



**Carleton College
Student Research Symposium and Celebration**

2013-2014

October 24, 2014

3:30-5:30 PM

Weitz Center for Creativity

October 24, 2014

Welcome to this Year's Student Research Symposium and Celebration at Carleton College. Today we honor the many students who have engaged in advanced work in their respective fields, building on the knowledge and skills they acquired throughout their course work both at Carleton and on off-campus programs.

Research is at the heart of a Carleton education. Through their posters and oral presentations these students reveal the habits of mind that an outstanding liberal arts education provides – a passion for intellectual exploration, skills of careful observation and analysis, the ability to frame questions in fruitful ways, to interpret both quantitative and qualitative data, and to convey their findings clearly and concisely, both verbally and visually. We are proud of their accomplishments.

We also wish to acknowledge and celebrate the great diversity of research represented here. Faculty and staff from twenty-two departments and programs have supervised student research projects, as well as several staff members who work in Academic Civic Engagement, Academic Skills Support, and the Cowling Arboretum, among others. Taken together, the work of these students attests to the breadth of research opportunities at Carleton and the many ways in which faculty and staff throughout the College inspire and support student scholarship.

Finally, we call attention to the many significant mentoring relationships that fostered this work and were deepened as a result of it. As generations of Carleton students will attest, the opportunity to work closely with faculty is among the most impactful and memorable of their experiences here. Behind each of these presentations is a faculty or staff member whose guidance, encouragement and coaching enriched the education of students and inspired them to go further than they imagined they could. We are grateful for the dedication and attentiveness of all these mentors.

We are pleased that this research symposium is part of a larger Day of Student Engagement, for research at its best is just that – the result of deep intellectual engagement of students and faculty and staff with their subjects and with one another. We invite you to engage with these students, to question them about their work and its significance. In this way, we hope you will join them, at least briefly, on the intellectual journey they have undertaken.

Thank you for joining us for this symposium and celebration.

Bev Nagel
Dean of the College

Hudlin Wagner
Dean of Students

Hydrothermal Synthesis of the Spinel Compound CuCo₂S₄

Akinlabi, Arafat 2015

Author/Contributors: Dr. R. Lee Penn (Chemistry Department, University of Minnesota); Alexandre H. Pinto (Graduate Student, University of Minnesota)
Summer 2014

Supervisors: Dr. R. Lee Penn (Chemistry Department, University of Minnesota); Alexandre H. Pinto (Graduate Student, University of Minnesota)

Transition metal chalcogenide nanocrystals are promising materials for solar cells and super capacitor electrodes. Copper cobalt (II) sulfide (CuCo₂S₄) has been successfully synthesized using a hydrothermal approach, which is a less toxic and less expensive synthetic process than typically used to produce metal sulfides. X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectrometry (EDS), ultraviolet-visible spectroscopy (UV-Vis) and transmission electron microscopy (TEM) were used to characterize product materials. The most important reaction variables were temperature, the molar ratio of the metal cations to the sulfur source (thiourea), and whether ethylenediamine was added to the reaction mixture. For example, synthesis at room temperature yielded a partially crystallized product while synthesis at 250°C yielded a crystalline one. Adding ethylenediamine resulted in a slightly smaller mean particle size but superior purity as compared to syntheses without the added ethylenediamine.

A Bridge from Yangon; Public Memory in Burma

Bahn, Jackson 2016

Author/Contributors: Professor Tun Myint (Political Science); Jake Yanoviak, Peter Sang
Winter 2014

Supervisor: Professor Tun Myint (Political Science)

As Burma embraces the political and economic transitions begun with democratic elections in 2011, the villages across the Rangoon River from Rangoon are experiencing a dramatic transformation of livelihood and land use. Collaborating with Professor Tun Myint, Bahn collected evidence of uncompensated land seizure, political reclassification of land and extreme speculation, but also of uneasy cooperation between villagers and a now vote-seeking government. They sought to document what societal change looks like beyond GDP, life expectancy and other indices. With help from Jake Yanoviak '16 and Peter Sang '17, Bahn made a short documentary that considers the impact of public memory which was featured in a Spring 2014 library exhibit entitled "A Bridge From Yangon: Public Memory in Burma." The documentary offers a glimpse of towns on the cusp of development, how residents interact with the government and how the reforms of recent years have changed their lives.

CO₂ and Na⁺ Cation Behavior in Aluminum-Substituted Zeolites
Bamberger, Nathan 2015

Authors/Contributors: Professor Daniela Kohen (Chemistry); Kit Pavlekovsky
Summer 2014

Supervisor: Professor Daniela Kohen (Chemistry)

Zeolites are microporous crystalline materials capable of selectively adsorbing CO₂ from CO₂/N₂ and CO₂/CH₄ mixtures, making them attractive candidates for carbon capture and natural gas purification technologies. Atomistic computer models can accurately predict the behavior of zeolite-gas systems and help us gain a better understanding of what causes their behavior on a molecular level. In certain aluminum-substituted zeolites, mobile cations are sited in narrow channels, blocking gas molecule diffusion. In a process called cation gating, CO₂ molecules induce temporary movement of the blocking cations to allow diffusion, but N₂ and CH₄ cannot induce such movement and so their diffusion through the zeolite is severely reduced. Cation gating can thus further increase a zeolite's preference for adsorbing CO₂. In this project, we used atomistic simulations to investigate CO₂ and cation behavior in zeolite Na-RHO and found to our knowledge the first quantitative evidence of cation gating in this material.

A New Model of Theiler's Murine Encephalomyelitis Virus Infection
Barbetta, Hillary 2015

Authors/Contributors: Dr. Hyo-Jin Kim (Mayo Clinic), Dr. Benjamin Clarkson (Mayo Clinic), Geoffry Curran (Mayo Clinic), Kanish Mirchia (Mayo Clinic), Reghann LaFrance-Corey (Mayo Clinic), and Dr. Charles L. Howe (Mayo Clinic)
Summer 2014

Supervisor: Dr. Charles L. Howe (Mayo Clinic)

Multiple sclerosis (MS) is one of the most prominent causes of neurological disability in young adults. Despite its medical and financial burden, its etiology remains unclear. As such, there is an enormous demand for the development of effective animal models of MS. Theiler's murine encephalomyelitis virus (TMEV) inoculation in mice is a powerful model system in MS research, but these inoculations necessitate the use of intracerebral injections. Although intracerebral injections have previously demonstrated remarkable capability at infecting the brain with TMEV, the puncturing of the surface of the brain increases the likelihood of trauma- and damage-dependent immune activation. Such reactions introduce a multitude of confounding variables in the current TMEV model and may limit testing of potential translational therapies. The goal of this study is to investigate the ability of a carrier peptide, K16ApoE, to facilitate TMEV infection of the central nervous system without using intracerebral injections.

