

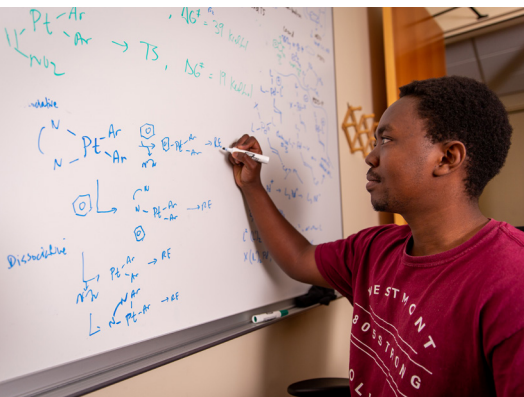


WESTMONT

Celebration of Summer Research

October 11, 3:30-5:00pm

Winter Hall 3rd Floor Atrium



RESEARCH PROJECT SUMMARIES

Improved synthesis of functionalized Pt square precursors

*Tabitha O. Roffelsen, Taylor Cheung-Damonte, and Nathanael J. Ruble
(Supervisor: Stephen M. Contakes, Chemistry)*

The development of easy high-yield syntheses of molecular cage precursors containing functionalizable groups is important for the development of methods for tiled assemblies of supramolecular cages that might find utility for molecular electronics applications. In the present work we report the results of our efforts to develop syntheses for Platinum-based molecular square vertices containing functionalized bipyridine-based capping groups. In this poster we describe the results of our efforts to prepare monometallic square precursors containing Platinum diamine vertices, including a simple procedure for preparing dicarboxybipyridinedichloroplatinum(II) rapidly in quantitative yield.

Forgetting something? Let's find out tau to fix it.

Brandon Norris (Supervisor: Yi-Fan Lu, Biology)

Alzheimer's Disease is a debilitating neurodegenerative disease that is becoming more and more prevalent today. One of the biological factors that is associated with Alzheimer's Disease is the aggregation of the structural protein tau. Present research is focused on better understanding the aggregation of the tau protein and the effects this aggregation has on neurons in the brain. Cell cultures of mouse cortical and hippocampal neurons were grown in media with a derivative of tau protein and then analyzed via fluorescence microscopy, MTT assays, and electrical activity analysis. These tests sought to discover if these aggregates had any adverse effects on the morphology, survivability, or electrical activity on the neurons. So far, our research has indicated that these tau aggregations had no significant effect on morphology or cell survivability. However, our data seems to suggest that the aggregates may have an impact on the distribution of signal conduction between neurons, but more experimentation will be needed to confirm these results.

It's About Time You Got Some Sleep!

Brianna Gilman (Supervisor: Ronald See, Psychology)

Have you ever wondered what happens in your body when you go

to sleep late? Well, wonder no longer! This experiment compares melatonin and cortisol levels over the course of the day on a "normal" sleep schedule (11:30pm to 7:30am) with their levels when you shift your schedule 2.5 hours later (2:00am to 10:00am). Samples were collected in both schedules at 2:00am, 10:00am, 4:00pm, and 9:00pm and analyzed using salivary melatonin and cortisol enzyme immunoassay kits. The purpose of this study was to establish ELISA techniques, validate the previously unused melatonin assay, and to examine the effects of schedule shifts on hormone levels over a 5-day period. We hypothesized that both the melatonin and cortisol levels would peak later in the day and that the relationship between the melatonin and cortisol levels would remain stable across the schedule changes.

Identification of the Conformations of Biphenyl on Al₂O₃ by Fluorescence

Marissa K. Condie and Zackery E. Moreau (Supervisor: A.M. Nishimura, Chemistry)

Aromatic molecules with π -bonding can readily be optically excited and the spectroscopy of such compounds can be used to infer which molecular conformations exist in an adlayer when deposited on an Al₂O₃ surface and heated in temperature programmed desorption experiments. Vapor deposited biphenyl, a molecule with multiple conformations, readily fluoresces at 320 and 345 nm. Comparison of the spectra of biphenyl with the spectra of biphenyl derivatives limited to one conformation allows for the assignment of the peaks in the biphenyl spectra to specific conformations. Biphenyl derivatives locked in a twist conformation show fluorescence at 320 nm, so biphenyl 320 nm fluorescence is from the twist conformation. Biphenyl derivatives locked in a planar conformation show fluorescence at 345 nm, so biphenyl fluorescence is from the planar conformation.

