Materials Research Science and Engineering Center

UNIVERSITY OF MINNESOTA
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Summer Undergraduate Research Expo

August 11, 2011
McNamara Alumni Center
Memorial Hall
4:00-6:00pm

Undergraduate Poster Presentations
Listed Alphabetically by Presenting Author

1.	**Benjamin Absher** ***Semi-Fine Grained Modeling of Protein Synthesis in a Cell-Free Escherichia Coli System*** Summer Advisor: Vincent Noireaux Department or Program Sponsoring Summer Research: Physics Home Institution: Washington and Lee University **Abstract:** A semi-fine grain approach to modeling the expression of GFP-tagged protein in an escherichia coli cell-free system. The project deals with kinetic and parameter analysis of the system and fitting an adaptation of first-order Michaelis-Menten differential equations to data.
2.	**Garrison Adams** ***Spin Transport in Rubrene Based Organic Spin Valves*** Summer Advisor: Paul Crowell Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Michigan- Dearborn **Abstract:** Organic semiconductor based transistors possess properties which make their use desirable in charge transport devices. In addition to charge transport, the transport of spins could also be incorporated. The physics underlying spin transport in organic based devices is still not well understood. The properties that determine the lengthscales that spins can be transported before losing their spin polarization must be better understood to pave the way for technological applications. The goal of this research is to fabricate lateral organic-based field effect transistors (OFETs) to study charge and spin transport. The lateral spin devices employ rubrene, which can be synthesized with a higher carrier mobility (μ ~ 10 cm2V-1s-1) than most organic semiconductors (μ ~ 10-9- 10-1 cm2V-1s-1), making it a promising candidate for obtaining useful results.
3.	**Matt Amrein**, Ayan Paul, Dr. Chris Kim ***Test and Measurement of Power Delivery Techniques for Multicore Processors*** Summer Advisor: Dr. Chris Kim Department or Program Sponsoring Summer Research: Electrical and Computer Engineering Department Home Institution: Milwaukee School of Engineering **Abstract:** As we strive to continue to meet the expectations of Moore's Law, new ways to increase the performance of high-performance microprocessors must be realized. As the transistor density on microprocessors increase, the noise margins for the core voltage decreases. Also, as a result of the trend of increased leakage power at higher frequencies on these higher density chips, multicore processors have become prevalent to increase processor throughput. Looking at new techniques for decreasing voltage noise seen by the cores is important to not only increase performance, but also for correct operation of the processors. In this project we have looked at the noise propagated between cores in multicore processors where the cores are shorted to the same ground for decreased noise.
4.	**Beth Annoni** ***Improving Detection Limits (Extractions in the Gas Phase Using Microdialysis Probes)*** Summer Advisor: Dr. Tony Borgerding Department or Program Sponsoring Summer Research: URCS Home Institution: University of St. Thomas **Abstract:** The purpose of this project is to improve the detection limits of a rapid extraction system used for analyzing volatile analytes in aqueous solutions using gas chromatography with a flame ionization detector (GC-FID). Microdialysis membranes are used for the extraction from the aqueous solution into the gas phase. Volatile analytes in the extraction stream are trapped within the carbon nanotubes inside of a silcosteel tube and desorbed by sending a current through the silcosteel. The greater volume of analyte improves the detection limits of the GC-FID. Tests have shown trapping extracted acetone from a .01M aqueous solution for 30 seconds and desorbing gives a signal that is between 3 and 7 times stronger than signals from untrapped analysis.

5.	**Bjorn Berntson**, Heather Blundell ***Magnetite Anodes used in the Electrolysis of Water*** Summer Advisor: J. Woods Halley Department or Program Sponsoring Summer Research: Physics Home Institution: University of Minnesota **Abstract:** We have investigated the possibility of using a magnetite anode to electrolyse water and achieved steady state currents on the order of 100 uA. The consumable magnetite electrode actively participates in the endothermic chemical reaction and supplies some of the free energy needed for the reaction, while the remainder is supplied electrically. We have searched several possible solid-state, chemical, and electrical conditions to extremize the asymptotic current, limited by diffusive processes, which may be exploited in the context of hydrogen generation in alternative energy economies. Cyclic and step voltammetry are the standard techniques in electrochemistry that formed the basis for our experimental investigation.
6.	**Bryne Berry**, Nic Kramer ***Self-Assembly of Silicon Nanowires by Annealing of Silicon Nanoparticles*** Summer Advisor: Dr. Uwe Kortshagen Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Iowa **Abstract:** Silicon nanoparticles can be used for the assembly of nanowires for use in nanodevices and solar cells. Researchers are using multiple techniques such as etching to try to effectively synthesize ordered arrays of nanowires in order to increase the absorption of incident light for electrical conversion. However, the technical and financial challenges of ordering the arrays by etching make it impractical for mass manufacturing and reproduction. Thus, our lab uses a non-thermal plasma to create and deposit nanoparticles for the self-assembly of silicon nanowires. However the challenge is contracting these self-assembled structures to create thinner, ordered nanowires as the by annealing the deposited nanoparticles. The goal is to test different temperatures and annealing times, to see their effect on nanowire formation.
7.	**Jason Brennan**, Eric Olson, Melissa Fierke ***Reduction Mechanics of 2,4-Dinitrotoluene*** Summer Advisor: Philippe Buhlmann Department or Program Sponsoring Summer Research: Heisig/Gleysteen Chemistry Program Home Institution: University of Minnesota **Abstract:** Detection of 2,4-dinitrotoluene (DNT), a common impurity in all 2,4,6-trinitrotoluene based explosive devices, has become increasingly important in recent years. While using gold, platinum, and unmodified three-dimensionally ordered macroporous carbon electrodes in cyclic voltammetry experiments, a strong blue color evolved from the surface of the electrode. Principal component analysis of UV-Visible spectra for solutions containing the blue compound indicates that one species dominates the visible region of the spectra. These spectra strongly suggest that deprotonated DNT is primarily responsible for the blue color. It is believed that electrochemical reduction of DNT leads to radical anion formation which then deprotonates a second, neutrally charged DNT molecule.
8.	**Jacob Brutman**, William Gramlich ***Self-healing Polylactide Thermoset*** Summer Advisor: Marc Hillmyer Department or Program Sponsoring Summer Research: Lando/NSF-REU Home Institution: University of Vermont **Abstract:** Much research has been conducted in search of self-healing polymers. While many have been discovered, there is still a lack of research for renewable, biodegrable, and continuous self-healing thermosets. In this study, the self-healing properties of a polylactide (PLA) thermoset containing tin (II) octoate (Sn(Oct)2) were investigated. The thermosets were produced from DL-lactide polymers (PDLLA), which were functionalized with methacrylic anhydride (MAAH) and subsequently crosslinked with either di-tert-butyl peroxide (DTBP) or dibenzoyl peroxide (DBPO). Sn(Oct)2 was added during or before crosslinking of the polylactides. Various molecular weights of the initial polylactides were investigated, from 1,500 g/mol to 20,000 g/mol, to determine which had the highest healing efficiency. Mechanical testing was then performed to determine the self-healing efficiency of each thermoset.

9.	**Eileen Burke**, Maria Miranda ***Indium Catalyzed Stereoselective Polymerization of Lactide*** Summer Advisor: William Tolman Department or Program Sponsoring Summer Research: Chemistry, Lando/REU Home Institution: Montana State University **Abstract:** Plastics derived from renewable resources, such as polylactide (PLA), are becoming increasingly attractive alternatives to those derived from petroleum. The aim of this research was to develop an indium catalyst for the stereoselective polymerization of lactide (LA) into PLA. This catalyst was designed, synthesized, characterized, and its use in polymerization was then demonstrated.
10.	**James Byrnes** ***Assessment of the Viability of Ozonation as a Water Treatment Method for the Elimination of the Antibiotic Roxithromycin*** Summer Advisor: Kristine Wammer Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of St. Thomas **Abstract:** The occurrence of antibacterial resistance in populations of environmental bacteria has gained increased attention over the past several years. One potential facet of the cause of resistance is the presence of antibiotically active molecules in both drinking water and treated wastewater. This study examines the effects of ozonation, a process used to treat water, on the antibiotic roxithromycin. Previous studies present evidence suggesting these ozonation products retain their antibacterial activity, a possibility further investigated by this study. Samples of roxithromycin were ozonated using an aqueous ozone method and the degradation products were analyzed using high performance liquid chromatography and liquid chromatography-mass spectrometry. These ozonation mixtures are currently being tested for antibacterial activity using a biological assay employing Staphylococcus epidermidis as a test organism.
11.	**Asude Cetin**, Dawen Niu, Dr.Thomas R. Hoye ***Synthetic Approaches to Dimeric Methylene Blue Analogues*** Summer Advisor: Thomas R. Hoye Department or Program Sponsoring Summer Research: Lando/NSF Summer Research Program Home Institution: Middle East Technical University, Ankara, Turkey **Abstract:** Methylene blue (MB) is valuable in photodynamic therapy (PDT). Solutions of MB show concentration dependent behavior because monomeric and dimeric forms have different absorption and photophysical properties. We are interested in studying covalently linked dimers as novel PDT agents in drug delivery strategies.
12.	**Kyle Chamberlain**, Westley Bauer ***The Effect of Polyethylene Glycol Conjugation on the Binding Affinity of DNA with Polyethylenimine.*** Summer Advisor: Lisa Prevette Department or Program Sponsoring Summer Research: University of St. Thomas department of chemistry Home Institution: University of St. Thomas **Abstract:** Although polymeric gene delivery has become a favorable alternative to viral methods, scientists are struggling to improve the efficiency of gene expression in vivo. Adding polyethylene glycol (PEG) to the polymer to "cloak" the DNA-polymer complex (polyplex) as it travels through the blood stream has proven to be highly successful at increasing circulation times, yet how PEG affects the DNA binding of the polymer is not well-studied. This study attempts to shed light on this matter by PEGylating polyethylenimine with three lengths of PEG, at three different ratios. These graft copolymers were characterized with NMR and GPC techniques. The binding affinity of DNA with these polymers is being determined with gel electrophoresis, microcalorimetry, light scattering and fluorescence assay.