The QUIC Measure of Quantitative Reasoning Ability

Batten, Quinn 2017

Authors/Contributors: Professor Neil Lutsky (Psychology), Sam Hayward

Summer 2014

Supervisor: Professor Neil Lutsky (Psychology)

The goal of this project was to create an assessment that measures quantitative reasoning (QR) proficiency before and after completion of an introductory course on basic QR skills. The assessment measures general QR ability with an emphasis on statistics, research methods, and contextual interpretation of numerical claims. Topic selection was guided by the goal of helping citizens become intelligent consumers of research. To select topics, we reviewed the relevant literature, listing the frequently mentioned topics and selected those we deemed most relevant to a student's growth in numerical literacy. In addition, we examined a diverse array of tests in our search for topics, including the MCAT, SAT, and more tightly numeracy-focused measures such as the expanded numeracy scale by Peters et. al., 2007 and the Berlin Numeracy Test. Ease of administration in a real classroom setting was deemed vital, so the assessment consists of only 25 questions, all in multiple-choice format.

Overexpression of the Hox gene mab-5 in C. elegans Using the unc-119 Promoter

Bible, Marianna 2016

Author/Contributor: Professor Jennifer Wolff (Biology)

Summer 2014

Supervisor: Professor Jennifer Wolff (Biology)

Hox genes *lin-39* and *mab-5* are linked to the fates of male sex-specific neurons in *C. elegans*. A distinct region of interaction defined by overlapping expression of *mab-5* and *lin-39* is indicated by expression patterns of other genes. Expression changes in *lin-39* (*ccc-16*) mutant animals further suggest interaction between *mab-5* and *lin-39*. In attempt to further understand this Hox gene interaction, a *mab-5* overexpression plasmid using the promoter of the panneuronally expressed gene, *unc-119*, was designed through modification of an *unc-119::gfp* plasmid. A unique *Sal1* site was introduced to the original plasmid using site directed mutagenesis, and *mab-5* cDNA was isolated from RNA of wild type animals. Ligating the modified *unc-119* plasmid with *mab-5* cDNA should result in a plasmid that uses the *unc-119* promoter to overexpress *mab-5*. Upon injection into worms, analysis of neuronal development should help to reveal the nature of interactions between *mab-5* and other Hox genes.

A Quantum Mechanical Mechanistic Study of Enantioselective Organocatalysis

Blise, Katie 2015

Author/Contributor: Professor Daniela Kohen (Chemistry)

Spring 2013 - Summer 2014

Supervisor: Professor Daniela Kohen (Chemistry)

The use of chiral organocatalysts in the reaction of cyclic anhydrides to induce enantioselectivity has become increasingly popular. However their mechanisms are not fully understood, which makes research from a theoretical point of view extremely appealing. Our research involves using density functional theory to understand the reactivity and mechanism behind the organocatalytic desymmetrization reaction of a cyclic anhydride with a quinine-derived organocatalyst. Thus far we have succeeded in locating diastereomeric transition states leading to each enantiomer. Interestingly, we have discovered that there are two possible mechanistic pathways for each enantiomer. Our most recent results indicate that the major enantiomer forms through a step-wise pathway involving two transition states, and the minor one is formed through a concerted pathway with only one transition state. Our hope is to continue using density functional theory to test out manipulations of the catalyst in order to understand and enhance its enantioselectivity.

Evaluating the Effect of Dominant Tallgrasses on Nematode Biodiversity in Restored Tallgrass Prairie

Boyd, Anais 2016

Authors/Contributors: Professor Jennifer Wolff (Biology), Professor Daniel Hernandez (Biology), Jennifer Schmitt

Summer 2014

Supervisor: Professor Jennifer Wolff (Biology)

Nematodes play important roles in ecosystem processes, though the relationship between nematode diversity and ecosystem functioning remains largely unknown. Carleton's work restoring tallgrass prairie to the Arboretum constitutes the introduction of an ecosystem unstudied in nematode diversity. Two tallgrass species, Sorghastrum and Andropogon, dominate plant life in newly restored prairie ecosystems. This summer's research began the evaluation of the differences in soil nematode biodiversity between restored prairie plots containing and lacking these two dominant tallgrass species in the 2012 G.R.A.S.S. Experiment in the Arboretum. Nematodes extracted from soil subsamples were prepared for individual PCR of their small subunit ribosomal gene. Nematode biodiversity of the restored prairie types will be analyzed using Blaxter's jMOTU program, which clusters barcode sequences into molecular operational taxonomic units. In the future, we hope to explore high throughput sequencing as a faster, easier method of PCR, increasing the accessibility of nematode metagenomics studies in Carleton's Arboretum.

Simulating Experiments With Geant4

Bromell, John 2016

Authors/Contributors: Dr. Lee Sobotka (Washington University), Cole Pruitt

Summer 2014

Supervisor: Dr. Lee Sobotka (Washington University)

The goal of this research was to simulate two experiments using Geant4, a simulation toolkit developed by CERN. The main motivation for simulating both of these experiments is to quantify and characterize the background noise that is expected from well-understood physical phenomena. The first experiment is designed to detect a unique decay of ^{137}Cs predicted by Second Order Perturbation Theory. By simulating this experiment, we found that the background data produced by Compton scattering would not be significant. The second experiment is designed to detect the Hoyle state, an excited state of ^{12}C which is a critical stage for the formation of ^{12}C in stars. The Hoyle state would be detected using a neutron beam and an Active Target Time Projection Chamber. The simulation demonstrated that the effects of background tracks are mostly negligible, though there are still lingering concerns about neutron absorption by Carbon in our target.

Urban Ecology: Marine Invertebrate Diversity across a Metropolitan Gradient

Buckner, Emily 2015

Authors/Contributors: Dr. Jameal Samhouri ((Northwest Fisheries Science Center), Dr. Andrew Shelton, Greg Williams, Dr. Nick Tolimieri, Shannon Hennessey, Andrea Wong, Emma Garrison, Mira Klein
Summer 2014

Supervisor: Dr. Jameal Samhouri (Northwest Fisheries Science Center)

This project examines the impact of urbanization on the near-shore ecology of Puget Sound. Past research has examined effects of pollution and seawalls on marine life but the consequences of 'urbanization' itself are not well studied. Scientists from the Northwest Fisheries Science Center in Seattle are conducting a long-term study measuring marine invertebrate diversity across a gradient of urban and non-urban sites. Preliminary results suggest that there is no significant difference in marine invertebrate diversity between more urban and less urban sites. The implications of this study elicit questions regarding how much 'city' is too much, pinpointing what it is about urban spaces that are detrimental to the surrounding environment, and how to create more sustainable metropolitan systems.

