also, there was a steady decrease in ISCU in FRDA patients according to disease severity in comparison to the control. In both tissue samples and lymphoblast cells, a steady decrease in FXN isoforms from normal to patients was observed. Based on these results, it is possible that ISCU could be interacting with other iron chaperone proteins to maintain iron balance in order to compensate the inadequate expression of FXN.

Mariecus C.M. Jarvis: Preparing to Examine the Binding of Two Circadian Clock Proteins, Cryptochrome and Period

Mariecus C.M. Jarvis, Karla E. Marz

Circadian rhythms are biological internal clocks that help regulate the biochemistry of many different organisms. These organisms all function on a twenty-four hour schedule because of several negative feedback loops in which certain genes are repressed. Two proteins, Cryptochrome (Cry) and Period (Per), bind to one another in the central negative feedback loop and are essential to the functioning of a circadian rhythm. The interaction between Cry and Per was the focus of this research project. In order to cause repression, Per must enter the nucleus and attach to the proteins BMAL and CLOCK. However, Per cannot enter the nucleus on its own, so it is necessary for Cry to carry Per across the nuclear membrane. The question is what surfaces are essential for these proteins to bind to one another. Mutations along the surface of the Cry protein were created. In order to test their effects, it was necessary to create a DNA construct so Per could be transcribed and translated in mammalian cells and identified by light microscopy. The summer was spent trying to create this construct. Unfortunately, by neither of two methods was the necessary construct obtained. This DNA will need to be produced before both Cry and Per can be expressed in cells and the results can be analyzed.

Carrie Johnson: Total Synthesis of Biologically Active Natural Products: Amathaspiramides

Carrie Johnson, Arash Soheili,* and Uttam Tambar*
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In the field of drug research and development, the study of natural products often leads to the discovery of pharmacophores for new drugs. A pharmacophore is the part of a molecular structure that is responsible for the biological action of a drug. In this work our goal was to develop an enantioselective synthetic strategy to yield the natural product Amathaspiramide A, a polycyclic brominated alkaloid which has been shown to have antimicrobial, antifungal, and cytotoxic activity. The synthetic approach utilized a palladium-catalyzed [2,3]-sigmatropic rearrangement as a key step where a variety of carbonate analogs and proline derivatives were the reactants. The sigmatropic rearrangement was successfully used to generate the core structure of Amathaspiramide A. The proposed completion of the synthesis entails an oxidative cleavage and amide formation.

Maja Johnson: Photodegradation of the Herbicide Imazamethabenz-methyl
Maja Johnson, Megan Crow, and Amanda Nienow

Imazamethabenz-methyl is an imidazolinone herbicide used in the agricultural industry to prevent weeds in corn, soybeans, and cereal grains. Due to the detection of imidazolinone within Midwestern water systems, we are interested in determining rates and mechanisms of abiotic degradation. We observed the photolysis of the compound in DI water at various pHs. Imazamethabenz-methyl degraded slower at lower pHs and remained consistent from pHs 5 to 9. The compound degraded faster with 254 nm light than 310 nm light. Currently, we are working to synthesize imazamethabenz-acid, the compound produced during hydrolysis in basic conditions. In the future, we would like to conduct a study examining the hydrolysis of imazamethabenz-methyl at various pH values and the photolysis of imazamethabenz-acid.

Jessica Johnston: Prevalence of gene markers among environmental and enteric strains of Escherichia coli
Jessica Johnston, Brian Badgley,* and Michael Sadowsky*
*University of Minnesota
Escherichia coli is a common fecal indicator bacterium used for monitoring recreational water quality. Recent studies, however, indicate that some E. coli strains may persist in the environment even in the absence of fecal inputs and are thought to be naturalized to soils and water. The presence of naturalized strains confounds the use of these bacteria as indicators of fecal contamination. Gene sequence markers that are unique to strains from specific animal sources and environmental habitats have been identified by taking advantage of genetic variation between host-dependent and environmental strains. Here, PCR and nucleic acid probe-based methods were used to investigate the strength of association between proposed gene markers and isolates obtained from a variety of enteric and environmental sources. Our results indicate that the proposed genetic markers are not specific to either enteric or environmental E. coli isolates assayed in this study. However, before any conclusions regarding the utility of these markers can be made, a larger number of fecal and environmental bacteria must be screened in order to incorporate geographically diverse isolates.