PSMa3 contributes to cell death in THP-1 cell lines.

Court Shepard (Supervisor: Yi Fan Lu, Biology)

This summer, my team and I investigated the cytotoxicity and interactions of PSMa3 with the human cell line THP-1. The purpose of this experimentation was to observe the properties of amyloid fibers, and the roles they can assume as functional, improperly aggregated proteins. PSMa3 is an amyloid fiber formed by *Staphylococcus aureus*, and has been shown to have a functional

role in phagosomal escape and cell replication in the host body. To test the limits of these properties, we introduced varying concentrations of PSMA3 in its peptide form to monocytic THP-1 cell lines in order to observe cytotoxicity as well as any chemotactic properties. Our findings indicated that above 35 μ M, PSMA3 produces cell death in both monocytic and phagocytic THP-1 cells, as well as potentially causing cell clumping prior to apoptosis. Though hard to make a teleological conclusion, we believe that it is the fibril form of PSMA3 that is cytotoxic, and it may only form fibers above 35 μ M (though this is purely hypothetical).

God loves all his children, from the Type A's to the Z-type: An Exploration of the Effect of Z-type Binding on Transition Metal Reactivity Using Computational Chemistry

Chisondi S. Warioba (Supervisor: Brandon E. Haines, Chemistry)

One of the main interests in organometallic chemistry is the ability to control the reactivity of a transition metal center. An emerging avenue for unlocking new reactivity in transition metals is with Z-type ligands, which accept electrons from the metal. This is unique from the typical metal-ligand interaction in which the metal accepts electrons from the ligand. The goal of this research is to conduct a mechanistic study on the effect of Z-type binding in organometallic reactions using density functional theory (DFT) calculations. A better understanding of how Z-type ligands affect different reactions will help capitalize on their potential for new catalytic reactions. Here, geometries, energetics and orbital interactions for the elementary steps of two full reaction coordinates, zinc-induced reductive elimination and gold-catalyzed hydroamination, were obtained and analyzed. The data indicates that Z-type ligands do not directly influence reductive elimination; however, there is promise for Z-type influence in gold-catalyzed hydroamination. How does ligand environment influence the β -effect of transition metals?

How does ligand environment influence the β -effect of transition metals?

Winston C. Gee (Supervisor: Brandon E. Haines, Chemistry)

The β -effect is the stabilization of positive charge by a group at the β -position, the second atom away from the charge. This effect is well-known with silicon and recently was observed with transition metals, but the significance of the ligands complexed with the

transition metal is not well understood. Therefore, the influence of ligand environment on the β -effect of transition metals was investigated with computational methods. Varying the identity, number, and arrangement of the ligands complexed with the transition metal palladium, the free energy barrier (ΔG^\ddagger) in a model reaction pathway was computed as evidence of the β -effect. The investigation found a wide range in ΔG^\ddagger values for different ligand environments: ΔG^\ddagger is generally lowered with more ligands on the metal center, particularly so for ligands that are more electron-donating. Overall, these findings suggest changing the ligand environment as a means to tune the β -effect of transition metals.

Forcing Bordetella to Cough Up Its Secrets: Newly Identified Virulence Genes

Alexa Spandrio and Jennifer Ikeda (Supervisor: Steve Julio, Biology)

The focus of this study is Bordetella, a bacterial respiratory pathogen that causes the human disease whooping cough. Due to an increase in recent whooping cough reportings, our goal is to identify bacterial genes that Bordetella uses to infect its host. We have developed and validated a plasmid library genetic system using basic molecular and microbiological techniques to characterize virulence genes in the bacteria. Using an animal model, we identified and isolated virulence genes expressed only during infection. Moving forward, we will continue the identification and characterization of virulence genes in hopes of improving the current whooping cough vaccine.