13.	**Minna Chen**, Lee A. Meier, Zeeshan Syedain, Robert T. Tranquillo ***Endothelialization of Decellularized Tissue Engineered Vascular Grafts*** Summer Advisor: Robert T. Tranquillo Department or Program Sponsoring Summer Research: UROP Home Institution: University of Minnesota- Twin Cities **Abstract:** Tissue-engineered vascular grafts (TEVGs) can provide a viable solution to the shortcomings of current arterial replacement therapies. Work in the Tranquillo lab focuses on fibrin-based constructs seeded with ovine dermal fibroblasts (oDFs) and then decellularized following a period of maturation. Integral to the success of this approach is the ability to mitigate thrombogenicity through the presentation of an intact endothelium to circulating blood; preliminary implants with constructs lacking an endothelium have indicated rapid clot formation. Tissue samples coated with ovine blood outgrowth endothelial cells (oBOECs) were evaluated for oBOEC coverage at multiple time-points. Studies showed a confluent monolayer of oBOECs at 24 hours, although coverage declined over time. Reduced coverage may have resulted from the cytotoxicity of detergents used in the decellularization process.
14.	**Wendy Consoer**, Samuel Jensen ***Determining Current Sulfamethoxazole and Streptomycin Resistance Levels in the Minnesota River*** Summer Advisor: Kristine Wammer Department or Program Sponsoring Summer Research: University of St. Thomas Department of Chemistry Home Institution: University of St. Thomas **Abstract:** The potential for constant, low concentrations of antibiotics to select for resistant bacteria in the environment has recently become of concern. Sulfamethoxazole and streptomycin are two antibiotics of interest that may ultimately end up in river water from farm runoff and wastewater discharge. This project investigates the current levels of resistance to these antibiotics in wastewater effluent, agricultural runoff, and surface waters in a portion of the Minnesota River Valley in southern Minnesota. To date, we have successfully grown bacteria from four sites in the presence of both antibiotics to determine baseline susceptibility levels. Thus far, no significant differences have been observed among the four sites. Another sampling trip is planned in early August so we can examine additional sites.
15.	**Brian Cornille** ***Photophysical Properties of a Caged, Cancer Drug*** Summer Advisor: Professors David Blank and Mark Distefano Department or Program Sponsoring Summer Research: Chemistry Home Institution: University of Wisconsin - Madison **Abstract:** The Distefano research group at the University of Minnesota is investigating the feasibility of the photoactivated release of farnesyltranferase inhibitors (FTI) using photosensitive caging groups. One such caging group is Bhc. The complete molecule Bhc-FTI has been under investigation in treated cell samples radiated for one- and two-photon absorptions, yet the mechanism for the photolysis of the drug and caging group is not fully understood. This summer's research has focused on developing an understanding of this process using computational tools as well as ultrafast spectroscopy techniques. These experiments and calculations were done through the Blank research lab at the University of Minnesota.
16.	**Jonathan Dang**, Katie Klotz, Valerie Pierre ***Cellular Uptake and Localization of Macrocyclic Lanthanide Complexes*** Summer Advisor: Valerie Pierre Department or Program Sponsoring Summer Research: Heisig/Gleysteen Chemistry Program Home Institution: University of Minnesota Twin Cities **Abstract:** Among the various chemical agents that can be used for cellular imaging, lanthanide-based complexes offer several distinct advantages. Lanthanides have large Stokes shifts, narrow emission bands, and long luminescent lifetimes, which are ideal properties for cellular imaging. Free lanthanide ions cannot be used for cellular imaging due to their toxicity. However, macrocyclic lanthanide complexes are thermodynamically and kinetically stable and can be made to be water soluble, making them ideal for biological imaging. Since the cell permeability, localization and uptake mechanisms of lanthanide complexes are not well understood, a library of lanthanide complexes with varying hydrophobicity, charge and size are synthesized and their cellular toxicity, uptake and localization are investigated.

17.	**James Duin** ***Reconstructing Ancient Greece in Virtual Environments*** Summer Advisor: Daniel F. Keefe Department or Program Sponsoring Summer Research: Department of Computer Science and Engineering Home Institution: Hastings College **Abstract:** Current research in the Department of Writing Studies at the University of Minnesota is concerned with the visual and acoustical characteristics of structures where ancient Greeks staged performances of political and legal oratory. The Interactive Visualization lab works in collaboration determining how best to exploit emerging interface and 3D graphics technologies to improve interaction with the physical settings of these ancient sites. The research involved loading a 3D model reconstruction of the Thersilion at Megalopolis in a head-mounted display tracked in real-time. Sketching various user experiences to determine how to best present data to scholars in the Classics. These involved interfacing virtual globe software with the 3D models, presenting the acoustical properties of the structures and an interactive map with hyper-links to panorama camera views.
18.	**Emily Dvorak** ***Isolating Electrons in CMS's Hadron Calorimeter using Segmentation to Prepare for the Upgrade of the LHC*** Summer Advisor: Jeremiah Mans Department or Program Sponsoring Summer Research: Physics Home Institution: Univ. of Wisconsin - River Falls **Abstract:** In preparation for the upgrade of the large hadron collider to the super large hadron collider I researched the ability to isolate electron signals from the proposed background expected from SLHC. This upgrade will include doubling the luminosity of the LHC and also doubling the center of mass of the collision within the Compact Muon Solenoid. To isolate the electrons simulations of Monte Carlo data are ran through a software version of CMS. Here we took a look at separating the data collection from different layers of the HCAL as well as different geometries of the sampling clusters. Comparing this to data we simulated at the current CMS setup we can tell which of or segmentations and cluster define the data better, and which elements of the detector to upgrade to detect to most events possible.
19.	**Maritza Flores**, Dr. Michelle Mok ***Phase Behavior of Block Copolymer/Ionic Liquid Micelles*** Summer Advisor: Prof. Tim Lodge Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Texas Pan American **Abstract:** Block copolymers added to a solvent soluble for one block will self-assemble into micelles with a dense insoluble polymer core surrounded by a solvated soluble polymer shell. Ionic liquids have recently been explored as selective solvents for block copolymers because of their advantageous properties including high thermal and chemical stability. We take advantage of this stability to explore the phase diagram of the block copolymer micelles in solvent to higher temperatures using dynamic light scattering and fluorescence. The system studied was block copolymers of polystyrene-poly(methyl methacrylate) in 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)amide ionic liquid. We were able to determine upper limits to critical micelle concentrations using fluorescence, but were unable to detect any critical micelle temperatures up to 200 °C in the range of concentrations with detectable scattering.

20.	**Jessie Freese**, Dr. Shun Wang ***Electrostatic modulation of the metal-insulator transistion in LaSrCo3*** Summer Advisor: Prof. Chris Leighton Department or Program Sponsoring Summer Research: MRSEC REU Home Institution: Mount Holyoke College **Abstract:** The perovskite cobaltite La1-xSrxCoO3 (LSCO) is known to possess interesting magnetoelectronic properties, including magnetoelectronic phase separation, glassy ferromagnetism, spin state transitions, and metal-insulator transitions. Two factors in modulating these properties are charge carrier density and structural distortion. Electrostatic gating allows us to study the effects of charge modulation without the accompanying structural distortions introduced by chemical doping. In such experiments, ionic liquids have been widely used for their ability to induce high charge carrier densities as compared to traditional dielectrics. In this project, we use epitaxially grown LSCO films gated with an ion gel ([EMIM][TFSI] in a triblock copolymer matrix) to study the metal-insulator transition in LSCO in a four-terminal field effect transistor geometry by measuring resistivity as a function of temperature and gate voltage.
21.	**Christopher Frye** ***Identifying Electromagnetic Showers in the Forward Hadron Calorimeter*** Summer Advisor: Jeremiah Mans Department or Program Sponsoring Summer Research: Physics Home Institution: University of Central Florida **Abstract:** The Forward Hadron Calorimeter (HF) is a component of the Compact Muon Solenoid detector in the Large Hadron Collider (LHC) at CERN. Lying outside the range of the inner tracking system, we can only rely on the shapes of showers that hit the HF to determine whether they are due to electromagnetic particles or jets. With the present LHC setup, current methods in distinguishing shower types suffice, but as the LHC upgrades to higher luminosities, increases in pileup will reveal faults, such as an efficiency that depends on shower energy. I improved current methods by developing a new longitudinal shower-shape variable and introducing a new two-dimensional shower-shape cut. I provide a summary of my work, as well as an analysis of its success.
22.	**Gregory Gauthier**, Faisal Hadi, Victor Lai, Spencer Lake, Victor Barocas ***Quantifying Fiber Reorientation In Simulated Collagen Network Models Under Uniaxial Extension*** Summer Advisor: Victor Barocas Department or Program Sponsoring Summer Research: MRSEC Home Institution: College of Menominee Nation **Abstract:** Collagen is a ubiquitous protein used in tissue engineering and in the design of biomaterials since collagen fibrils and their networks play a primary structural role in mammalian tissues. However, the mechanics of collagen networks are still poorly understood. A better understanding of how these networks behave mechanically can be readily applied to solve current problems in biomedical engineering such as in creating more resilient tissue engineered heart valves and arteries. I used a fiber-based mechanical model for a type-I collagen network to simulate collagen deformation. I created a new computational network analysis tool to visualize how such networks reorganize under various loading conditions. Quantifying various fiber parameters in the collagen network can give us new insight into the underlying physics governing network deformation.
23.	**Thomas Gentle** ***Synthesis of a Novel Polymerizable Isoluminol Derivative*** Summer Advisor: J. Thomas Ippoliti Department or Program Sponsoring Summer Research: Chemistry Department Home Institution: University of Saint Thomas **Abstract:** Isoluminol derivatives are popular options for tagging molecules in luminescent assays. The purpose of this study is to synthesize a new brighter isoluminol derivative that can be used to tag target molecules in assays. So far in this study poor yields and low purity have been observed. When reducing the starting imide with LiAlH, undesired products have been observed, including what appears to be an aldehyde, which is unusual in a reduction. One explanation is that in these experiments, the endo isomer of the starting anhydride has been used instead of the exo isomer and the steric hindrance maybe interfering with the reduction. As this study continues, experiments will be done using the exo isomer to test whether or not the configuration plays a role in later steps.