Michelle Kirkvold and Mike Sterling: Intramolecular Deils-Alder Reaction in Siloxyfurans
Mike Sterling, Michelle Kirkvold, and Scott Bur

This research's purpose was to observe a possible reaction that a molecule could undergo, wherein the molecule's conjugated diene and its dienophile perform a cycloaddition reaction known as the Diels-Alder reaction. This project uses a variety of standard organic reactions and techniques to prepare both the diene and the dienophile so the cycloaddition can occur, including the addition of Electron Withdrawing/Donating groups to the dienophile and diene (respectively), Nuclear Magnetic Resonance, and Flash Column Chromatography. By observing this method of synthesizing polycyclic structures, we

can discover more efficient ways to create natural products. An example of a polycyclic structure that we would be able to synthesize would be Hypoglaunine B, an anti-HIV drug.

Elliot Larson: Toward development of a multi-dimensional liquid chromatography method for the analysis of furanocoumarin compounds in apiaceous vegetables and citrus fruits
Elliot Larson, D. Christopher Harmes, Sabrina Peterson,* and Dwight Stoll

Furanocoumarins are a family of compounds that are found in various fruits and vegetables (e.g., celery). These compounds have been found to have anti-carcinogenic properties, creating a growing demand for their study. There are currently seven compounds of interest and conventional extraction and separation methods used for the determination of furanocoumarin concentrations are very tedious and time consuming. The goal of this work is to create a comprehensive multi-dimensional liquid chromatography method that significantly reduces overall time of extraction and analysis. Multi-dimensional separation provides greatly improved resolution of the target compounds because it involves two differing conditions involved in the separation process. This provides a versatile method of separation allowing larger number of compounds to be separated successfully, which in turn allows for a reduction in analysis time, as well as a simplification of the sample extraction process. Not only does sLC x LC reduce the overall time required to prepare and analyze a particular sample extract, it also provides increased reliability of results because the second dimension separation serves as confirmation of putative compound identification. Preliminary data suggest that using a multi-dimensional separation method to determine furanocoumarin concentrations in various plant extracts will significantly reduce overall analysis time, while improving the reliability of the quantitative results. This in turn will positively influence the types of biological studies that can be carried out with the furanocoumarin family of compounds.

Laura Leland: Using genetics to find mRNAs Degraded by the Exosome in *S. cerevisiae*
Laura Leland and Jeff Dahlseid

Post-transcriptional regulatory mechanisms of gene expression are interesting and important to study. By better understanding these mechanisms in *S. cerevisiae*, baker's yeast, we can apply this knowledge to more complex systems, including humans. One mechanism for regulating gene expression involves the exosome, a multisubunit complex that mediates the degradation of mRNA. This exosome is particularly interesting because, in addition to recognizing structurally deficient mRNA, it also degrades normal mRNA. Little is known about how the exosome recognizes these normal mRNA, and we hope to investigate the recognition using a specific substrate. We have previously shown that the exosome does not directly degrade the mRNA of *CTF13*, a gene involved in mitotic centromere function. Rather, it indirectly affects the expression of *CTF13*. We have developed a model for *CTF13* regulation, in which the exosome degrades an mRNA responsible for transcriptional promotion of *CTF13*. This in turn decreases the amount of *CTF13* mRNA produced. We aim to identify the mRNA that interacts with

CTF13 in the regulatory mechanism. To do this, we created a reporter gene plasmid designed to display a copper-resistant phenotype under conditions where *CTF13* mRNA production is promoted. Then, we introduced this plasmid into yeast. Our next step is to screen the yeast genome for genes that promote a copper-resistant phenotype, and therefore *CTF13* mRNA production. The genes found to promote the phenotype can then be evaluated to determine which are regulated by the exosome.