Sustainability of Smartphone-Based Directly Observed Therapy in the San Francisco Tuberculosis Control Program

Buswell, Mary 2015

Authors/Contributors: None
Summer 2014

Supervisor: Dr. Julie Higashi (San Francisco General Hospital)

A best practice for case management of active tuberculosis (TB) treatment is to administer medication by directly observed therapy (DOT). However, health departments lack staffing to support daily DOT for all active cases. To build capacity for providing DOT, the San Francisco TB Control program piloted a videophone-based DOT program (VDOT). To assess the program's sustainability, a cost comparison analysis was conducted to determine the cost of VDOT relative to existing forms of DOT. Satisfaction

surveys were also administered to gather patient and staff opinions of the VDOT program. The cost analysis revealed that the per-patient monthly cost of VDOT (\$112) was less than existing DOT programs, and patient and staff surveys reflected positive opinions of VDOT in comparison to other DOT modalities. Thus for health departments, VDOT is a cost-effective, patient-centered, and sustainable approach to monitoring TB treatment.

Optogenetic Study of Perceptual Decision-Making in the Posterior Parietal Cortex

Cannon, John 2015

Authors/Contributors: Dr. Anne Churchland (Cold Spring Harbor Laboratory), David Raposo
Summer 2014

Supervisor: Dr. Anne Churchland (Cold Spring Harbor Laboratory)

Perceptual decision-making is the process by which the brain makes decisions about the nature of external sensory stimuli. Previous work using pharmacological inhibition has identified the posterior parietal cortex (PPC) as a potentially critical region for accurate perceptual decision-making. We performed optogenetic excitation of the PPC using channelrhodopsin-2 (ChR2) in Long-Evans Rats performing a complex perceptual decision-making task. The task required the experimental subjects to differentiate between high vs. low frequency stimuli presented either visually or auditorily for 1000ms. Exciting the PPC throughout the duration of stimulus presentation significantly impaired accurate perceptual decision-making. Furthermore, the effect of PPC activation was significantly more pronounced in the visual stimulus presentation trials. Experiments activating the PPC during restricted windows of 250ms of the total stimulus presentation suggest that there is a temporally specific early requirement for PPC activity. Overall, these results suggest that the PPC plays a critical role during perceptual decision-making.

Philosophy Begins in Wonder

Chang, Alexandra 2016

Authors/Contributors: Professor Daniel Groll (Philosophy), Adrienne Falcon(Sociology), Bart Schultz
Summer 2014

Supervisor: Professor Daniel Groll (Philosophy)

The goal of this research was to develop a curriculum for a philosophy for children outreach program, and gain a greater understanding of the pre-collegiate philosophy movement as a whole. To do this, we looked into the existing literature on philosophy for children, and visited current leader in the field, Bart Schultz, at the University of Chicago. We examined multiple approaches to educating children in philosophy, including philosophy through Socratic dialogue, children's literature, and interactive games and activities. We intend to use a combination of these approaches with 1st graders at Greenvale Elementary school this coming spring. Carleton students will be trained in a course taught by Daniel Groll to engage young students with philosophy, as well as explore the larger field of philosophy of

education. The motivation behind both this research and program is the belief that children are naturally capable of philosophical thinking, and would benefit from the time and space to explore their creativity with the guidance of Carleton philosophy students.

Searching for Higher Order Cladding Modes in Fiber Optic Based Optical Levers

Charous, Brian 2015

Author/Contributor: None

Summer 2014

Supervisor: Dr. Eric Gustafson (California Institute of Technology)

Advanced LIGO uses fiber-coupled diode lasers as input to its optical lever system. The optical levers make up an auxiliary system that provides error signals in pitch and yaw in the first step of the lock of the interferometer. Currently, the optical levers contain noise which makes it harder to bring the interferometer into lock and sometimes provide false positives of seismic noise. A possible source of that noise is in the optical fibers; if excess light is coupled into the cladding of the otherwise single-mode fiber, the fluctuating higher-order mode could appear as beam wiggle and be interpreted as test mass motion. In addition, a small ring appears around the core of the laser spot at the end of its throw, decreasing the precision of the optical levers. In this experiment, we examined whether the single-mode optical fibers used could really be carrying higher-order modes, and if the ring around the core of the beam could be reduced or eliminated. Our analysis indicates that the optical fibers do not contain excess mode content, and the ring may be caused by diffraction in the optics of the optical lever telescopes.

Tangible Creativity: Designing with Affordances of Handheld Interactive Objects for Creative Composition

Chen, Michelle 2015

Author/Contributor: Mary Lou Maher (UNC-Charlotte)

Summer 2014

Supervisor: Mary Lou Maher (UNC-Charlotte)

Digital Interactive Keys (DINKs) is a design that takes advantage of the affordances of handheld interactive objects as a complement to touch screens for creative composition, such as composing poems. Affordances are actions that an agent can perform on an object, and we focused on the affordances of the interaction that can be sensed by the devices or that are important to tangible and gesture based interaction. Our design enables tangible interaction with elements of a composition, along with touch interaction with the whole composition on a larger touch-sensitive display. The design is unique in using handheld interactive objects for spatial exploration of elements in a composition that is synthesized on a touch screen. We examined design precedents and their affordances for integrating smaller physical elements with larger display devices. Additionally, we developed a prototype application for limerick composition that utilizes the DINKs design.”

An Examination into the Substrate Specificity of DapD and TabB; Two Enzymes in the Tabtoxin Biosynthetic Pathway

Danson, Eli 2015

Author/Contributor: Professor Chris Calderone (Chemistry)

Summer 2014

Supervisor: Professor Chris Calderone (Chemistry)

Tabtoxin is a unique toxin with an unusual beta-lactam, making it an interesting secondary metabolite to study. It is believed that the biosynthetic pathway of tabtoxin in *Pseudomonas syringae* pv. *tabaci* is branched off of the lysine biosynthetic pathway due to similarities in their structure. Accordingly, finding the point at which they diverge is important for future studies of tabtoxin. Through large scale protein expression and UV spectroscopy, it was found that DapD and TabB, two different acyl transferases in *P. syringae*, each have a different acyl groups they transfer onto their substrate THDPA. In addition, an organic synthesis was carried out for THDPA. Future work hopes to confirm TabB and DapD as the divergent point for tabtoxin by seeing which catalyzed product made by DapD and TabB works with the DapC, the next enzyme in the lysine biosynthetic pathway.

Small-molecule Activation by Ambiphilic Late-metal Complexes

Deetz, Zander 2015

Author/Contributor: Professor Matthew T. Whited (Chemistry)

Summer 2014

Supervisor: Professor Matthew T. Whited (Chemistry)

Metal-ligand multiple bonds are noteworthy for their ability to engage in interesting reactivity, particularly in cases where incomplete bonding leads to significant disparity of electron density, creating adjacent Lewis-basic and -acidic sites. We have targeted late-metal complexes containing such “electronically-frustrated” linkages incorporated into pincer-type ligand architectures in an effort to stabilize these otherwise highly reactive moieties. We will present studies on the synthesis and metallation of several related ligand scaffolds with group 9 metal precursors and the reactivity of the resulting complexes.