24.	**Phillip Goldblatt** ***Chemistry of (N-methyl-N-phenylcarbamoyl)disulfanyl Chloride and a More Efficient Synthesis of (Chlorocarbonyl)disulfanyl Chloride*** Summer Advisor: George Barany Department or Program Sponsoring Summer Research: UROP - Chemistry Home Institution: University of Minnesota **Abstract:** A more efficient synthesis of (chlorocarbonyl)disulfanyl chloride was established by modifying a previously published (alkoxydichloromethyl)disulfanyl chloride pathway. While (methoxydichloromethyl)disulfanyl chloride and (ethoxydichloromethyl)disulfanyl chloride are known and stable, (iso-propoxydichloromethyl)disulfanyl chloride was found to be an unstable transient species which loses iPrCl spontaneously to yield (chlorocarbonyl)disulfanyl chloride. The iso-propoxydichloromethyl intermediate was observed in situ by 1H NMR. (Carbamoyl)disulfanyl chlorides, a new class of compounds, were synthesized by careful addition of limiting secondary aromatic amine (2 equiv.) to (chlorocarbonyl)disulfanyl chloride or by treatment of bis(carbamoyl)disulfanes with SO2Cl2. The compounds were observed in situ by 1H NMR and cyclized to form dithiazinones. Quenchings and trappings of (carbamoyl)disulfanyl chlorides were performed to verify the identity of the intermediate, based on similar quenches of (carbamoyl)sulfenyl chlorides as a precedent.
25.	**Kathy A. Grimes**, Shruti Patil ***Evaluating and Improving Computer Systems Through Integration of NEMS*** Summer Advisor: David Lilja Department or Program Sponsoring Summer Research: Electrical and Computer Engineering Home Institution: Southern Illinois University Carbondale **Abstract:** Current CMOS technology is reducing in size, however the reduction in size has not come with a reduction in power. A promising emerging technology that is capable of addressing the power dissipation challenges in computer systems is NEMS (NanoElectroMechanical Systems). This project focuses on evaluating the NEMS technology for reducing power in a general pipelined architecture, while maintaining its performance. We evaluate a computer system's delay and power and compare the results of the system simulated using (1) only the CMOS technology, (2) only NEMS technology, and (3) combined CMOS and NEMS technology. Through analysis of gathered data, we expect to understand the trade-offs of using NEMS and to determine the optimal power-delay implementation in hybrid NEMS-CMOS systems.
26.	**Sarah Gruba**, Benjamin Manning; Christy Haynes ***Quantitation of Mast Cell-Secreted Serotonin by High Performance Liquid Chromatography with Electrochemical Detection to Differentiate Stimulant-Mediated Differences in Degranulatuon*** Summer Advisor: Christy Haynes Department or Program Sponsoring Summer Research: Lando Home Institution: Creighton University **Abstract:** Mast cells, granulated leukocytes found in most connective tissues, are commonly recognized for their role in type I hypersensitivity (allergic) reactions of the immune system. The main mechanism by which mast cells influence the immune response is through regulated exocytosis of biologically active mediators, including histamine and serotonin, from preformed granules. Serotonin is electroactive and detected and quantified in cell culture supernatants using high performance liquid chromatography with electrochemical detection. With the aid of different stimuli, mouse peritoneal mast cells co-cultured with mouse 3t3 fibroblasts were stimulated to degranulate using immunoglobulin E (IgE)-mediated pathway or the calcium ionophore A23187. Results show a significant difference in the amount of serotonin released by each stimuli. A23187-mediated degranulation resulted 51.6% more serotonin released than the IgE-mediated pathway.

27.	**Peter Hansen**, Elizabeth Smith, Patrick Macdonald ***Quantifying Protein Expression Distributions in COS Cells*** Summer Advisor: Joachim Mueller Department or Program Sponsoring Summer Research: Physics REU Home Institution: University of Nebraska-Lincoln **Abstract:** For the quantitative study of protein-protein interactions in living cells, it is important to control and understand the expression level of each protein to maximize their interactions. Fluorescent proteins such as GFP and YFP (green and yellow fluorescent protein) are introduced to COS cells in the form of plasmid DNA through cationic lipid mediated transfection using the reagent GenJet™. After transfection, we studied the distribution of expression ratios of GFP to YFP over a cell population. Herein, we quantify the variability of protein expression using a binomial probability distribution. This work is an important piece in understanding the capabilities and limits of the transfection.
28.	**Zach Henseler** ***Microdialysis for Analysis of Nitric Oxide*** Summer Advisor: Tony Borgerding Department or Program Sponsoring Summer Research: URSC Home Institution: University of Saint Thomas **Abstract:** Nitric oxide, (NO) is a neurotransmitter in the brain proposed to have important connections to pain, memory, stroke and Alzheimer's disease. Microdialysis extraction offers near real time monitoring with minimal invasiveness, but requires lower detection limits to read physiological concentrations of NO. To decrease our detection limit, a NO trap was created capable of absorbing and releasing large quantities of NO. Our current setup allows for the absorption of over five minutes worth of NO at a flow rate of one milliliter per minute at room temperature. We have also seen release of absorbed NO using temperatures around 700o C which gives an increased signal of at least ten times the normal signal.
29.	**Amy Howard** ***Solid-State Studies of Some Strictly Isosteric Organic Molecules*** Summer Advisor: William Ojala Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of St. Thomas, St. Paul, MN **Abstract:** We define strict isosteres as chemically different molecules that are nonetheless closely similar with respect to both van der Waals radii and connectivity. If solid-state molecular packing depends on molecular size and shape, strict isosteres should be capable of assuming identical molecular packing arrangements, yielding isostructural crystals. Strict isosteres that are not isostructural might serve as seed crystals for obtaining new polymorphs from solutions of their corresponding strict isosteres. Here we describe the molecular and crystal structure of 3,4-bis(4-chlorophenyl)-1,2,4-oxadiazol-5(4H)-one and compare its molecular packing to that of the strictly isosteric furoxan and sydnone. Disorder in both polymorphs of the furoxan makes it the crystallographic surrogate of the corresponding bis(4-chlorophenyl) maleic anhydride derivative, the structure of which is compared here as well.
30.	**Aaron Huang**, Timothy Gillard, Frank Bates ***Thermodynamic Behavior of poly(isoprene-b-lactide) Near the Frank-Kasper Sigma Phase*** Summer Advisor: Prof. Frank Bates Department or Program Sponsoring Summer Research: MRSEC Home Institution: Washington University in St. Louis **Abstract:** A diblock copolymer is a molecule that consists of two different homopolymer chains that are covalently linked together. This covalent link prevents macroscopic phase separation of the two homopolymer segments and instead leads to a tendency of these copolymers to self-assemble into a variety of ordered phases on a mesoscopic scale (5-50nm). The self-assembly of diblock copolymers has been studied extensively over recent decades. A product of these studies is the establishment of a universal phase behavior in high molecular weight diblock copolymers. However, a recently published report has presented the discovery of a new phase – the Frank-Kasper σ phase – in a low molecular weight poly(isoprene-b-lactide) polymer. Our project aims to explore the region of the thermodynamic phase diagram near the reported σ phase to determine range of compositions and molecular weights for which the σ phase is stable in this system. We will use living anionic polymerization to synthesize various poly(isoprene-b-lactide) diblock copolymers and characterize the molecular, mechanical, and thermodynamic properties of these copolymers using NMR spectroscopy, SEC, DSC, and rheological techniques.

31.	**Samuel Jensen** ***Estrogenic Activity of UV Filter Photoproducts*** Summer Advisor: Kristine Wammer and Dalma Martinovic Department or Program Sponsoring Summer Research: University of St. Thomas Home Institution: University of St. Thomas **Abstract:** Ultraviolet (UV) filters are used in sunscreens to protect users from the harmful radiation emitted by the sun. Benzophenone and its derivatives are commonly used as UV filters. Benzophenone may break down into harmful photoproducts when exposed to sunlight. Specifically, previous work has indicated that some of the photoproducts formed may interfere with normal endocrine function by mimicking the female hormone estradiol. This may be of concern in aquatic environments if the photoproducts were to end up in natural waters. The main goal of this project is to measure estrogenic activity for a series of benzophenone samples that have been exposed to sunlight, and to identify photoproducts that exhibit estrogenic activity in aqueous solutions. Work to date has identified two photoproducts of potential concern.
32.	**Cole Johnson** ***The Stabilization of Urease for Use in Analytical Devices (Without the Need of Refrigeration)*** Summer Advisor: Gary Mabbott Department or Program Sponsoring Summer Research: Chemistry Department Home Institution: University of St. Thomas **Abstract:** The goal of our research project is to create a paper device that can detect the amount of urea in blood accurately and can be stored for long periods of time without refrigeration. There are a few ways of doing this. We can attempt to bond the urease to the paper device by adding a positively charged enzyme to it, which might stick the urease to the paper, in turn possibly stabilizing it. This is the method we have used so far, and it has stabilized the enzyme for about 2 weeks, with our goal being 3-4 months. Urease has been stabilized into a paper device, but not without refrigeration for long storage, which is what we aim to do.
33.	**Eric Jones**, Richard Liptak ***Tunnel Junctions for Multi-Layer Solar Cells*** Summer Advisor: Stephen Campbell Department or Program Sponsoring Summer Research: Electrical and Computer Engineering REU program Home Institution: Franklin W. Olin College of Engineering **Abstract:** This project explores the possibility of utilizing metal-oxide thin films as tunnel junctions incorporated into multi-layer solar cells. Theoretically, cells based on this architecture can double the efficiency of traditional Silicon photovoltaic systems because they use materials with band gaps tuned to efficiently capture the energy of incident photons. Two metal-oxide thin films, Copper Aluminum Oxide ($CuAlO_2$) and Zinc Stannate (Zn_2SnO_4), have been proposed as tunnel junction materials. Each is transparent across the solar spectrum and has a wide band gap – both properties are required to separate p-n junctions in the solar cell. A RF sputtering process was developed for each material, and the optical, electrical, and structural properties were investigated as a function of the process conditions to optimize the films before device integration.
34.	**Julian Jones**, Ke Li ***Modeling, Experimentation, and Simulation of Hydraulic Opposed Piston Opposed Cylinder Free Piston Engine*** Summer Advisor: Zongxuan Sun Department or Program Sponsoring Summer Research: Center for Compact and Efficient Fluid Power Home Institution: University of Minnesota **Abstract:** The goals of this project were to improve engine technology using the Free Piston concept to reduce particulate emissions, harmful nitrous oxides, and add efficiency and fuel economy. Many energy sources in use today are non-renewable and damaging to the environment. Fluid power consumes 56 billion dollars in agriculture, mining and construction sector. It is costly to maintain and dispose of. By improving energy efficiency of passenger vehicles by 10 percent 20 billion dollars will be saved (CCEFP Website). We want a smaller energy storage device and high power density for a smaller compact and more efficient engine not to mention improve pump efficiency. We wanted to design, model, and control a hydraulic Free Piston engine for an automotive propulsion system. Chemical energy is converted in to linear motion and then into high-pressure fluid through hydraulic pumps. Due to variable compression ratio fuel efficiency is greater and reduced friction than the common internal combustion engine. Also rapid heat release and low in-cylinder peak pressure were other positive observations from the HCC ignition type.