Dan Marino: Metals and Organic Carbon Cycling in an ombrotrophic peatland

Dan Marino, Emily Seelen, Ben Carlson, Jeff Jeremiason, Stephen Sebestyn,* Martin Tsui,** and Meghan Jacobson**
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Relationships between dissolved organic matter (DOM), trace metals including mercury were examined in the S2 wetland of the Marcell Experimental Forest. DOM is known to bind trace metals and is a key component controlling trace metal transport from wetlands. However, the complex and largely unknown character of DOM prevents the construction of reliable models to predict delivery of toxic metals from wetlands. As several studies have reported increased DOM transport from wetlands, a better understanding of complex DOM-metal relationships is critical. In this study, we utilize the heavily instrumented and studied S2 wetland and an array of sampling locations within S2 to further understand the complex relationship between DOM and trace metals. Samples were collected in 2010 and 2011 from the outflow weir, lagg and bog porewaters, and in subsurface flow from the uplands. DOM was characterized by measuring total and dissolved organic carbon and by UV spectroscopy. Distinct differences were found between Hg and many other metals, helping us to better understand Hg dynamics in the S2 system. Hg and several metals were found in significant quantities in the subsurface runoff. Metals that bind to soil organic carbon, such as Pb and As, and redox sensitive metals such as Mn and Fe, were low in the subsurface runoff, relative to the weir and lagg porewaters. Hg, which also has high affinity for soil carbon, had higher or similar concentrations in the subsurface runoff as the weir and lagg porewaters, demonstrating different binding affinities for soil and/or dissolved organic carbon.

Matthew Martin: (title and abstract pending)

Hannan Mir: Geochemical Analysis of Gunflint Iron Formations

Hannan Mir, Julie Bartley

Banded iron formations (BIF) are among the largest commercial sources of iron ore in the world. The Gunflint Iron Formation, exposed in Northern Minnesota and southern Ontario, is a Paleoproterozoic (~1.85 billion year-old) iron formation, associated with significant economic iron deposits. In 1953, it was discovered that Gunflint contained fossilized microorganisms. Trapped within the rock, preserved by petrification in silica, were microorganisms that thrived in the iron- and silica-rich seas. As the silica

precipitated from seawater, BIFs take a snapshot of their environment, trapping both microorganisms and trace elements. If the rocks do no undergo significant metamorphism, they can preserve their original chemistry and provide information about the environment in which they formed. The concentrations and relative ratios of rare earth elements (REE) within samples of Gunflint rocks were examined and analyzed. A majority of the samples displayed REE patterns diagnostic of original seawater chemistry, suggesting that key features of 1.85 billion year-old seawater are preserved in the Gunflint Iron Formation. Future steps will examine the REE patterns and attempt to formulate a hypothesis regarding oxygen content of the ancient sea.

Jean-Paul Noel: Genetic Component to the Hemodynamic Response Function in the Visual Cortex
Jean-Paul Noel, Bobby Shannon,* and Sheng He*
*University of Minnesota

The use of fMRI technology has morphed from being used for purely spatial purposes, to also encompassing the temporal domain. With the use of event-related designs, the study of the neuronal mechanisms underlying the onset of visual processing is accessible through the analysis of Hemodynamic Response Functions (HRFs) in the visual cortex. These responses are still poorly understood, with the only apparent consensus being that they are variable between subjects, yet somewhat stable within participants (Aguirre, 1998). It was therefore the aim of this study to provide certain coherence to the variance in HRFs, proposing that genetics might influence the shape these responses take. Time to peak and peak amplitude, for both responses to foveal and peripheral stimuli, were analyzed. Results showed no significant correlation between MZ twins, yet because of low statistical power, trends could be argued. Further studies with additional trials and a bigger sample size, would prove more conclusive.

Jean-Paul Noel, Anthony Mefford: Meta-Awareness as a Spatial Baseline?
Jean-Paul Noel, Anthony Mefford

The concept of time seems to be implemented through an understanding of the physically more tangible concept of distance. In this study, it was hypothesized that the meta-awareness of where one's attention is, would create a psychological distance that could affect different spatiotemporal judgments. It was also of interest to compare the effects of an external distance prime with a hypothesized self–induced mental readiness for spatial and temporal judgments created by meta-awareness. The results indicate that meta-awareness caused an underestimation of distances, while the lack of such, resulted in an overestimation. These effects showed a certain coherence producing on average a slight overestimation of actual lengths. On the other hand, time estimates, as well as reaction times were not affected by meta-awareness. Finally, the comparison between self-induced mental readiness and external primes was not feasible because of the lack of statistical significance of the priming conditions.