High-Throughput Screening to Identify and Characterize Compounds that Interfere with Europium- and Terbium-based AlphaScreens

Eyermann, Charles 2016

Authors/Contributors: Nathan Coussens, PhD; Natalia Martinez, PhD

Summer 2014

Supervisor: Dr. Nathan Coussens (NIH/NCATS); Mr. Ajit Jadhav (NIH/NCATS)

AlphaLISA is a widely used improvement upon the traditional ELISA technology. AlphaLISA allows for the rapid identification of hits from high-throughput screens for many types of targets, including enzymatic activity, receptor-ligand interactions, nucleic acid levels, and even detection of small molecules. The PerkinElmer AlphaLISA TruHit kit was designed as a follow-up assay to identify compounds that reduce signal output in AlphaLISA screens, also known as "false positives". The additional TruHit counterscreen adds time and cost to a project. Currently, no database exists that lists compounds from a large chemical space that interfere with AlphaLISA technology. Towards this end, we are screening 450,000 compounds in 5-point titrations to identify molecules that give false positive results with europium- and terbium-based AlphaLISA assays. The results will be made available to the public. Herein we present results with the europium-based AlphaLISA assay from multiple libraries, including the Library of Pharmacologically Active Compounds (LOPAC).

High Temperature Emplacement of Clastic Breccia Dikes and Implications for the Development and Magnetization of Impact Craters

Fairchild, Luke 2015

Authors/Contributors: Nicholas L Swanson-Hysell (UC Berkeley), Sonia M Tikoo (UC Berkeley)

Summer 2014

Supervisor: Dr. Nicholas Swanson-Hysell (University of California Berkeley)

Breccia dikes are ubiquitous features of meteor impact craters. They are composed of lithic fragments that are broken up and injected into the crater floor upon impact. Most rocks record the magnetic direction of Earth's magnetic field at the time of their formation, although rocks can be remagnetized by later events such as chemical alteration, shock, or significant heating. My research is focused on whether breccia dikes are emplaced at temperatures high enough to remagnetize the lithic fragments they carry. Clarifying the magnetic characteristics of breccia dikes could have implications that range from quantifying the rates of post-impact crater modification to constraining the life and death of magnetic dynamos on other planetary bodies.

Role of Transient Receptor Potential Channels (TRPC) on Vascular Reactivity Responses to Endothelin in Sheep Exposed Antenatally to Betamethasone

Fehring, Jennifer 2016

Authors/Contributors: Dr. Jorge Figueroa MD/PhD, Angela Massamann MD, Jie Zhang MD

Summer 2014

Supervisor: Dr. Jorge Figueroa, Wake Forest Medical School

Significant evidence has shown that many diseases, such as elevated glucocorticoid levels, that manifest in adulthood are related to alterations in fetal development. Antenatal betamethasone, a glucocorticoid, is used to prevent neonatal respiratory distress syndrome in preterm infants. Glucocorticoids are routinely administered to pregnant women at risk of preterm delivery. Antenatal GC treatment has been

shown to significantly increase blood pressure and vascular reactivity in sheep. Here we interpret the effect of factors such as obesity and TRP channels, which act as mediators of the response to ET-1. We interpret this finding to be the result of an upregulation of TRP channels in smooth muscle and endothelium.

Tissue Morphology of the Dorsal Crest in the Lizard Genus Anolis

Ficklin, John 2015

Authors/Contributors: Professor Matt Rand (Biology), John Ficklin, Morgan Gerace
Summer 2014

Supervisor: Professor Matt Rand (Biology)

Male lizards of the genus *Anolis* use a variety of dynamic morphological modifiers to enhance social signaling. While details of coloration and dewlap function have been described thoroughly, the morphological and physiological dynamics of dorsal crest erections have been ignored. We investigated the tissue-level mechanisms behind the erection of this structure. We examined the crests under light microscopy with and without stimulation by isoproterenol in both males and females of two anole species, *Anolis sagrei* and *Anolis carolinensis*. We hypothesized that crest erection was mediated through either subcutaneous muscle contraction or hemotumescence. Histological examination revealed no evidence of gross vascular changes or the presence of associated muscular tissue, forcing us to reject our original hypotheses. The crests appears to become erect through an increase in interstitial fluid within an encapsulated organ just under the skin. Histological examination revealed no evidence of gross vascular changes yet the crests appears to become erect through an increase in interstitial fluid within an organ just under the skin.

Generation of Resident Memory in WT And ADAP-KO CD8+ T Cells Using An In Vitro Cytokine Programming Treatment

Fireside-Ostergaard, Elly 2016

Authors/Contributors: Dr. Yoji Shimizu (University of Minnesota), Brandon Burbach, Jess Fiege
Summer 2014

Supervisor: Dr. Yoji Shimizu (University of Minnesota)

Antigen recognition by T cells drive the immune response. Different subsets of T cells exist throughout the body with varying functions. Resident memory (RM) T cells confer long term resistance to pathogens and are found in peripheral, non-lymphoid tissues. The Adhesion and Degranulation Adapter Protein (ADAP) regulates signaling pathways in adhesion events between T cells and antigen-presenting cells (APC). Previous research has shown that ADAP-knockout mice have less RM T cells than WT mice when compared 60 days after infection. We investigated the differences in RM T cell generation between WT and aKO OT-1 T cells by stimulating activated T cells in vitro with TGF-B and IL-33. We used CD103 expression, measured by flow cytometry, to judge the success of the treatment. We also examined basal CD103 expression in naive WT and aKO T cells. We found that activated WT and aKO cells responded

similarly to the cytokine treatment. Overall, basal levels of CD103 expression were slightly lower in naive aKO T cells than WT. We concluded that activated aKO cells were able to respond to the cytokine treatment and express the resident memory phenotype.

Does Flour Beetle Segmentation Depend on Oriented Cell Division?

Fisher, Jeremy 2016

Authors/Contributors: Professor Lisa Nagy (University of Arizona), Miriam Matei, Susan Hester, James Cooley, Terri Williams, Ryan Pace

Summer 2014

Supervisor: Professor Lisa Nagy (University of Arizona)

We observed a burst of mitosis during the early development of red flour beetles (*T. castaneum*) that appeared not to affect either their elongation, or the addition of segments to the animal's body. We hypothesized that this burst was unrelated to either elongation or segmentation. To test this, I worked on two projects: (1) we injected mitosis inhibiting drugs and stained for proteins known to be important to insect development; and (2) I built a computer model of this process that used only cell migration, and ignored cell division. Unfortunately, our in vivo experiments were inconclusive because of our drugs' toxicity. However, my computer model supports our hypothesis, showing that cell migration is sufficient to properly mold the shape of the embryo.

Identifying Fundamental Principles Underlying the Intersection Between Development Ethics and Climate Ethics

Flowerman, Camila 2015

Author/Contributor: Professor Laurence Cooper (Political Science)

Summer 2014

Supervisor: None

This project explores the ethical concerns that arise from the intersection between efforts to mitigate climate change and our goals of reducing poverty and inequality around the world. Specifically, I researched the relevant philosophical literature in both climate ethics and development ethics, and attempted to identify whether there were fundamental ethical principles underlying our understanding of both. I also read and considered relevant international policy in order to understand how our policy goals and expectations match up with these broader ethical principles, and how they deal with the concerns that arise from the potentially conflicting nature of environmental preservation and economic development.