35.	**Priscilla Kelly**, Philip I. Cohen PhD., Sara Rothwell ***Analysis of Turbostratic Graphene Grown Using the CVD of Acetylene on Sapphire*** Summer Advisor: Philip I. Cohen PhD. Department or Program Sponsoring Summer Research: Electrical Engineering REU Home Institution: UC San Diego **Abstract:** Graphene, a fundamental allotrope of carbon, has sparked great interest due to its unmatched combination of intrinsic mobility, transparency, and mechanical strength. Sapphire has a coincidence lattice match with graphene as it has a similarly hexagonal crystal lattice. Sapphire substrates are also available in relatively inexpensive single crystal wafers. Our goal, then, is to prepare large domain graphene with high electrical quality on sapphire substrates. At this stage of my research, we are confirming the deposition rate of turbostratic graphene on sapphire, disordered graphene sheets in random rotational orientation. Our poster demonstrates the properties of turbostratic graphene from data collected by Raman spectroscopy, scanning electron microscopy (SEM), sheet resistance measurements, and optical imaging.
36.	**Julie Kessler**, Lindsay M. Hinkle, Kent R. Mann ***Synthesis and Characterization of Cu(I) Complexes for Use as Molecular Oxygen Sensors*** Summer Advisor: Kent R. Mann Department or Program Sponsoring Summer Research: LANDO/NSF Home Institution: Hartwick College **Abstract:** Oxygen is essential for many biological, industrial, and environmental processes. Current oxygen sensors are hindered by multiple emission sites, slow responses, and sensor degradation. Our group studies solid-state transition metal complexes for use as oxygen sensors due to their desirable photophysical properties. Recently, we have demonstrated that crystalline phen-based Cu(I) complexes are viable oxygen sensors for their stability, uniform emission sites, and low cost. Fifteen Cu(I) complexes of the form [Cu(X)(Y)]Z have been synthesized (where X= Bis[2-(diphenylphosphino)phenyl]ether (POP), or 4,5-Bis(diphenylphosphino)-9,9-dimethylxanthene (xantphos); Y= 1,10-phenanthroline (phen), 4,7-diphenyl-1,10-phenanthroline (dpp), or 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (bdmp); and Z= tetrafluoroborate (BF4-), tetrakis(pentafluorophenyl)borate (pfpb-), or Tetrakis[bis-3,5-(trifluoromethyl)phenyl]borate (tfpb-)). Microcrystalline samples were characterized by quantum yield, lifetime, and emission spectroscopy. Three compounds sense oxygen with Ksv's > 3.00, indicating they may be promising oxygen sensors.
37.	**Charles Kieffer** ***Exploring a New Synthesis of BN-Pyrene*** Summer Advisor: Eric H. Fort Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of St. Thomas **Abstract:** The goal of this research is to produce a more efficient synthesis of BN-Pyrene and explore its reactivity. This molecule, an analog of Pyrene, is unique in that it is still an aromatic compound, thus very stable; however, its electronic properties have been changed by replacing the central carbon atoms with a boron and a nitrogen. The proposed new route will involve fewer unstable intermediates and fewer steps than the old route. This should allow for easier, more efficient synthesis of BN-Pyrene. Once successful, we will analyze the differences in the distribution of BN-Pyrene's electron density in regard to its regioselectivity in aromatic substitution reactions.

38.	**Mikhail Klimstra** ***A Comprehensive Study of the General Parameters for G-Wire Self-Assembly*** Summer Advisor: Dr. Thomas C. Marsh Department or Program Sponsoring Summer Research: Department of Chemistry and Young Scholars Grant Program Home Institution: University of St. Thomas **Abstract:** The conformation and stability of G-DNA is strongly influenced by environmental factors including the species of coordinating cation, temperature, and sequence. In the case of guanine-rich oligonucleotides (GROs) the appropriate conditions can lead to the formation of supramolecular polymers of G-DNA. Several different supramolecular G-DNAs have been reported but there is no general model for predicting the formation of these structures. A systematic study is underway to define the general environmental parameters that facilitate supramolecular G-DNA structure formation, particularly G-wires. Analysis by polyacrylamide gel electrophoresis (PAGE) indicates the extent of G-wire formation is influenced by the number of guanine units within the sequence, the positioning of thymine and guanine nucleosides as well as incubation temperature and coordinating cation concentration.
39.	**Austin Lane**, Tim Anglin ***Structural Changes in Annealed Organic Field-Effect Transistors*** Summer Advisor: Aaron Massari Department or Program Sponsoring Summer Research: MRSEC Home Institution: Texas A&M University **Abstract:** Thermal annealing can be used to improve the crystallinity of the polymer layer of an OFET at the interface between the polymer and the insulator, where the majority of the charge transport occurs. Our goal is to make the semiconducting polymer layer conduct charges as effectively as possible, by varying the annealing process used while examining the polymer layer. To accomplish this, we will monitor the thermal annealing process in-situ, using a combination of FTIR and UV-vis analysis to examine the structure of regio-regular poly(3-hexylthiophene) during heating and cooling. This data will be compared to electronic experiments measuring the charge mobility of the polymer layer on functionalized oFETs. By examining how the structure of the surface changes with temperature, we will gain an understanding of how the annealing process works to enhance charge mobility at the polymer-insulator interface.
40.	**Xiaoyue Li** ***3DOm Carbon for New Energy Absorption Application*** Summer Advisor: Andreas Stein Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Texas-Pan American **Abstract:** Advanced energy absorption systems have recently been developed, in which external work is converted into stored energy by infiltrating nanoporous materials with liquid phases. The ability of the porous material to absorb energy depends on pore sizes and on the hydrophobic/hydrophilic interactions between the surface and the infiltrating liquid. In this project, three-dimensionally ordered mesoporous (3DOm) carbon is studied as a new material for energy storage. 3DOm carbon is synthesized by replication of 10-40nm silica nanoparticles. 3DOm materials in general have the property of highly interconnected pores and large surface areas. Various polymers and molecular precursors are used as the carbon sources to replicate silica spheres. The final product is highly porous carbon with large surface area with is ideal for mechanical energy absorption.

41.	**Shengsi Liu**, Mehmed Z. Ertem, Laura Gagliardi, Christopher J. Cramer ***Mechanism Study and Characterization of Transition metal Complexes*** Summer Advisor: Laura Gagliardi Department or Program Sponsoring Summer Research: Heisig/Gleysteen Chemistry Program Home Institution: University of Minnesota-Twin Cities **Abstract:** One of the main reasons that transition metals are so interesting comes from the availability of multiple d-electrons and their diverse electronic structures. Yet to fully understand and make use of their properties, investigation of such systems at the molecular level is needed. We employ high-level quantum chemistry methods, such as DFT and CASSCF/CASPT2, to gain insight of possible orbital interactions and electronic structures of monometallic, homometalic and heterometalic systems. Under such treatment, we are able to take into account of high degree of electron correlation and relativistic effects, which is critical for determining reaction mechanisms and the transition metal bonding nature.
42.	**James Lloyd**, Professor Natalia Tretyakova, Susith Wickramaratne ***A Novel Method for the Synthesis and Purification of Butadiene-Induced DNA Cross-Links*** Summer Advisor: Professor Natalia Tretyakova Department or Program Sponsoring Summer Research: Department of Chemistry in association with the Department of Medicinal Chemistry Home Institution: University of Minnesota - Twin Cities **Abstract:** 1,3-butadiene (BD) is a common environmental and industrial chemical that enters the environment through multiple sources, including automobile exhaust and cigarette smoke. Upon inhalation into the body and incorporation into cells, BD undergoes a series of metabolic transformations, leading to the formation of several reactive metabolites, one of which is 1,2,3,4-diepoxybutane (DEB). With two electrophilic oxirane moieties, this compound can alkylate cellular biomolecules, resulting in the formation of DNA-DNA and DNA-protein cross-links. In an effort to study the effects of DEB-induced DNA-DNA cross-links on DNA structure, replication, and repair, we have developed a novel method for the synthesis and purification of DNA oligodeoxynucleotides containing site and stereospecific 1-(N6-2'-deoxyadenosyl)-4-(N7-guanosyl)-2,3-butanediol (N6A-N7G-BD) adducts. Following purification, these DNA substrates will be used for structural and biological studies.
43.	**Daniel Martens**, Andrew Lyle, Jonathan Harms, Angeline Klemm, August Lentsch ***Demonstrating Effects of Spacing and Device Size on MTJ-based MQCA*** Summer Advisor: Jian-Ping Wang Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Cincinnati **Abstract:** Logic devices are an integral part of technological infrastructure, and finding ways to make them smaller and less power-consuming are highly desired. One option uses magnetic quantum cellular automata (MQCA) devices for a non-volatile logic system. These devices can be made with magnetic tunnel junctions (MTJ) which can be high or low resistance, depending on the magnetic orientation of their magnetic layers. The integration of MTJs provides an interface between MQCA and other electronics in the infrastructure. In this work we demonstrate the strong effects of the individual size of the nanomagnets and the distance of separation between elements on the performance of the devices.
44.	**Sarah Matt**, Can Zhou ***Micelle Behavior of Poly(ethylene oxide)-b-Poly(N,N-isopropylacrylamide) Block Copolymers*** Summer Advisor: Dr. Tim Lodge Department or Program Sponsoring Summer Research: Lando Chemistry REU Home Institution: Wartburg College **Abstract:** Poly(N,N-isopropylacrylamide) or PNIPAm is a thermoresponsive polymer, meaning a physical change occurs at a specific temperature known as the lower critical solution temperature (LCST). PNIPAm has an LCST of 32°C which encourages biological applications due to its similarity to the 37°C human body temperature. Block copolymers with Poly(ethylene oxide) or PEO were synthesized at varying PNIPAm molecular weights to explore changes in LCST and micellization behavior. Through Dynamic Light Scattering (DLS) studies, it was discovered that there is micellization or aggregation below the LCST of the copolymer. It was also determined that there is an inverse relationship between the PNIPAm content and the LCST of the copolymer. Further experimentation could include synthesis of a broader range of molecular weights and DLS exploration at additional temperatures.