Rachel P. Oien: Geomorphology, oslages and volume estimates of a Nipissing Beach ridge/dune complex near Kangaroo Lake, Door Peninsula, WI

Rachel P. Oien, Carolyn Branecky,* Natalia Chavez, ** Jacob Ruiz,*** J. Elmo Rawling, III[§], Paul Hanson,[] and David J. Hart[]
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This study focuses on the geomorphology and geochronology of a beach ridge/dune complex near Kangaroo Lake, on the Door Peninsula of Wisconsin. These features are located on a strand-plain ~800m inland from the present day level of Lake Michigan (~177 m) at the Nipissing highstand shoreline (~184 m). Within the Nipissing strand-plain complex, smaller beach ridges and dunes are closer to Lake Michigan and have up to ~6 m of relief, while the largest ridge is furthest from Lake Michigan and is covered with parabolic dunes that have up to 25 m in relief. These are separated from a series of lower elevation dunes (likely Algoma or younger in age) by 0.3 kms of the strand-plain. Our investigation focused on eolian sand and included optically stimulated luminescence (OSL) dating, particle-size analysis (PSA), GIS analysis of a LiDAR-based DEM, and ground penetrating radar (GPR).

Our subsurface investigations showed the eolian sediments are composed of fine to medium sand that directly overlies coarse gravelly sand. The depth of the coarse sediment was used to create a surface for volume calculations, the average elevation of which is 182 m. This calculation revealed that approximately 122,000 m^3 of sediment was transported to this region by littoral and eolian processes during the Nipissing phase. This portion of the strand-plain accumulated four times the amount of sediment compared to the nearby Algoma portion of the strand-plain, which contains ~32,000 m^3 of sediment.

Preliminary OSL ages from eolian sand at Kangaroo Lake indicate that dunes were active between around 6.6 and 3.7 ka. Previous research conducted at Clark Lake, located ~11 km to the southwest of our study site, indicates that dunes were active multiple times in the late Holocene from ~7 to 1 ka. Unlike the results from Clark Lake, there is little evidence suggesting that dunes were reactivated in the late Holocene at Kangaroo Lake. Therefore, factors other than regional climate variability, such as sediment availability, may have influenced the differences in eolian activity at these two sites. This research was conducted by the Dune Undergraduate Geomorphology and Geochronology (DUGG) project, funded by the National Science Foundation Research Experience for Undergraduates program.

Jeff Rossow: Role of CTLA-4 in CAR-transduced T Cells

Jeff Rossow, Brian Till*

(abstract pending)

Carl Schiltz: Developing a Method to Regulate Production of Authentic mRNAs in Yeast
Carl Schiltz and Jeff Dahlseid

In the yeast *Saccharomyces cerevisise* the regulation of galactose-metabolizing enzymes is carried out by a genetic switch consisting of a regulatory protein and a DNA sequence called an upstream activating sequence (UAS). The switch promotes transcription in the presence of galactose and suppresses transcription in the presence of dextrose. The regulatory function of the switch has been applied to other genes through fusion of the UAS from the *GAL1* gene to the gene of interest. The goal of this research is to develop a systematic method for fusing the *GAL1* UAS to a gene of interest, such that authentic mRNA is produced from the fusion. We have previously succeeded in using this approach with the *CTF13* gene. To test if this approach can be applied to other genes, we used the method on the *PPR1* gene. A plasmid DNA containing the fusion was transformed into yeast and the *PPR1* mRNA produced from the fusion was found to be the correct size. Yeast transformants grown in galactose-containing media showed an increase in *PPR1* RNA abundance of more than 10-fold compared to those grown in dextrose-containing media, confirming the expected function of the *GAL1* UAS. Our next step is to determine the transcription start site for the *GAL1* UAS-*PPR1* fusion, which will address the authenticity of the mRNA. Confirming the effectiveness of a systematic approach for making *GAL1* UAS gene fusions will offer a reliable tool for further research, especially that on RNA decay.

John Schmidt: Characteristic frequency analysis of a macroscopic cantilever in water and in air
John L. Schmidt, Thomas M. Huber

The vibrational modes of a macroscopic cantilever were found in water and air using a variety of methods. Non-contact ultrasonic excitation was used to find the vibrational modes of the cantilever submerged in both water and air. Two analytical methods were found which match empirical results reasonably, one gave results within 16% of empirical results and another method gave results within 10% of empirical results. A COMSOL computer model is being built to supplement both the experimental and analytical results.

Emily Seelen: Mercury and Metal Cycling in an Ombrotrophic Peatland
Emily Seelen, Dan Marino, Ben Carlson, Jeff Jeremiason, Steven Sebestyen,* Martin Tsui,** Megan Jacobson,** and Katelin Fitzgerald***
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Mercury is a toxic element found naturally in the environment, but anthropogenic sources have increased global mercury deposition and altered its chemical forms in the environment. Mercury exposure causes neurological and reproductive problems as well as developmental abnormalities in humans and wildlife. The form of mercury that poses the largest threat to human health is the organic form, methylmercury, which is produced microbially from inorganic mercury. Methylmercury is readily absorbed by biota and bioaccumulates in aquatic and terrestrial food chains.