Defining Primary Cortical Neuronal Signaling Bursts of the MED64 Presto System

Zion I. Shih and Kristi L. Cantrell (Supervisor: Yi-Fan Lu, Biology)

With a set of electrodes in each well of the plate, the microelectrode array (MEA) is an interface recording neuronal signals. Specifically, the MED64 Presto System, a 384 multi-channel MEA, may be used to analyze the effects of derivatives of the Tau protein's R3 domain, implicated in Alzheimer's disease. We developed an algorithm to identify neuronal signaling bursts of a primary cortical neuronal network from P0-1 wildtype mice interacting with derivatives of Tau's R3. Distinguishing a burst from the background involved a derivative method creating well-dependent thresholds, unlike the fixed threshold across wells in the original Symphony software. Our algorithms automated analysis of raw spike data to define network

bursts, permutating and generating empirical p-values and graphs from the refined data. Over the course of three replicate trials, the uncapped R3 domain tracked more similarly with the control than the capped version of the region with p-values of 0.01.

“Anxiety or Depression: Which has a Greater Impact in Parkinson’s Disease?”

Amelia McGowan (Supervisor: Steven Rogers, Psychology)

The present study sought to determine similarities and differences in the relationship between cognition and both anxiety and depression among patients with Parkinson’s Disease. Participants completed comprehensive neuropsychological assessment as part of outpatient neurological evaluations. The results suggest different cognitive profiles for Parkinson’s patients who have anxiety compared to those with depression. Both state anxiety and depression were negatively correlated with visual scanning, response inhibition, nonverbal memory, and visual perception and construction. However, worse simple attention, graphomotor speed, working memory, and divided attention were also exhibited by those with greater state anxiety, but not state depression. Anxiety also appears to have a differentially worse impact than depression on the processing speed and verbal memory of those with PD, suggesting a need for customized conceptualization and treatment. The cognitive difficulties of those with PD can therefore vary with the specific psychiatric condition/symptomatology, with anxiety portending worse cognitive outcomes than depression.

College is for the memories...literally! How higher education impacts cognitive health in Alzheimer’s and Parkinson’s Disease.

Jackie George (Supervisor: Steven Rogers, Psychology)

Education strengthens neuronal pathways and increases cognitive resilience, but there is some uncertainty about the way education influences cognitive decline between degenerative conditions, such as Alzheimer’s (AD) and Parkinson’s disease (PD). This study examines how education differentially impacts cognitive decline in AD compared to PD. A total of 124 patients with AD and 99 patients with PD indicated educational attainment on a questionnaire and completed a neuropsychological battery. Higher education levels seem to benefit frontal-executive functioning for both those with AD and PD, but differentially influence the learning, visuospatial abilities, and visual processing speed of those with AD and the

language and attention of those with PD. Having college or graduate degrees seems to distinctly benefit the learning, memory, visual perception, and semantic language abilities of those with PD, whereas differences in cognition disappear among those with the lowest levels of education. These have implications for differential prevention and intervention of cognitive decline in PD versus AD.

Does Your Baby Have Moves Like Jagger? The Computer Can Tell You

Jonathan Lee, Nathan Young, Mohan Singh, Kaylee Yoon, Ryan Kleinberg, and Isaiah Chu (Supervisor: Donald J. Patterson, Computer Science)

Premature babies are at risk for numerous medical problems, including Cerebral Palsy (CP). Heinz Prechtl developed a method of observing the movements of premature babies to reliably and accurately identify whether a baby has neurological disorders that cause CP. Unfortunately, most hospitals do not have the time nor training to properly utilize Prechtl’s method. We have developed a deep learning model called a convolutional neural network that can learn the method by analyzing various data in order to identify newborns that are at risk. The necessary data is collected through the use of a color and depth tracking camera and small unobtrusive accelerometers on the wrists and ankles of the newborns, allowing for hospital staff to go about their jobs as they normally would while the program analyzes any potential signs of CP. In the future, we hope this can be applied to recognizing many different kinds of movements.

Steps Towards the Photocatalytic Destruction of a Difficult Pollutant

Madison J. Foster, and Taylor Cheung-Damonte (Supervisor: Stephen M. Contakes, Chemistry)

Persistent, harmful inorganic pollutants are found in public water supplies and ground water throughout the United States. Removal of these ions is difficult because they are non-volatile and stable in water. Work in our group has focused on the development of methods for reducing inorganic pollutants to harmless products using nanoparticle-assisted photoreduction. The present work focused on the development of a complete photosystem, the selection of conditions for substrate reduction, and the investigation of inexpensive analytical methods that can be used to determine how the composition of substrate-containing mixtures change as a function of reduction time.