45.	**Logan McDermott** ***Synthesis and Study of 10a-aza-10b-borapyrene*** Summer Advisor: Eric H. Fort Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of St. Thomas **Abstract:** For decades, the distinctive chemistry of aromatic systems has been the grounds for innovation. Intriguing variations on polycyclic aromatic molecules have caught the attention of chemists worldwide. Our research emphasis is on the incorporation of boron and nitrogen bonds in place of carbon-carbon bonds in polycyclic aromatic hydrocarbon (PAH) analogs, in particular, 10a-aza-10b-borapyrene (BN-pyrene). BN-pyrene is of interest due to its potential for unique reactivity in substitution reactions. The study of BN-pyrene may be an important contribution to materials science.
46.	**Rachel Mensch** ***Constant Photocurrent Measurement of Optical Absorption in Thin Film Amorphous Semiconductors*** Summer Advisor: Jim Kakalios Department or Program Sponsoring Summer Research: Physics REU Home Institution: Washington and Lee University **Abstract:** There has been a recently growing interest in amorphous hydrogenated silicon (a-Si:H) because of its applications as a thin film semiconductor. The thing holding back its widespread use is the Staebler-Wronski effect: a light-induced increase in the defect density of the material, which currently has no clear solution. However, recent studies have shown that doping the a-Si:H with silicon nanoparticles can lead to a reduction in the Staebler-Wronski effect. In this study, we have used the Constant Photocurrent Method (CPM) to measure the optical absorption spectrums of various films in order to determine the effects of different doping and dilution. The results prove to be interesting because these particular materials have never existed before.
47.	**Adam Miller**, Alex Rudd ***Exploration into Heterobimetallic Complexes of Chromium and Cobalt*** Summer Advisor: Dr. Connie Lu Department or Program Sponsoring Summer Research: LANDO/NSF (Chemistry Department) Home Institution: Bloomsburg University of Pennsylvania **Abstract:** Homogenous heterobimetallic complexes containing an early-late transition metal pair have not been researched thoroughly, despite their possible use as catalysts for processes involving small molecule activation. Using a bifunctional ligand based on a tris-(2-aminophenyl)amine backbone with pendant phosphine donors (TrenPhos), bimetallic complexes consisting of chromium and cobalt were targeted in various oxidation states. These bimetallic complexes will be examined for reactivity toward small molecules, such as dinitrogen, dihydrogen, and carbon monoxide. These reactivity studies could show the catalytic viability of these complexes for transformations like hydroformylation. The synthesis and characterization of the monometallic chromium precursor along with the preliminary efforts towards these chromium-cobalt bimetallic complexes will be presented herein.
48.	**Noah Mitchell** ***Star Formation Rates in a Survey of Nearby Starburst Dwarf Galaxies*** Summer Advisor: Dr. Evan Skillman, Dr. Kristen McQuinn Department or Program Sponsoring Summer Research: REU Physics Home Institution: St. Olaf **Abstract:** We examine 20 starburst dwarf galaxies in the nearby universe. Using multiband imaging photometry, we reduce new and archival GALEX FUV and NUV images and archival Spitzer MIPS (24um, 70um and 160um) images in order to compare between multi-wavelength data sets. We perform background subtractions, cut out Hubble Space Telescope fields of view, resample images for matching-resolution comparisons across wavelengths, and mask foreground stars and background galaxies in the GALEX and MIPS images. Additionally, we design and build a multi-wavelength archive providing the astronomical community with access to processed data sets. We then calculate the current star formation rates of the surveyed galaxies from UV emission and compare to the averaged star formation rates over varying timescales derived from optically resolved stellar populations.

49.	**Maia Moffatt**, James Byrnes ***Significance of Antibacterial Resistance to Tetracycline and Tylosin in the Minnesota River*** Summer Advisor: Kristine Wammer Department or Program Sponsoring Summer Research: University of St. Thomas Department of Chemistry Home Institution: University of St. Thomas **Abstract:** The potential for antibiotics to select for antibacterial resistant organisms in surface waters is an issue of growing concern. The extensive use of antibiotics both in human medicine and in agriculture has led to frequent detection of these compounds in the environment. In this study, we are investigating resistance to the antibiotics tetracycline and tylosin. We began by determining the effective concentrations for each antibiotic using E. Coli DH5α. Based on these results, we measured baseline susceptibility levels of bacterial communities from several Minnesota River sites to these two drugs. We plan on obtaining more samples from these sites throughout the next couple of years to compare results among sites and test for any seasonal effects.
50.	**Derick Monroy**, Katherine L. Braun ***Compact Hydraulic Ankle-Foot Orthosis*** Summer Advisor: William Durfee Department or Program Sponsoring Summer Research: Center for Compact and Efficient Fluid Power Home Institution: New Mexico State University **Abstract:** Motivation: Generally, ankle-foot orthosis are passive devices. In the rehabilitation of persons with diminished gait functionality, a powered orthosis aids in restoring normal locomotion of the joint by actively activating both dorsiflexion and plantarflexion. A compact, non tethered and hydraulic powered ankle-foot orthosis has been designed using commercially available components to demonstrate the current ability to produce the torque necessary for the complete range of motion. Customized components will be utilized in future systems to increase compactness and reduce the overall weight.
51.	**Darrell Montonera** ***Application of an Electric Field on Superfluid Helium Near the Lambda Transition*** Summer Advisor: William Zimmermann Department or Program Sponsoring Summer Research: Physics Home Institution: Gordon College **Abstract:** An electric field was applied to superfluid helium at a temperature .0002 K below the lambda point. Using a resonator to drive and detect second sound, the change in amplitude of second sound at resonance is measured before and after the applied electric field.
52.	**Ross Moretti** ***Elucidation of Reaction Pathways of O-Ethyl Thiocarbamates with Chlorocarbonylsulfenylchloride to Form 1,2,4-Dithiazolidine-3,5-diones*** Summer Advisor: Dr. George Barany Department or Program Sponsoring Summer Research: Lando/NSF-REU Home Institution: Lafayette College **Abstract:** 1,2,4-Dithiazolidine-3,5-diones (also known as Dts-amines) are a synthetically useful class of compounds, functioning as protected amines for peptide synthesis and precursors for symmetric disulfides and in situ-generated isocyanates. The reaction of N-benzyl, O-ethyl thiocarbamate with chlorocarbonylsulfenylchloride to provide the Dts derivative of benzylamine was investigated in order to determine the identities of two byproducts, as well as routes for their formation. One of the impurities was identified as benzyl isocyanate, which was confirmed by quenching the reaction mixture with N-methylaniline and doping with an authentic standard. Order of addition studies and other experimental observations led us to propose that the second byproduct is bis(N-benzylcarbamoyl)disulfane, a new compound. An alternative route to the product, by reaction of bis(chlorocarbonyl)disulfane with excess benzylamine, supported this hypothesis.

53.	**Jonathan Morris** ***Diffusion Processes of eGFP*** Summer Advisor: Vincent Noireaux Department or Program Sponsoring Summer Research: School of Physics and Astronomy REU Home Institution: University of Minnesota **Abstract:** Although diffusion in fluids is well studied, it does not provide an adequate model for diffusion processes in the cellular environment. A cell contains many structures and including networks of microtubules and cytoskeleton. Ordered network do not allow for normal diffusion, where the mean square displacement of a particle is linear in time. Instead, anomalous diffusion, where the mean square displacement of a particle follows a power law is thought to occur. An attempt to characterize this process is performed by localizing DNA onto a microsphere, serving as a point source for coupled transcription-translation, and observing the concentration gradient of eGFP expressed radially around the microsphere via fluorescence microscopy.
54.	**Heidi Nelson**, Kyle Bantz ***Monitoring Alkanethiol SAM Formation with LSPR*** Summer Advisor: Christy Haynes Department or Program Sponsoring Summer Research: Heisig/Gleysteen Chemistry Summer Research Program Home Institution: University of Minnesota **Abstract:** Localized surface plasmon resonance (LSPR) biosensors work by using UV-visible spectroscopy to monitor wavelength shifts upon the binding of analyte molecules to nanoparticles. In this experiment, LSPR was used to monitor the formation of alkanethiol monolayers on a silver film over nanospheres (AgFON). The AgFON was incubated in an alkanethiol solution over time or with an applied electric potential, and the LSPR shift was monitored. Additionally, the monolayer thickness was estimated from the LSPR response. Longer alkanethiol chains consistently produced significant LSPR shifts, with the magnitude increasing over time and with increasing chain length. An applied potential produced a significant shift for all alkanethiols. This LSPR response could ultimately be used to sensitively detect other molecules partitioning into the alkanethiol monolayer.
55.	**Sarah Nelson** ***Ion-Selective Electrodes and Solutions to Biofouling*** Summer Advisor: Dr. Phil Buhlmann Department or Program Sponsoring Summer Research: Lando/NSF Summer Research Program Home Institution: St. Catherine University **Abstract:** Biofouling of ion-selective electrodes results in signal drift and a reduction of selectivity when working with biological samples. Fluorous compounds, due to their low polarity, may be useful in limiting the effects of biofouling. The addition of a fluorous alcohol to the electrode membrane may inhibit the hydrogen bonding of interferents to the ion-selective ionophore. The behavior of electrodes doped with a fluorous alcohol was observed in the presence of known interferents as well as equine serum, and compared to the behavior of electrodes lacking a fluorous alcohol. The selectivity of the alcohol-doped electrodes was also measured to determine the effects of the fluorous alcohol on the selectivity of the electrode.
56.	**Hieu Nguyen** ***Ultrasound Imaging with High Frequency Transducer*** Summer Advisor: Emad Ebbini Department or Program Sponsoring Summer Research: Electrical and Computer Engineering Home Institution: Texas Southern University **Abstract:** Using 20 Mhz single-element transducer to create 2D images of different organs.

57.	**Brandon K. One Feather**, Santoshkumar Khatwani, Mohammed Rashidian ***Expression and Purification of Various Proteins for Spin Labeling*** Summer Advisor: Mark Distefano Department or Program Sponsoring Summer Research: LANDO Home Institution: Oglala Lakota College **Abstract:** Several proteins where expressed and purified using three purification techniques including affinity, denaturing and precipitation/solvent extraction. The proteins will potentially undergo prenylation, which is the addition of C15 or C20 isoprenoid groups through the formation of thioester bonds near the C-termini of the proteins. Prenylated proteins act as a membrane anchor for signaling proteins that regulate cell growth (cancer), it is the precursor to many natural products with medicinal activity (drug development) and it initiates the process in plants that results in the formation of natural rubber (biotechnology).
58.	**Bee Kian Ong**, Professor Wayland E. Noland, Paul J. Erdman, Glen C. Gullickson, Dr. Venkata S. Narina, Kenneth J. Tritch ***One-pot Syntheses of 4-Substituted Benzofurazan 1-Oxides and Azobenzene Derivatives*** Summer Advisor: Professor Wayland E. Noland Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of Minnesota - Twin Cities **Abstract:** Benzofurazan oxides have been shown to have biological activities such as antibacterial and antileukemic properties while azobenzenes are versatile compounds that can be used in dyes, molecular switches, or UV light-absorbing drug capsules. Of all halogenated benzofurazan 1-oxides and azobenzenes, the fluorinated analogs are especially interesting because, rather than forming a mixture of the two, only the azobenzene was formed, but the conversion was incomplete. Further study on the fluorinated analogs showed that the more basic medium favors the formation of benzofurazan 1-oxides, whereas less basic medium favors the corresponding azobenzenes. As a result, this observed behavior could be manipulated to allow one-pot syntheses that are simpler and greener.
59.	**Gabriella Perell** ***Mild Synthetic Reduction of an Amide to an Amine*** Summer Advisor: J.T. Ippoliti Department or Program Sponsoring Summer Research: Chemistry Department Home Institution: University of Saint Thomas **Abstract:** The process of converting an amide carbonyl into a methylene group, also known as a reduction, normally utilizes harsh and extreme conditions and requires the use of relatively dangerous chemicals. This research project entailed the development of new synthetic methodology to carry out this conversion under mild conditions. To carry out this project, I tested different reagents ability to convert an amide carbonyl into a methylene group. Converting the amide into a more easily reducible entity was the first step. This involved reaction of the amide, triphenylphospine and carbontetrachloride. I then reduced this intermediate with a mild reducing agent, sodium triacetoxyborohydride. Conditions such as concentration, temperature, solvent, and starting amides were varied. The conditions that successfully reduced acetamide will be presented as well as characterization of an intermediate.
60.	**Dayne Plemmons**, Aloysius Gunawan ***Optical Properties of Colloidal Lead Selenide Nanocrystals*** Summer Advisor: Andre Mkhoyan Department or Program Sponsoring Summer Research: MRSEC Home Institution: North Carolina State University **Abstract:** Lead selenide (PbSe) nanocrystals have shown promise for a variety of optoelectronic applications including photovoltaics due to the ease of colloidal synthesis and the ability to absorb light in the infrared region. The nanocrystals, often referred to as quantum dots (QDs), can be easily deposited onto a variety of substrates through simple solution-cast methods and in fact self-assemble into highly ordered hexagonally oriented monolayers. It has been previously shown that thin films of PbSe QDs can exhibit high carrier mobilities due to strong electronic coupling between the QDs; however, surfactants required for colloidal stability often decrease the conductivity of the thin films. We aim to further study the effect of inter-QD electronic interaction on the optical coupling between the QDs by using spectroscopic ellipsometry to determine the dielectric function of the PbSe monolayer and its dependence on parameters such as inter-QD spacing and surfactant identity.