Buddhism and the Spread of "Interconnectedness"

Fox, Ella 2015

Authors/Contributor: Professor Asuka Sango (Religion), Ella Fox
Summer 2014

Supervisor: Professor Asuka Sango (Religion)

The concept of "interconnectedness" is far-reaching in its global scope, but the origins and spread of this idea are strongly associated with Buddhist thought and philosophy. In order to understand where this idea may have originated, and to grasp its migration throughout history, we examined (among others) the fields of Buddhist-Christian dialogue, systems theory, eco-Buddhism, and feminist thought. Each theme was explored through articles, books, or journal and encyclopedia entries. In most cases, Buddhism played a strong role in influencing successive work on interconnectedness. Many writers who explored the theme drew on Buddhist sources to ground and deepen their own work. Generally speaking, the results show that Buddhism likely inspired or influenced (to varying degrees, of course) the way more modern and contemporary thinkers of various disciplines have explored the notion of interconnectedness.

Metabolomic Analysis of Bone Cells Using NMR Spectroscopy

Freier, Max 2016

Authors/Contributors: Dr. Bruce Hammer (University of Minnesota Twin Cities), Dr. Lou Kidder, Ph.D.
Summer 2014

Supervisor: Dr. Bruce Hammer (University of Minnesota Twin Cities)

This project examined the behavior of bone cells in several environments using metabolomics. Cell cultures were first exposed different degrees of radiation. In addition, cells were placed in a 14.4 T magnetic field at several different points to simulate varying degrees of microgravity. Afterwards, cultures were analyzed with NMR spectroscopy. NMR spectra were then profiled and binned using the Chenomx Software Suite in an attempt to determine the effects of each environment on the cells' development. Irradiated cells showed observable differences in spectra, while other samples were inconclusive.

Vole-nerable? Potential edge effects on small mammals in the Cowling Arboretum

Freymiller, Laura 2015

Authors/Contributors: Professor Daniel Hernandez (Biology), Robert Harris, Corina Perez, and Julia Reich
Summer 2014

Supervisor: Professor Daniel Hernandez (Biology)

Edge effects, caused most frequently by fragmentation by roads, agriculture, or other land use shifts, can alter ecological processes and the distribution of organisms. However, the impacts of edge effects

created by recreational trails, particularly in prairies, are unknown. We used infrared motion-sensing along trails in the restored prairies Cowling Arboretum to examine whether small mammal visitation rates was affected by distance from the edge created by recreational trails. We established 12 transects in six different planting years that recorded visitation by mammals at distances of 0, 2, 4, 8, 16, 32, and 64 m from the trail. In total, we recorded approximately 3,000 visits, including mice, voles, rabbits, thirteen-lined ground squirrels, and several species of mesopredator. We found that voles were significantly impacted by distance from trail, visiting most frequently at 8m and 16m and less frequently at 0,2,4,32 or 64m from the trail. The other most common species, thirteen-lined ground squirrels and mice, did not show significant variation in visits. Our findings suggest that trails have an impact on some small mammals in prairies.

Examining the Role of Japanese Confucian Ethics in Modern Japanese Prisons

Friedhoff, Carolyn 2017

Authors/Contributors: None

Summer 2014

Supervisor: Professor Laurence Cooper (Political Science)

This project seeks to identify a modern implication of ancient Japanese Confucian ethics. It identifies a unique phenomenon of Japanese culture- a highly ordered, stringently rule bound prison system enforced by what have been called arbitrary and draconian punishments- construed positively by the Japanese government in the face of accusations of human rights violations. It traces the intellectual history of Confucianism, from its start in China, before Confucius himself, to Japanese intellectual and political circles to identify the origin and development of Japan's values of strict social heirarchy and obedience, which contributed to the establishment of what used to be the country's prison culture.

The T: Examining the Ontology and Shifting Discourse of Trans* Narratives in American Nonfiction Cinema

Fryer, Britney 2015

Authors/Contributors: ProfessorLaska Jimsen (Cinema & Media Studies), Professor William North (History)

Summer 2013 - Ongoing

Supervisor: Professor Laska Jimsen (Cinema & Media Studies)

Trans* narratives, positive and negative, increasingly appear in American mainstream media discourse. As positive voices like Laverne Cox and Zackary Drucker have moved to the forefront of the media attention in fictional and nonfiction trans* narratives, the ontology of this trans* genre has shifted from spectacle to reclamation. Yet because queer media theory often ignores trans* representations or folds issues of gender into sexual orientations, the field of Trans* Media is largely unstudied. My research investigates and articulates the changes in trans* narratives and media structures with special attention to nonfiction American media. It combines film analysis of popular American nonfiction films, genre

studies, classic film theory, and reflexive filmmaking practices. In doing so, it sheds light on how we choose to represent groups within American media and how representations can shift from being largely negative and isolating to positive, holistic, community-centered, and multiplex narratives.

Physiological Mechanisms of Dorsal Crest Erections in Anole Lizards

Gerace, Morgan 2015

Authors/Contributors: Professor Matt Rand (Biology), John Ficklin
Summer 2014

Supervisor: Professor Matt Rand (Biology)

Male lizards erect a ridge of tissue along their backs during fights. We hypothesized that stress hormones mediated crest erection through β -adrenergic receptors. The β -agonist isoproterenol (ISO) initiated crest erections within 2-3 minutes and a β -blocker delayed, but did not inhibit induced crests. Mirror-simulated aggressive encounters, induced crest erections in a comparable timeframe. Injection of β -blocker prior to the mirror encounter inhibited crest erections, though preserved all other agonistic behaviors. Examination of the crest tissue indicated that an increase in extracellular fluid increased the tissue volume, suggesting inflammation. In separate experiments the inflammation blockers indomethacin and Na-cromolyn failed to inhibit ISO-induced crest erections. These lizards appear to use a mechanism for crest erection previously not described in a social signaling context.

St. Dominic's Church: Lived Religion in Rural Minnesota

Goldman, Sarah 2017

Authors/Contributors: Professor Shana Sippy (Religion), Carly Born, Geoffrey Goddard
Spring & Summer 2014

Supervisor: Professor Shana Sippy (Religion)

This project is a comprehensive anthropological investigation of religious life at St. Dominic's church in Northfield, Minnesota. The project aims to document how individuals perceive and practice religion. Culminating in a detailed multi-media website, this project will contribute to the larger public scholarship Religious Diversity in Minnesota Initiative, recording the histories and rich diversity of religious life and culture in Minnesota. Eventually, it will be available on the ReligionsMN.carleton.edu website. Focussing on qualitative data, on the personal stories, experiences, and traditions of church congregants, this project is situated in a precarious time and place, revealing a rich narrative about immigration, discrimination, collective impact, and community development in Northfield. The church is an amorphous institution, influenced by the individuals who have inhabited its grounds.