Avoid the Amyloid: Understanding Bacterial PSMa3 Peptide Aggregation

Grace Schonfeld, Court Shephard, Amber Gray, Thanh Do, and Yi-Fan Lu (Supervisor: Kristi Lazar Cantrell, Chemistry)

The phenol soluble modulins (PSMs) are secreted by the bacteria *Staphylococcus aureus* (*S. aureus*). Recent research proposes this peptide causes disease inside a host by forming amyloid fibrils, an ordered arrangement of protein aggregate. The PSMa3 peptide exhibits a novel cross α -helical structure in solution. To study fibril formation PSMa3 WT and three mutant peptides (F3A, G16A, K9P/F11P) were synthesized using Boc chemistry, and purified using reverse phase high pressure liquid chromatography (RP-HPLC) in a gradient of water and acetonitrile. The peptides were then analyzed using circular dichroism (CD) spectroscopy and transmission electron microscopy (TEM) in 20mM ammonium acetate, pH 6.8. CD spectroscopy revealed no structural change occurred in the WT or three mutant PSMa3 peptides over a 2-week period of incubation at room temperature. A small number of fibrils were observed in PSMa3 WT by TEM.

“Digging a Well: An Exploration into Human Limits and the Tools that Expand Them”

Gavin Hoioesen and Michael C. Oldach (Supervisor: Timothy A. Van Haitsma, Kinesiology)

Mental strength (MS) training increases endurance performance, but the mechanisms have not been elucidated. This study examined the effects of multi-week MS training on physiological and psychological changes that occur following MS training. Thirty-four participants (17 MS, 17 Control) participated in five weeks of testing. After determining ventilatory threshold (VT), participants performed four time trials to exhaustion (TTE) at 110% of VT. MS training consisted of watching one video daily for 21 days. There were significant increases in TTE (7.9% [$\pm 13.3\%$], $F=4.560$, $p < 0.05$) following mental strength training. CON end-exercise heart rate (HR) of the final TTE were significantly lower than initial TTE or for final MS TTE ($p < 0.05$). There were no perceptual or psychological differences between groups following training. After three weeks, mental strength training increases performance. The decreased end-exercise HR for CON suggests a potential study fatigue or lack of desire to endure discomfort.

Chemistry as Cheap as (a) Nickel; Nickel Catalyzed Borylation of Aryl Sulfamates

Alyssa Avila, Festo Mugire Muhire, and Edwin Wertz (Supervisor: Amanda Silbertstein, Chemistry)

As organic chemists, our area of research focuses on the synthesis of small molecules that contain carbon bonds. One type of bond that has proven to be beneficial in pharmaceutical drug syntheses is the aryl-aryl carbon bond. Although the process of making an aryl-aryl carbon bond has been well studied, one of the precursors to this reaction, the boronic ester, has proven to be difficult to synthesize for a number of reasons. Current methods either use unstable precursors that are bad for the environment or an expensive palladium catalyst, while also having poor functional group tolerance. Using our novel mechanism involving a nickel catalyst, we are able to synthesize boronic esters with more functional group tolerance in a much cheaper and environmentally friendly way. As a demonstration of the utility of this method, we are aiming to synthesize Diflunisal, a commercially available NSAID.

The Taming of the Laser Beam: Measuring the Width of and then Attempting to Form the Ideal Laser Beam Using Cavity Ring-Down Spectroscopy

Kelsey J. Feustel (Supervisor: Michael A. Everest, Chemistry)

Cavity ring-down spectroscopy (CRDS) is an ultrasensitive method that can be used to quantify the amount of a substance. Central to a CRDS setup is a laser whose beam is trapped between two highly-reflective mirrors. CRDS is of interest to the Everest research group because of its application in evanescent-wave cavity ring-down (EW-CRD) imaging, which is used to create 2D images of molecules adsorbed to a glass prism's surface. In EW-CRD imaging, a thinner laser beam results in higher-resolution 2D images. This summer, the Everest research group focused on minimizing the width of the laser beam by adjusting the CRDS setup. The width of the laser beam was measured using either a square of razor blades or a dye-coated microscope slide. The widths of the beam were found to be approximately two times wider than the theoretical values, and widths depended most on adjustments made to the CRDS setup.