61.	**Kristina Poss**, Ben Monson, Mark Distefano, James Wollack ***An Isoprenoid Diphosphate Substrate Suitable for Copper-Free Bioorthogonal conjugation Through Tetrazine Ligation*** Summer Advisor: James Wollack or Program Sponsoring Summer Research: St. Catherine University Chemistry Department, 3M Grant, Fairchild Fund, Conroy Fund Home Institution: St. Catherine University **Abstract:** Many non-natural isoprenoid diphosphate analogs have been shown to be substrates for Protein Farnesyltransferase (PFTase). Transferable analogs include azide and alkyne containing isoprenoid derivates, which can subsequently be used as handles to perform click chemistry after modification. The limitation for bioconjugations using click chemistry is that these reactions must be completed in the presence of copper, which can degrade biological molecules. An alternative method is tetrazine ligation: a bioorthogonal reaction which proceeds through an inverse electron demand Diels-Alder mechanism at a rate comparable to copper-catalyzed click reactions, without cytotoxicity. Here we report the synthesis of cyclooctene and norbornene containing isoprenoids that are substrates for PFTase. Proteins and peptides labeled with these moieties are candidates for tetrazine ligation—a particularly useful bioconjugation method in biological environments.
62.	**Johnny Ramirez** ***Integrated Surface Acoustic Wave (SAW) Device on a Aluminum Nitride Wafer*** Summer Advisor: Mo Li Department or Program Sponsoring Summer Research: ECE Home Institution: University of Texas at El Paso **Abstract:** Surface acoustic wave (SAW) devices are essential for many signal processing applications, ranging from filtering a signal, creating a device for military use, or using them to create a cell phone with better reception. Surface acoustic waves are generated by applying an electric signal to a piezoelectric substrate, which then turns the electric signal into an acoustic wave. SAW devices contain rectangular-looking figures known as interdigital transducers, essential for converting the acoustic wave back into an electric signal at the output. Therefore, at least two SAW devices are required for this effect to occur. The piezoelectric substrate used in this project is Aluminum Nitride (AlN), which allows the user to send a high frequency to the SAW device and operate at high temperatures.
63.	**Kayla Ryan** ***Synthesis of Novel Alkaline-Earth Metal Organic Frameworks*** Summer Advisor: Dr. Marites Guino-o Department or Program Sponsoring Summer Research: Chemistry Department Home Institution: University of St. Thomas **Abstract:** Metal Organic Frameworks (MOF's) are compounds consisting of metal ions coordinated to rigid molecules to form structures that can be porous. The pore size can be influenced by the organic linker and the metal center. MOF's in the literature predominantly utilize d-block metals.
64.	**Maritza Reyna**, Ryan Knutson ***Metal Sulfide Nanoparticles for Photovoltaics and Photocatalysis*** Summer Advisor: Prof. R Lee Penn Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Puerto Rico at Humacao **Abstract:** Presently, most of the energy consumed globally comes from the use of fossil fuels, namely oil, natural gas and coal. These sources of energy are nonrenewable resources. This project focuses on the synthesis and characterization of promising photovoltaic and photo-catalytic materials that are non-hazardous, cost efficient, made from abundant elements, and easy to fabricate. Sulfide nanoparticles were synthesized using transition metals like Cu, Zn and Tin (IV). The SHArK (Solar Hydrogen Activity Research Kit) system, a high throughput method to screen combinatorial libraries of materials, was used to characterize photocatalytic activity by quantifying water splitting. Results show that the copper and zinc sulfides have active area leading them to be the most promising materials for photocatalysis.

65.	**Emily Rohkohl**, Alexandra Frank ***Weak Intermolecular Interactions in the Crystal Structures of Fluorine-Substituted Glycosylamines*** Summer Advisor: William Ojala Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of St. Thomas, St. Paul, MN **Abstract:** We are examining the molecular and crystal structures of the derivatives formed when small-molecule carbohydrates react with nitrogenous bases. The crystalline derivative may occur as the open-chain Schiff base or as the cyclic glycosylamine, depending on the carbohydrate and the reaction conditions. In previous work, we determined the crystal structures of the N-2-fluorophenyl-, N-3-fluorophenyl, and N-4-fluorophenylmannopyranosylamines and noted that close C-H…F-C contacts may play a significant role in determining the molecular packing arrangements in these solids. Here we describe the crystal and molecular structures of the N-2-fluorophenyl- and N-4-fluorophenylgalactopyranosylamines. Unlike their mannose analogues, these galactose derivatives assume crystal structures from which directional C-H…F-C contacts are absent, indicating that such contacts have little influence in determining the packing arrangement common to both galactose derivatives.
66.	**Amber Schoenecker** ***Interaction of Tat Peptide and Cell Surface Glycosaminoglycans to Aid Understanding of Drug Delivery*** Summer Advisor: Dr. Lisa Prevette Department or Program Sponsoring Summer Research: Young Scholars Grant Home Institution: University of St. Thomas Chemistry Department **Abstract:** Cell-penetrating compounds (CPCs) are positively charged molecules with the ability to cross cell membranes. Understanding the interaction between CPCs and certain cell receptors may help scientists to better design drugs for maximum efficacy. The goal for this study was to compare binding between the CPC trans-activating transcription factor (Tat) peptide and five glycosaminoglycans (GAGs), negatively charged polysaccharides that exist to different extents on different types of cells. Interactions between Tat peptide and the GAGs heparin, dermatan sulfate, and chondroitin sulfate A were analyzed. Using isothermal titration calorimetry, we determined the binding constant (K), enthalpy (ΔH), and stoichiometry (n) of the interactions. Differences in binding strength were observed, possibly due to the negative charge density or stereochemistry of the GAG.
67.	**Alex Schrader** ***Synthetic Routes to, Transformations of, and Rather Surprising Stabilities of (N-Methyl-N-phenylcarbamoyl)sulfenyl Chloride, ((N-Methyl-N-phenylcarbamoyl)dithio)carbonyl Chloride, and Related Compounds*** Summer Advisor: George Barany Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of Minnesota **Abstract:** The title compound classes, (carbamoyl)sulfenyl chlorides and ((carbamoyl)dithio)carbonyl chlorides, have been implicated previously as unstable, albeit trappable intermediates in organosulfur chemistry. The present work reports for each of these functional groups: (i) several routes to prepare it in the N-methylaniline family; (ii) its direct structural characterization by several spectroscopic techniques; (iii) its rather unexpected stability, and its ultimate fate when it decomposes; and (iv) a series of further chemical transformations that give highly stable derivatives, each in turn subject to thorough characterization. Given that the title compounds can be isolated and are relatively stable, they may find applications in the preparation of thiolyzable and/or photolabile protecting groups for the sulfhydryl function of cysteine, and for the development of new protein synthesis and modification reagents.

68.	**Holly Schwarzbauer,** Alireza Shokri ***Hydroboration and the Mystery Behind the Mechanism of Hydride Induced Cyclopropanation*** Summer Advisor: Dr. Steven Kass Department or Program Sponsoring Summer Research: Lando/NSF Home Institution: St. Catherine University **Abstract:** Almost two decades ago, a graduate student reacted (E)-1-vinyl-1-methoxy-2-(2,4,6-triisopropylbenzenesulfonyl)-4,4-dimethyl-5-cyclohexene with Li(CH2CH3)BD in an attempt to replace the sulfonate ester with deuterium. Surprisingly, a cyclopropane ring was produced. After stereochemical evidence disproved an SN2 mechanism, other mechanistic pathways needed to be considered. This research aims to determine if the reaction proceeds by a hydroboration mechanism. The same starting material was used and reacted with diborane/THF complex and 9-BBN. Diborane/THF was not selective enough, reducing both double bonds and not producing the cyclopropane ring. The reaction with 9-BBN only produced starting material, likely due to steric hindrance. A dialkylborane will be used next to try to mitigate the aforementioned over-reactivity and steric hindrance problems.
69.	**Mark Schwerkoske** ***Quaternary Ammonium Compounds as Anti-Malarial Agents*** Summer Advisor: Dr. J.T. Ippoliti Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of St. Thomas **Abstract:** It has been found that certain quaternary ammonium salts play an active role in inhibiting the growth of the Plasmodium falciparum parasite, more commonly known as malaria. Through the years the parasite has gained resistance to traditional malaria medications. Variations of quaternary ammonium compounds have shown to be a new, effective, and relatively cheap malaria treatment. Quaternary ammonium compounds that have a cholesterol moiety attached are not known. A series of 1-bromo carboxylic acids were coupled with cholesterol as a starting point for this research. To these starting materials various amines and diamines will be added and sent out to form quaternary and diquaternary ammonium salts respectively. These compounds will then be tested for anti-malarial properties.
70.	**Gillian Shaw**, Ewa Papajak ***Efficient Basis Set Extrapolation Methods for Quantum Thermochemistry*** Summer Advisor: Dr. Truhlar Department or Program Sponsoring Summer Research: Lando/NSF Summer Undergradu ate Research Home Institution: Monmouth University **Abstract:** One way to calculate energy of molecules involves Moller-Plesset second-order perturbation theory (MP2). Wave function is constructed as a combination of functions in the provided basis set. As the basis sets becomes larger, the quality of the results increases and eventually approaches the complete basis set (CBS) limit. Unfortunately, increase in the basis set size also means increase in computational cost. Therefore, we used two small basis set energy values to extrapolate to benchmark values. Since Hartree-Fock term and a correlation term converge to their respective CBS at different rates, separate extrapolation parameters are needed. We calculated such parameters for different databases (absolute and atomization energies, barrier heights, hydrogen bonding). These constants can be tested and possibly applied to other types of energy.
71.	**Scott Sievert** ***Particle Segregation an Flow in Slurries: Dependence on the Interstitial Fluid Viscosity and Angular Velocity*** Summer Advisor: Dr. Kimberly Hill Department or Program Sponsoring Summer Research: Undergraduate Research Opportunities Program Home Institution: University of Minnesota, Twin Cities **Abstract:** Binary granular mixtures of different sizes rotated in a circular drum segregate radially. At fill levels just above half, and at moderate angular velocities, stripes appear. Here, we investigate the effect of interstitial fluid viscosity and drum angular velocity on stripe width and wavelength. We find that an increase in angular velocity brings an increased stripe width and that an increase in viscosity brings marginal stripe width increases, except in the one stripe case.