Life in Direct Provision: Accommodation for Asylum Seekers in Ireland

Goodman, Sarah 2015

Authors/Contributors: Professor Shana Sippy (Religion), Professor Adriana Estill (English & American Studies)

Summer 2014

Supervisor: Professor George G. Shuffelton (English)

This project explores the experiences, lifestyle, and world view of both asylum seekers and refugees living in Dublin, Ireland. In particular, it examines how Direct Provision affected the experiences of migrants living in Dublin. Direct Provision is a system of government accommodation for asylum seekers while their claims are being considered, a process that can take years. This summer, Goodman conducted field research interviewing scholars, directors of pertinent local NGOs, activists, refugees and asylum seekers. This project allowed Goodman to gauge the difficulties of integration and migration in a new national context and from within the European Union. It also highlighted how government systems of accommodation refract the experiences of migrants.

Applying Density Functional Theory to Aid Research in Synthetic Inorganic Chemistry

Green, Eliza 2015

Authors/Contributors: Professor Matt Whited (Chemistry), Professor Daniela Kohen (Chemistry), Katie Blise, Zander Deetz

Summer 2014

Supervisors: Professor Matt Whited (Chemistry); Professor Daniela Kohen (Chemistry)

Research in this Kohen-Whited Lab collaboration uses the computational method of Density Functional Theory (DFT) to probe inorganic and organometallic chemical systems of synthetic interest to the Whited Lab. This summer's main projects included development of protocols for comparisons of constitutional isomers and a written guide to essential computational chemistry for future use by the Whited Lab. I will present preliminary findings on the use of computational methods to understand unusual chemical bonding situations (such as metal-silicon multiple bonds) that are difficult to achieve synthetically.

An Investigation of Age-Position Relationships and Provenance of the Paleogene Orca Group, Chugach-Prince William Terrane, Alaska, Using U-Pb Dating of Detrital Zircons

Grimm, Bill 2015

Authors/Contributors: Professor Cameron Davidson (Geology); Dr. John Garver (Union College), Rudy Molinek (Carleton College), Eileen Alejos (Union College), Kaitlyn Suarez (Union College), Rainer Lempert (Amherst College), Elaine Young (Ohio Wesleyan University)

Summer 2014

Supervisors: Professor Cameron Davidson (Geology); Dr. John Garver (Union College)

The Upper Cretaceous to Early Tertiary Chugach-Prince William (CPW) composite terrane is exposed for approximately 2,200 km along the southern Alaskan continental margin. Understanding the tectonic evolution of the CPW terrane since its formation has been the subject of a multi-year Keck Geology Consortium study led by Cameron Davidson (Carleton College) and John Garver (Union College). I participated in field work for this project in June and July 2014. I am working on determining age-position relationships in, and commenting on the provenance of, the Paleogene Orca Group in eastern Prince William Sound, AK, using U-Pb dating of detrital zircons from coarse-grained sandstones. Samples were collected from the field and processed at Carleton College and Union College in June - September 2014. Samples will be dated using laser ablation-multicollector-inductively coupled plasma mass spectrometry (LA-MC-ICPMS) at the University of Arizona's LaserChron Center in December 2014.

Anacapa Island and the American Sublime

Guasco, Anna 2016

Author/Contributor: Professor Elizabeth McKinsey (English and American Studies)
Summer 2014 – present

Supervisor: Professor Elizabeth McKinsey (English and American Studies)

This interdisciplinary research analyzes Anacapa Island (of Channel Islands National Park) through the lens of the "American sublime." Part of Guasco's research focuses on aesthetic, nationalistic, and social constructions of the nineteenth century idea of the "sublime." Guasco is examining how the concept of the American sublime applies to Anacapa Island. Guasco's research questions are: how has Anacapa been imagined as both barren and sublime? How do the twenty-first century Channel Islands National Park and others actors reproduce and re-imagine the aesthetic idea of the American sublime? Why do perceptions and representations of Anacapa matter for the future of the island and the park? This research utilizes field observations, personal interviews with local artists, and archive research accomplished during the summer, as well as secondary literature and primary source analysis during Fall Term. Guasco will present a public lecture on her research in December at the park visitor center.

The Effect of Diet on Fatty Acid Content and Assimilation Efficiencies in *Fundulus Heteroclitus*

Hall, Alison 2015

Authors/Contributors: Supervisors: Dr. James Nelson, Dr. Amanda Spivak
Summer 2014

Supervisors: Dr. James Nelson, Dr. Amanda Spivak

Fundulus heteroclitus is a species of killifish that is abundant in Atlantic tidal marshes. Mummichogs play an important role in the ecosystem as both a secondary consumer and a prey species. Mummichogs are considered omnivores. However, a comparison of assimilation efficiency values between diets of algae, protein, and detritus has not been done before. We examined the fatty acid profile and assimilation efficiencies of mummichogs given four different diets: a protein diet of crickets, marsh detritus, naturally growing algae, and a diet consisting of mix of the three. Mummichogs that consumed cricket

are significantly longer and weigh more than mummichogs that consumed algae, detritus, or a mixed diet. Quantifying and comparing the assimilation values will help us understand the observed changes in mummichog biomass after eutrophication induced primary production changes.

Assimilation and Educational Reform: An Ethnography of Heritage Speakers of Spanish

Harb, Anthony 2015

Author/Contributor: Professor Beatriz Pariente-Beltran (Spanish)

Summer 2014 – Present

Supervisor: Professor Beatriz Pariente-Beltran (Spanish)

Heritage speakers of Spanish are people who grow up in the United States speaking Spanish at home. As a result of the rapidly growing number of Latino students in the United States, enrollment of heritage speakers of Spanish has increased in Spanish language courses in institutions of higher education. However, the vast majority of American universities do not offer courses that are designed to teach heritage speakers in the most effective way possible, as most of them are geared toward learners of Spanish as a foreign language (SFL). Through interviews I will conduct with heritage speakers enrolled in introductory Spanish language courses at Carleton College, I will write an ethnography that explores their experiences learning Spanish, identify the issues in the classroom, and attempt to understand the ways in which American universities can make language courses more productive for all of their students.

Translating Visuals: Miguel Brieva's "Welcome to the World"

Harb, Anthony 2015

Author/Contributor: Professor Palmar Alvarez-Blanco (Spanish)

Summer 2014

Supervisor: Professor Palmar Alvarez-Blanco (Spanish)

A Spanish cartoonist, Miguel Brieva, will be making an appearance at Carleton College during the Fall of 2014 to present his collection entitled "Welcome to the World." In anticipation of his arrival, I have worked with Professor Palmar Alvarez-Blanco, Margaret Pezalla-Granlund, and Laurel Bradley to organize and execute an exposition in the Gould Library. I translated the text in all twenty four of the cartoons and with the help of those mentioned above, printed, cut, framed, and hung all of the images. Since Brieva is characterized by his use of dry humor and irony, the project illuminated the challenges translation art presents, one of which was allowing the focus to be the visual while making the text understood to all audiences. The complexity of the boundaries between the images and the text in both English and Spanish spoke to the important and difficult role of a translator of not only text, but visual art.