Our study was to further our understanding of the biogeochemistry of mercury and other metals in the S2 ombrotrophic peatland watershed at the Marcell Experimental forest, MN. Specifically, we examined the transport of mercury and other metals from the upland to the peatland and the conversion of mercury to methylmercury within the peatland. Samples were collected in the lagg area around the peatland, subsurface runoff collectors, and in peat porewater transects extending from the lagg to the center bog area of the peatland. Samples were analyzed for trace metals, total mercury, and methylmercury content using an ICP-MS. Results show that a significant amount of mercury and many metals enter the lagg area from the upland during rainfall events, while other metals that bind strongly to soil organic matter (e.g. lead and arsenic) have little input from the upland. Methylmercury levels in the upland were low relative to levels in the lagg and bog areas. Further analysis is needed to determine what areas are most important for mercury methylation.

Anja Swenson: Impact of Temperature and Mg++ on Actomyosin Mechanochemistry

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Familial hypertrophic (HCM) and dilated (DCM) cardiomyopathies are autosomal dominant heart conditions that can lead to heart failure and sudden death. Mutations in myosin and other sarcomeric proteins are known to contribute to the HCM and DCM phenotypes. Understanding factors that can alter myosin motor activity may lead to potential drug treatments designed to modulate contractile activity in cardiomyopathies. This study examines the impact of temperature and free Mg++ concentration on monomeric myosin V (MV 1IQ), dimeric myosin V (MV HMM), and dimeric skeletal muscle myosin II (SK HMM) using ATPase and motility assays. A sequence comparison reveals an alanine in the nucleotide binding region of SK HMM that is a tyrosine (Y439) at the equivalent position of MV. Our results indicate MV HMM and MV 1IQ are inhibited by high concentrations of Mg++ in both ATPase and motility assays. SK HMM exhibits Mg++ inhibition in ATPase assays, but only a slight decrease in motility is observed at 10 mM Mg++. The rate-limiting step for motility and ATPase assays is thought to be ADP release in myosin V. In skeletal muscle myosin the rate-limiting step in ATPase assays is thought to be phosphate-release while in motility assays it is proposed to be ADP release. The Y439 residues may alter the Mg++ coordination properties of myosin V which causes this step to be slow and rate limiting. Mg++ coordination can confer key functional differences between myosin isoforms and may be of therapeutic potential for modulating myosin motor activity in disease conditions.

Tuan Tran: Characterization of Carbon-Modified Silicas for Analytical Liquid Chromatography

Tuan Tran, Dwight Stoll, Jon Thompson, and Doug Fryer

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. Users of carbon-based phases are aware that some compounds are very difficult to elute from existing commercial carbon-based materials, however this problem is significantly reduced using this new family of carbon-modified silicas. We will report the basic characteristics of these materials, as they relate to wide range of carbon loading, including: retention of non-polar and polar compounds, chromatographic selectivity, elution of compounds that are strong Lewis bases.

Xiu Xiao: Metalloprotein II's (MPII) Role In Cadmium Resistance In *Nereis diversicolor*

Xiu Xiao, Krishan Jethwa, Gamachu Melkamu, Nick Guttormson, and Jeff Dahlseid

Nereis diversicolor (hagworms) have been shown to live in contaminated sediments that have high levels of toxic metals, which are usually incompatible with biological organisms. *Nereis diversicolor* might be able to survive under these conditions, at least in part, because of the function of Metalloprotein II (MPII) in the worm's gut. MPII is known to be a cadmium binding protein and so may function to resist cadmium toxicity. We sought to address whether MPII is directly involved in cadmium resistance using two approaches. First, we compared the MPII gene DNA sequence isolated from worms that are metal resistant to the sequence from worms that are not metal resistant. Our results show that there are no differences in the two DNA sequences. For our second approach, we used *Saccharomyces cerevisiae* (baker's yeast) as an assay system to test the growth of yeast with and without MPII on media with and without cadmium. Thus far our results show that MPII confers no detectable cadmium resistance to yeast. The results of our experiments do not support a function for MPII in cadmium resistance. To further our studies, we will address whether MPII is actually binding cadmium in yeast. The results should clarify whether MPII lacks a role in cadmium resistance or whether there is some complication with the experiments themselves.