72.	**Jenny Sisombath**, Kristin Braden ***Preparation of Model Membranes to Study the Interaction Between Cell-penetrating Compounds and Proteoglycans*** Summer Advisor: Dr. Lisa Prevette Department or Program Sponsoring Summer Research: Young Scholars Program and University of St. Thomas Department of Chemistry Home Institution: University of St. Thomas **Abstract:** Model membranes are important for studying drug delivery and cell surface interactions. This study focuses on preparing large unilamellar vesicles (LUVs) to incorporate membrane proteins and fuse these proteoliposomes to giant unilamellar vesicles (GUVs). Through this method, biologically relevant model membranes are produced to study the binding interactions between proteoglycans and cell-penetrating compounds (CPCs), such as Tat peptide. LUVs and GUVs have been made and characterized by dynamic light scattering and microscopy. Control binding experiments were performed on Tat and LUVs of different lipid composition. The goal is to investigate the effect of vesicle composition on the interaction of different proteoglycans and CPCs and compare the results to that of glycosaminoglycans in solution. These results will be useful for future studies involving drug delivery mechanisms.
73.	**Michael Slitts** ***A Novel Synthesis of Triazole-Based N-Heterocyclic Carbene Precursors*** Summer Advisor: Dr. Marites Guino-o Department or Program Sponsoring Summer Research: Chemistry Department Home Institution: University of St. Thomas **Abstract:** Due to their effectiveness and integral role in the catalytic dehydrogenation of borane amine, we seek to investigate triazole-based N-heterocyclic carbenes more thoroughly. Here, we present the synthesis of a family of carbene precursors through microwave synthesis, appropriated from literature. The substituents were chosen to express a range of electron donating and withdrawing capabilities and steric effects. These triazoles will be deprotonated, and the subsequent carbene ligands coordinated with nickel for steric and electronic investigation.
74.	**Bradley Slowinski**, Josh Speros, C. Daniel Frisbie ***Crosslinking of Conjugated Polymers for Organic Photovoltaics*** Summer Advisor: Marc A. Hillmyer Department or Program Sponsoring Summer Research: Department of Chemistry Home Institution: University of Minnesota **Abstract:** Conjugated polymers (CPs) are excellent materials for low cost organic photovoltaic devices, as they are flexible and solution processable. It is generally accepted that increasing CP molecular weight improves device performance. Crosslinking strategies have the potential to increase molecular weight well beyond values commonly documented in the literature. Post-polymerization attempts were made to crosslink poly(3-hexadecylthienylene vinylene) using benzoyl peroxide and oxygen radicals. Although radical crosslinking methods were successful, they also gave rise to an undesired loss in polymer conjugation. Additionally, a metathesis crosslinking agent (1,3,5-tripropenylbenzene) was synthesized for controllable in situ crosslinking reactions. 1,3,5-tripropenylbenzene was synthesized in three steps from trimethylbenzene-1,3,5-tricarboxylate. Crosslinked polymers were heavily characterized by size exclusion chromatography (SEC) and nuclear magnetic resonance spectroscopy (NMR).

75.	**Jordan Stoltz**, Andrew Block ***Sputtering of Magneto-Optic Yttrium Iron Garnet Thin Films*** Summer Advisor: Bethanie Stadler Department or Program Sponsoring Summer Research: Electrical and Computer Engineering Home Institution: University of Evansville **Abstract:** Magnetron sputtering was used to deposit thin films of amorphous Yttrium Iron Garnet (Y3Fe5O12) on bare Silicon substrates, which were then annealed to achieve their magneto-optic crystalline forms. Employing a two-step deposition process to avoid cracking during anneals, YIG layers of increased thickness (60-80nm) were deposited onto an initial, fully annealed seed layer (20nm) through additional sputtering. This technique was previously reported by Ross et. al., who used Pulsed Laser Deposition in lieu of a magnetron sputtering system. These secondary layers were then annealed in a similar manner and characterized both to verify their crystalline structure and to quantify any cracking that occurred during their anneals. Eliminating any possible cracking is of extreme importance here, as the optical integrity of these YIG films is paramount to their application in optics and photonics.
76.	**Mark Stranieri** ***Synthesis of 1-methylene-2,3-dihydro-1H-pyrrolizine and its Diels Alder Reactions*** Summer Advisor: Dr. Wayland E. Noland Department or Program Sponsoring Summer Research: Department of Chemistry LANDO/NSF Home Institution: Monmouth University **Abstract:** The objective of our work is to achieve an efficient laboratory synthesis of 1-methylene-2,3-dihydro-1H-pyrrolizine (1) and to determine what Diels-Alder reactions 1 can undergo. Merck and du Pont report syntheses of 1 that, after testing, do not satisfy our laboratory goals. We have tried four synthetic routes to 1, including cyclization of pyrrole-1-carboxylic acid derivatives, nitrile-based cyclization, and a Dieckmann cyclization. Our most successful route begins with the 2-acylation of pyrrole with trichloroacetyl chloride. The acylated pyrrole compound was then 1-n-alkylated with Ethyl 3-bromopripoante to afford a key intermediate. Our compound then undergoes a Dieckmann condensation, decarboxylation, and Wittig olefination, respectively. Characterization of 1 and its intermediate compounds prepared in our synthesis of 1 include NMR and MS.
77.	**Ruben Suarez Jr.** ***Auger Electron Spectroscopy of Carbon Nanofiber Reinforced Polymer Substrates Coated with Thin Metallic Films*** Summer Advisor: Dr. Eray Aydil Department or Program Sponsoring Summer Research: MRSEC Home Institution: University of Texas Pan American **Abstract:** Polystyrene Butadiene Copolymer (PSB) and High Density Polyethylene (HDPE) are being conducted in research to improve the Electromagnetic Interference Shielding Effectiveness (EMI SE) which will decrease the degradation of systems and improve system performance. Two methods are being used to improve the EMI SE of these polymers; Carbon nanofiber reinforcement and thin films deposition. In order to have maximum effectiveness for shielding, the thickness and type of material used is crucial. The Auger Electron Spectroscopy (AES) is a technique used to show a depth profile given by percentages of each element on the substrate as a function of time. With these results, imperfections of the amount of material on the substrate can be altered to improve the performance of shielding effectiveness against electromagnetic interference.
78.	**Jeremy Tempkin**, Hannah Leverentz, Bo Wang, Donald Truhlar ***Screened Electrostatically Embedded Many-Body Method*** Summer Advisor: Donald Truhlar Department or Program Sponsoring Summer Research: LANDO/NSF Chemistry Home Institution: University of Puget Sound **Abstract:** In previous work, the electrostatically embedded many-body (EE-MB) method has been shown to improve the accuracy of single point energy calculations at the pairwise additive (PA) and three body (3B) levels. Here, we introduce the screened charge model to improve on the simple point charges used in previous implementations of the EE-MB method. The screened charges are very successful in improving the accuracy of energy of binding calculations for small molecular clusters. Using the screened charge model in screened EE-PA and screened EE-3B calculations on a series of five water hexamer structures results in a mean unsigned deviation of 0.60 kcal/mol (1.1%) at the PA level and 0.24 kcal/mol (0.5%) at the 3B level compared to 1.32 (2.6%) and 0.54 (1.0%) kcal/mol for unscreened charges.

79.	**Bennett Thompson**, Andy Harned ***New Reagents and Reactions in Oxidative Dearomatization of Phenols Featuring Hypervalent Iodine*** Summer Advisor: Andy Harned Department or Program Sponsoring Summer Research: LANDO/NSF Home Institution: Ohio Wesleyan University **Abstract:** The development of catalytic and enantioselective oxidative dearomatization of phenols would provide a simplified route to dienone building blocks for natural product synthesis. Novel benziodazole triflouroacetates were prepared from the reaction of 2-iodobenzamides with Oxone in the presence of triflouroacetic acid. This synthesis provides species that may be used as novel reagents for the dearomatization of phenols. In pursuit of greater enantioselectivity, C2-symmetric aryliodine precatalysts were also explored.
80.	**Cindy Tran**, Morgan Schulze ***Natural Gas Purification Using Bicontinuous Crosslinked Polymer Membranes*** Summer Advisor: Marc Hillmyer Department or Program Sponsoring Summer Research: MRSEC REU Home Institution: University of Texas at Austin **Abstract:** Carbon dioxide and methane gas separation in industrial natural gas processing is currently dominated by energy-intensive amine absorption technology. Membrane-based separation is an alternative, energy efficient process that also features small environmental footprint, low capital cost, and limited maintenance. However, implementation of synthetic membranes in the treatment of natural gas has been limited due to plasticization of the membrane and its resultant low selectivity. One solution may be the use of a block copolymer of bicontinuous nanostructure. In our efforts, we strive to synthesize and characterize a P(S-co-DVB)-b-PEO block copolymer in which the cross-linked phase restricts chain mobility of the more permeable PEO domain such that plasticization effects are negated and high selectivity of carbon dioxide over methane is maintained.
81.	**Pashound Vue**, Aaron Massari ***Using Polyaniline to Grab Metal Ions*** Summer Advisor: Aaron Massari Department/Program Sponsor: ACS Seed Program Home Institution: University of Minnesota **Abstract:** Aniline in 1 M HCl solution was grown onto Indium Tin Oxide (ITO) through Electrochemistry. Growing aniline through electrochemistry allowed the aniline to make it longer, creating repeated chains of its structure. ITO was used as an electrode because of it's conductive property which is important because conductive polymers has the potential to replace conventional wires in circuits. The purpose of this project was to prepare a polymer whose properties could be altered by grabbing onto metals. Therefore, 2-pyridin-4-yl-phenalymine was polymerized into aniline and 1M HCl solution in order to give the polyaniline the ability to bind onto metal ions from solution and incorporate them into the film.
82.	**Alexander Trochez**, David Giles, Chris Macosko ***Investigating the End Effect Correction Factors for Rotational Viscometer Geometries*** Summer Advisor: David Giles and Chris Macosko Department or Program Sponsoring Summer Research: MRSEC (Materials Research Science and Engineering Center) Home Institution: Grambling State University **Abstract:** Concentric Cylinders are widely employed to measure shear viscosities of liquids whose microstructures require more than microseconds to equilibrate within a flow for complex solutions used in various technologies. The torque developed on both the inner or outer cylinders is very large and hence, the torque developed on the top and bottom ends of the fixed cylinder can be neglected. However, when the fluids cannot sustain their own weight, they must be contained in a cup thus exposing the bottom and/or top surfaces of the inner cylinder to fluid drag producing an end-effect. The goal of this work is to verify end effect correction factors for DIN Concentric cylinder rotational rheometer geometries in order to help provide guidelines for users on Rheometers.