Towards Expression of Helminth Aminoacyl-tRNA Synthetases in E. coli

Hare, Trish 2017

Authors/Contributors: Professor Joe Chihade (Chemistry), Joe Willenborg '15
Summer 2014

Supervisor: Professor Joe Chihade (Chemistry)

Helminths are parasitic worms. Helminthic infections cause several neglected tropical diseases, as designated by the World Health Organization. Most current medicines for these diseases have undesirable side effects or require extensive treatment regimes. Aminoacyl-tRNA synthetases (aaRSs) are essential enzymes that attach amino acids onto corresponding tRNAs, a crucial step in protein synthesis. aaRSs are evolutionarily divergent in animals, and differ significantly between humans and helminths. Targeting helminthic aaRSs to stop protein expression affords a potential route to kill parasitic worms without harming the human host. Through analysis of helminth genomes, previous workers identified aaRSs that differed substantially from their human homologs, and thus might serve as drug targets. Eight aaRSs were selected. DNA fragments encoding these aaRSs were synthesized by Integrated DNA Technologies. The fragments were assembled, restriction digested and ligated into the expression vector, pET28a. The resulting plasmids were transformed into E. coli. The final part of the project was done in partnership with twelve high school students taking part in the Carleton Summer Science Institute. Expression and purification of the desired proteins was assayed by gel electrophoresis. Results of the expression experiments were inconclusive. Current work is focused on improving expression methods and attempting to express additional aaRSs.

Effects of Dominant Grasses on Microbial Processes

Harris III, Robert 2017

Authors/Contributors: Professor Daniel Hernandez (Biology), Robert Harris III, Corina Perez, Laura Freymiller, Julia Reich
Summer 2014

Supervisor: Professor Daniel Hernandez (Biology)

Restoration of prairies throughout the Midwest of the United States has become a major topic of interest in recent years. The major question that has arisen is: What species should be included in restorations? In this study, we look at how dominant tall grass, *Andropogon gerardii* and *Sorghastrum nutans*, affect microbial processes. Previous studies have shown that the presence of dominant grasses can influence ecological processes. Soil cores were taken from plots with a grass treatment, a soil treatment, and a control plot. We conducted microbial enzyme assays on soil samples to evaluate the effects. The findings of this study can influence future decisions about prairie restorations.

Libet

Hellman, Abby 2016

Author/Contributor: Professor Jason Decker (Philosophy)

Summer 2014

Supervisor: Professor Jason Decker (Philosophy)

The goal of this research was to look into the intersection between neuroscience research and the concept of free will. More specifically we looked into how scientific data may bear on whether human beings are capable of having freedom of both will and action. Benjamin Libet did a very famous experiment attempting to use an EEG machine in order to map when brain waves occur in the process of making a simple decision. Many philosophers and psychologists have interpreted the results of Libet's experiments as showing that free will is "an illusion". Throughout the course of the summer we read some of Libet's original papers as well as researching subsequent responses and follow up experiments that other philosophers, psychologists, and neuroscientists have used to support and challenge Libet's work. This research is being continued this term in the form of an independent study.

Unusual Doping in VO₂ Nanowires

Hellwig, Luke 2015

Authors/Contributors: Luke Hellwig, Xingyue Peng

Summer 2014

Supervisor: Dong Yu (University of California, Davis)

I present the growth of free-standing, 100-nm-thick, vanadium dioxide (VO₂) nanowires on an unpolished quartz substrate. Device gating revealed that many of the nanowires were p-type, making us the first group to report p-type VO₂ nanowires. Resistance versus temperature measurements show an elevated insulator-to-metal phase transition region of 80 degrees C to over 125 degrees C. Scanning photocurrent microscopy showed the formation of small, separated metal domains in the nanowire, along with photocurrent spots due to band bending at the metal-semiconductor junction.

Effects of an Inflammatory Signaling Pathway on Histone Demethylase KDM5B

Hillmer, Emily 2015

Authors/Contributors: Dr. Stephanie S. Watowich (Univeristy of Texas M.D. Anderson Cancer Center);

Dr. Huiyuan Zhang (Univeristy of Texas M.D. Anderson Cancer Center)

Summer 2014

Supervisor: Dr. Stephanie S. Watowich (Univeristy of Texas M.D. Anderson Cancer Center); Dr. Huiyuan Zhang (Univeristy of Texas M.D. Anderson Cancer Center)

Epigenetic modifiers, such as histone demethylases, can regulate gene expression. Aberrant histone demethylase activity is observed in patients with Myelodysplastic Syndrome (MDS), a disorder of the

production of immune cells from hematopoietic stem cells. In innate immunity, Toll-like receptors recognize bacterial components and activate immune signaling pathways. One such pathway, the NF- κ B pathway, in conjunction with a protein called Ubc13, is thought to activate a STAT3 pathway, which may control production of histone demethylase KDM5B. Elevated Ubc13 levels are observed in patients with MDS. We sought to test whether overexpression of Ubc13 in a macrophage cell line affected KDM5B regulation. We performed RT-qPCR to assess transcription levels of KDM5B, and created a reporter construct to test the ability of STAT3 to activate the KDM5B promoter. Increased expression of KDM5B was observed 6 hours after stimulation. Additionally, STAT3, in conjunction with the cofactor C/EBP β , activated the KDM5B promoter.

Enantioselective Organocatalysis

Hodges, Connor 2015

Authors/Contributors: Professor David Alberg (Chemistry); Professor Gretchen Hofmeister (Chemistry), Katie Blise, Xiaodi Wang
Summer 2014

Supervisor: Professor David Alberg (Chemistry); Professor Gretchen Hofmeister (Chemistry)

Chiral organocatalysts provide new outlets to chiral molecules, as well as promising alternatives to otherwise environmentally damaging catalysts, or wasteful uncatalyzed reactions that give products in racemic ratios. In order to better understand how these organocatalysts yield high enantioselectivities, transition state analogues (TSAs) were prepared to study how substrate-catalyst interactions give rise to chiral products. The asymmetric desymmetrization of cyclic anhydrides is used to prepare chiral intermediates for the synthesis of natural products and potential drug candidates, and the transition state can be mimicked by hypervalent phosphonyl complexes that can interact with the organocatalysts without reacting. Research this summer was focused on developing and improving a synthetic route to a potential TSA. Insight into how the catalysts interact with substrate would provide information about how to better tailor catalyst design to specific substrates.