Comparing heart rates of male and gravid/non-gravid female Western terrestrial garter snakes (*Thamnophis elegans*) using field ultrasonography

AUTHORS: Caleb Rodriguez, Sierra Farrar, Giacomo Catalina, , and Amanda Sparkman

Abstract: Classic life-history theory predicts that males should exhibit the “live fast, die young” life history strategy. This theory also predicts fast-living individuals will have higher metabolic rates and consequently higher heart rates. We used field ultrasonography on garter snakes in the field and while in short-term (1-2 day) captivity to test our hypothesis that male heart rates would be faster. Our results suggested a trend for male heart rate to be lower than that of non-gravid females, but this trend was not statistically significant, perhaps due to a limited male sample. Interestingly, though, gravid female heart rate was significantly lower than that of non-gravid females. We suggest that this may be due to a trade-off between precise thermoregulation required for gestation and reduced feeding and stress response in gravid females. Future studies should continue to investigate heart rate differences between sexes to inform differences in life-history strategies. Further research to uncover gravid and non-gravid heart rate differences is also necessary to determine the ecological and evolutionary reasons for heart rate reduction during pregnancy.

Effects of island climate variables on tick prevalence in *Elgaria multicarinata*

AUTHORS: Caleb Rodriguez, Sierra Farrar, Giacomo Catalina, , and Amanda Sparkman

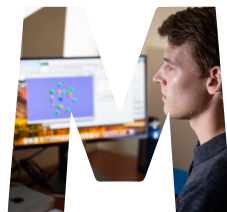
ABSTRACT: Ticks in southern california such as *Ixodes pacificus* (western black-legged tick) are well-known ectoparasites of reptiles such as *Elgaria multicarinata* (Southern alligator lizard). Studies have shown that tick infestation can transmit harmful blood parasites to lizard hosts and can reduce host activity. There is minimal knowledge of climatic variables affecting tick infections on lizards. We tested whether the prevalence of tick infection in *E. multicarinata* changes with climatic differences between years. Years with high total precipitation the previous fall yielded less ticks on lizards caught in early spring, while the opposite was observed in years with high precipitation in March-April. Ticks were more prevalent on late spring lizards when average temperatures for March-April were higher, May temperatures were colder, and

when total precipitation in May was higher. These results reflect complex relationships between tick life-cycles and variables affected by climate such as vegetation prevalence, temperature thresholds, and flooding. Future studies may explore climate variables within lizard and tick microhabitats, comparing the compatibility of those findings with the single island weather station.

Plump, Voluptuous, and Rubenesque: A 17th Century Master of Marketing

Octavia Ross (Supervisor: Judy Larson, Art)

Peter Paul Rubens (Dutch, 1577–1640) was a master of the Flemish Baroque style. His fame was based on his compositions with a rhythmic sense of movement, bright color palette, and a dramatic narrative content that usually included robust and sensual figures. Rubens had a large studio in Antwerp where a workshop of artists helped paint him large history paintings, portraits, as well as Biblical and mythological subjects, which were sought after by European nobility – especially Philip IV of Spain and Charles I of England. Rubens’ oeuvre was substantial; a catalogue of his recorded art lists 1,403 works. Rubens was very aware of his fame and strategically worked on increasing his popularity. One successful idea he had was to employ the best engravers he could find to make prints based on his compositions. These graphic works were disseminated throughout Europe and not only attracted the attention of top art collectors, they were also affordable enough for merchant class collectors to purchase, frame, and enjoy on the walls of their homes. Rubens employed printmakers to translate his paintings, drawings and tapestries based on how well their reproductive engravings and woodcuts presented his works. He was actively involved with his printmakers during the printmaking process. Rubens was a marketing genius and his stable of engravers and wood engravers established his reputation and authority as the top Baroque artist during his lifetime and after. The xxx prints presented here are from the Perry Collection of Prints, scheduled for exhibition at the Ridley-Tree Museum of Art in the fall of 2019. During the past summer, I had the opportunity to work with Tamara Vaughan and Judy Larson writing entries on each of the Rubens’ prints for a catalogue that will be published in the fall. First, I learned to identify different printmaking techniques and then read about Rubens’ workshop and his brilliant plans for promoting his works throughout Europe.



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