83.	**Maria Wahl**, Isha Koonar, Dr. Ron Siegel ***Engineering Multiblock Copolymers for Drug Delivery*** Summer Advisor: Dr. Ron Siegel Department or Program Sponsoring Summer Research: MRSEC Home Institution: Iowa State University **Abstract:** Block copolymers are composed of polymer subunits that are covalently bonded. In the present research, monomers are polymerized using RAFT, a relatively new living polymerization technique. We are presently synthesizing AB and BA diblock copolymers where the A block consists of N-Isopropylacrylamide (NIPAM) and the B block is a random copolymer of NIPAM and acrylic acid (AA). It was found in previous research that reversing the order of polymerization of the diblock alters properties of the copolymer in aqueous solutions. One hypothesis is that the RAFT chain transfer agent (CTA), a trithiocarbonate with a hydrophobic C12H25 tail, strongly influences phase behavior. To test this hypothesis the CTA will be removed and the effect of this operation on cloud points will be assessed.
84.	**Daphne Welter** ***Optimization of Microdialysis Extractions using Novel Mass Spectrometry Techniques*** Summer Advisor: Dr. Tony Borgerding Department or Program Sponsoring Summer Research: URCS Home Institution: University of St. Thomas **Abstract:** Microdialysis has been proven an effective sampling method in monitoring volatile analytes in aqueous solutions, but gas chromatography does not provide desirable detection limits. My project for the summer focuses on coupling microdialysis extractions with mass spectrometry in order to improve the detection limits for this technology, thus expanding its applications. I have interfaced microdialysis probes with several different kinds of mass spectrometry techniques, including atmospheric pressure chemical ionization, extractive electrospray ionization, and proton transfer reaction mass spectrometry. These techniques are very sensitive: in the chemical family of ketones, APCI-MS and EESI-MS are both one thousand times more sensitive than GC, and PTR-MS is ten thousand times more sensitive than GC. I am monitoring fermentation reactions to affirm the efficacy of these techniques.
85.	**Christopher White** ***Simulations of Condensate-Mediated Transmission in Superfluid Helium*** Summer Advisor: J. Woods Halley Department or Program Sponsoring Summer Research: Research Experience for Undergrads in Physics Home Institution: Rice University **Abstract:** Current experimental probes of the condensate fraction of superfluid ^{4}He are indirect and heavily dependent on theory. Halley et al. proposed a novel probe, based on condensate-mediated transmission ^{4}He atoms incident on a film of superfluid ^{4}He; Setty and Lutsyshyn calculated the probability of transmission via this mechanism with variational Monte Carlo and diffusion Monte Carlo methods, respectively.
86.	**Rob White** ***Characterizing Triclosan Resistance Genes through Metagenomics*** Summer Advisor: Justin J. Donato Department or Program Sponsoring Summer Research: University of St. Thomas Young Scholars Home Institution: University of St. Thomas **Abstract:** The antimicrobial agent triclosan is found in consumer goods to decrease bacterial contamination. However, widespread use of antimicrobial agents can lead to resistance. Therefore, there is need to identify resistance genes to understand how to make better antimicrobial agents and to understand the ecology of resistance genes in the environment. This project uses metagenomics, the introduction of DNA of unculturable bacteria into a culturable host bacterium, to look for resistance genes. E. coli with metagenomic DNA from Puerto Rican microbial mat bacteria were exposed to 7μM triclosan and 9 bacteria survived. End sequencing and transposon insertion were used to identify the potential active gene on each clone revealing an enoyl-CoA reductase, a multidrug efflux pump, and an acyl-CoA dehydrogenase.

87.	**Scott White**, Bryan Paulsen ***Molecular Weight Dependence of Organic Solar Cells*** Summer Advisor: Prof. Daniel Frisbie Department or Program Sponsoring Summer Research: Minnesota MRSEC Home Institution: The University of Iowa **Abstract:** Bulk heterojunction (BHJ) solar cells made from conductive organic molecules have the potential to provide an inexpensive, clean and renewable source of energy for our society. Molecular weight (MW) is among the most important properties governing polymer behavior, yet the MW dependence of donor polymers in BHJ solar cells has received little attention. In order to gain a better understanding of this relationship, we have designed experiments to investigate the effect of MW on light absorption, phase behavior, and charge transport in BHJ cells. Completion of these experiments will give insight into the mechanisms by which donor MW affects solar cell performance and will allow for better designs and more informed choices of materials for polymer/fullerene BHJ solar cells.
88.	**Grant Williams** ***Readback Scheme for Two Dimensional Magnetic Recording*** Summer Advisor: Randall Victora Department or Program Sponsoring Summer Research: Electrical Engineering Home Institution: Carroll College **Abstract:** As improvements in magnetic recording technology allow for increased densities of written media, advanced head structures and arrangements are necessary to provide sufficient track readback resolution. Three conventional read heads placed in an array are analyzed to resolve a bit sequence in the presence of adjacent track noise. Several head geometries are examined through variation of side read head offsets and optimization of the linear combination of correlating signals to improve total readback resolution. Optimization is determined through use of metrics including dibit extraction, minimum mean square error, and cross-correlation between the recovered signal and a single head response in a noise-free environment. The readback schemes are then applied to written Voronoi grains and analyzed using threshold detection to determine the feasibility of industrial application.
89.	**Sam Wood** ***CMOS Operational Amplifier*** Summer Advisor: Professor Ted Higman Department or Program Sponsoring Summer Research: Electrical Engineering Home Institution: Minnesota State University - Mankato **Abstract:** The aim of the research project was to develop a CMOS operational amplifier. The operational amplifier is designed to be used as a building block for other electronic devices, such as an instrumentation amplifier. Many standard techniques were employed in the design to maintain proper operation of the amplifier. Frequency compensation was used to negate the effect of a positive zero and control the phase margin. Common mode feedback was implemented to control the common mode at different nodes. A cascoded biasing scheme, due to its high output resistance, was used to increase the common mode rejection ratio (CMRR) of the amplifier. Simulations were done with Pspice and used .18 um model from Taiwan Semiconductor Company.
90.	**Andrew Zabel** ***Moon Shadowing for MINOS*** Summer Advisor: Marvin Marshak Department or Program Sponsoring Summer Research: Physics Home Institution: Bethel University **Abstract:** Eight years of neutirno induced muon events from the MINOS far detector were successfully categorized. Along with neutrino induced events, cosmic ray events were analyzed. Histograms of the angle between the cosmic ray events and the position of the sun and moon were created using ROOT. A moon shadow was successfully found and fitted with a Gaussian curve having a sigma of 0.48 degrees.

91.	**Dmitriy Zhukov**, Sang-Hyun Oh, Ph.D, Hyungsoon Im, Ph.D, Luke Jordan, Shailabh Kumar ***Black Lipid Membrane Biosensing with Surface Plasmon Resonance and Electrochemical Impedance Spectroscopy*** Summer Advisor: Sang-Hyun Oh, Ph.D Department or Program Sponsoring Summer Research: MRSEC Home Institution: The University of Texas at Austin **Abstract:** Microfluidic surface plasmon resonance (SPR) biosensors with surface-supported artificial lipid membrane are effective platforms for real-time label-free interrogation of membrane receptor-ligand combinations. Black lipid membrane (BLM) sensing is an analogous technique, but with free-standing membrane over nanopore array, with access to both sides of the bilayer. In addition to providing better simulation of biological membrane, the periodic nanopore array in BLM sensors engenders another favorable phenomenon, extraordinary optical transmission, which boosts light transmission at specific wavelengths mediated by the surface plasmons. Despite the advantages of BLM sensing, it is not frequently applied due to BLM fragility. A proposed solution to monitor bilayer stability and integrity is to incorporate potentiostat electrodes in the microfluidic chip. BLMs have characteristic dielectric properties and their capacitance values have been characterized through electrochemical impedance spectroscopy (EIS). My goal is to design a novel biosensor by combining SPR and EIS functionalities within a single microfluidic platform.

Poster Presentations for RET Participants
Listed Alphabetically by Presenting Author

92. **Joshua Ellis,** Zijun Chen, E.D. Dahlberg
Quantitative Measurement of Diamagnetism and Paramagnetism of H2O, NaCl and CuSO4
Summer Advisor: E.D. Dahlberg
Department or Program Sponsoring Summer Research: UMN MRSEC RET
Home Institution: University of Minnesota
Abstract:
We sought to develop a quantitative demonstration of the diamagnetic property of H2O that could be easily conducted in a high school classroom with a minimum of available materials and mathematical knowledge. Additionally, we investigated the effects of a magnetic field on H2O solutions containing NaCl and CuSO4. By mapping the deflection of an incident laser, we were able to determine both the size and shape of the deformation on the surface of the solution. Our findings strongly suggest that the change in gravitational energy density for each solution is due entirely to the effect of the magnetic and surface tension forces for all tested solutions.

93. **Claire L. Hypolite,** Kevin Dorfman
The Tank Emptying Problem: A Classic Chemical Engineering Problem for the K12 Classroom.
Summer Advisor:
Department or Program Sponsoring Summer Research: MRSEC
Home Institution: Edison High School
Abstract:
The new science standards for Minnesota students now include an engineering component. However, chemistry teachers have difficulty bringing in engineering-based labs because of material hazards and costs. Additionally, students at the secondary level have not had the math required to tackle many engineering problems. This inquiry-based activity will address this issue by allowing teachers to engage their students in the investigation of the emptying of a variety of simple water tanks. The activity uses low-hazard, easily acquired, minimal cost materials that allow students to study the different variables that affect the process. Through graphical simplified mathematical analyses, students can predict and verify the emptying times of other containers.

94. **Carla Steinbring**
Bioplastics for a High School Lab
Summer Advisor: Marc Hillmyer
Department or Program Sponsoring Summer Research: UMN MRSEC RET
Home Institution: Bloomington Kennedy High School
Abstract:
Most K-12 teachers have minimal experience in the field of engineering, and Minnesota has recently adopted new standards for science and engineering. I have created a materials engineering lab suitable for a high school chemistry classroom. Students will create a bioplastic from starch and use a tensile test to compare how adding a different composite materials will affect the properties of the plastic. Because the plastic in this lab is made from renewable biomass sources, this also allows for a discussion on renewable materials and biodegradation. Students will discover that while a plastic derived from starch alone is inherently brittle, there are multiple ways to create more flexible materials with more desirable properties for many different applications.