Printing and Binding an Artist's Book About the Dakota War

Hope, Soren 2015

Author/Contributor: Professor Fred Hagstrom (Art)
Summer 2014

Supervisor: Professor Fred Hagstrom (Art)

The Dakota War of 1862 took place in southwest Minnesota, and arose from the United States government's repeated treaty violations and extreme mistreatment of the Dakota people. This book by Fred Hagstrom, titled *When Men Are Hungry*, tells the story of the war and ultimate execution of 38 Dakota men through historical images, quotations, and narrative writing. The book was printed in letterpress and bound by hand in an edition of 36. It is 68 pages in length, with five to seven press runs on each page.

The Binary Pulsar B1913+16 and Tests of General Relativity

Huang, Yuping 2017

Author/Contributor: Professor Joel Weisberg (Physics and Astronomy)

Summer 2014

Supervisor: Professor Joel Weisberg (Physics and Astronomy)

Pulsars, known as extremely precise clocks in the universe, are fast-rotating and massive neutron stars. In the radio waveband, we can observe periodic pulses from them. B1913+16 is a pulsar orbiting around another massive neutron star. Thus the radio pulses it emits are subject to much stronger general relativistic effects. In this project, we carry on 40 years of analysis on the arrival time data of B1913+16 from the 300 meter Arecibo Observatory and perform tests of General Relativity. The results remain in good agreement with the General Relativity predictions. Additionally, the prospect of detecting the Shapiro delay, the time delay due to space-time curvature, is promising as it is predicted to have grown much larger since 2000, while the timing precision has improved to 15 microseconds.

Optofluidic Devices

Huang, Kai 2016

Author/Contributor: Professor Marty Baylor (Physics)

Summer 2014

Supervisor: Professor Marty Baylor (Physics)

Diffusive, light-sensitive polymers can be used to make optofluidics devices, such as refractometers and spectrometers that allow us to analyze fluids with light, much easier than traditional material platforms for these devices. We have successfully built a refractometer that measures the index of refraction of a fluid, but we want to expand on this work to produce spectrometer. By shining light on the polymer, we can create a fluid channel for a fluid to flow through and a waveguide to guide white light to the fluid. We can also create a grating by varying the refractive index of the polymer and divert different wavelengths to various detectors after interacting with the light. Thus we can measure the spectrum of the fluid. In this work we discuss our efforts to make a grating in our material and how we plan to integrate the grating into the spectrometer. By making the spectrometer, we hope to show that diffusive photopolymers simplify the fabrication of complex, integrated optofluidic devices enabling a wide variety of devices such as optofluidic temperature and pressure sensors and microscopes.

Quantitative analysis of Northfield air pollution using ATOFMS and SMPS-APS

Janes, Aurora 2015

Authors/Contributors: Professor Deborah Gross (Chemistry), Ernesto Polania

Summer 2014

Supervisor: Professor Deborah Gross (Chemistry)

Aerosol particles have been linked to both human health concerns and global warming. This study looked at the particles in Northfield, MN, a rural farming town 40 miles south of Minneapolis. The chemical compositions of the aerosol particles were measured using an Aerosol Time-of-Flight Mass Spectrometer (ATOFMS) and grouped into classes based on their chemical compositions. The mass concentrations of the aerosol particles were measured using a Scanning Mobility Particle Sizer (SMPS) and Aerodynamic Particle Sizer (APS) in tandem. The SMPS-APS data were used to create detection efficiency curves for the ATOFMS data. This allowed for a quantitative analysis of the chemical composition of aerosols.

Discovering Trans-Neptunian Objects with the Dark Energy Survey

Jennings, Ross 2015

Author/Contributor: Zhilu Zhang '17

Summer 2014

Supervisor: Professor David Gerdes (University of Michigan)

The Dark Energy Survey (DES) is a five-year astronomical survey intended to map the distribution of distant galaxies over a large region of the sky. Because the survey is so wide and deep, other interesting objects occasionally appear in the images. Among these are trans-Neptunian objects, large bodies composed of ice and rock that orbit the sun at distances greater than that of Neptune. With Professor David Gerdes ('86) of the University of Michigan and fellow student Zhilu Zhang ('17), I searched the data collected during DES's first season for observations of these objects. We eventually discovered six previously unknown outer solar system objects, including one whose orbital period is among the 50 longest known.

Manganese Speciation in the Broadkill River Estuary (Lewes, DE)

Jensen, Laramie 2015

Authors/Contributors: Varonique Oldham (University of Delaware, College of the Earth, Ocean and Environment); Dr. George W. Luther III (University of Delaware, College of the Earth, Ocean and Environment)

Summer 2014

Supervisor: Varonique Oldham (University of Delaware, College of the Earth, Ocean and Environment); Dr. George W. Luther III (University of Delaware, College of the Earth, Ocean and Environment)

Soluble Mn(III) represents an important intermediate in key aquatic redox cycles such as Fe, S, and O. As a one-electron oxidant and reductant, it can access a variety of chemical reactions. To date, soluble Mn(III) has been studied primarily in suboxic waters. We adapted the porphyrin spectrophotometric method of Madison et al (2011) to measure soluble Mn(III) bound to strong ligands and study the speciation of Mn in an oxic environment. From June 11th to July 30th, 2014, we found significant concentrations of soluble Mn(III), stabilized by organic ligands, ranging from 0 to 48% of total Mn in the Broadkill River Estuary. Overtime, analysis of the estuary yielded total Mn concentrations (MnT) from

250 to 800 nM. For three salinity transects of the estuary, MnT concentrations ranged from 75 to 1900 nM, and the maximum Mn(III) concentrations were found where salt marsh creeks merged with the Broadkill River Estuary indicating that humic substances likely stabilize Mn(III).

I Hear a Symphony: Listening to the Music of Motown

Jorizzo, Matt 2015

Author/Contributor: Professor Andy Flory (Music)

Summer 2014

Supervisor: Professor Andy Flory (Music)

I Hear a Symphony: Listening to the Music of Motown is a collection of essays pertaining to Motown's history and its relation to the R&B market. The book covers topics of crossover success, overseas marketing, and the creation of the signature "Motown Sound." Matt contributed in the editing process and helped to compile a bibliography and discography for the book.

Occupying Boston: An Intimate History of the Boston Massacre

Kalkowski-Farrand, Maureen 2017

Authors/Contributors: Professor Serena Zabin (History), Erin Young-Dahl, Lindsay Brandt

Spring 2014, Fall 2014

Supervisor: Professor Serena Zabin (History)

This project is a part of Professor Zabin's research for her book. The goal was to map the routes people took on the night of the Boston Massacre from depositions found in The Legal Papers of John Adams and The Short Narrative of the Horrid Massacre in Boston. By determining where people were that night, this project hopes to both clarify what happened the night of the massacre and to raise new questions about the role the massacre played in The Revolutionary War. This project uses resources such as ArcGIS, depositions from the 1770s, and a database compiled from property and marriage records to provide an accurate map of the actions and routes people took on that fateful night. Students worked in a group, using a digital map of Boston in 1770 to plot the routes and timing of people who lived through the massacre.

The Sound of Pealing Bells: The Blackfriary Community Archaeology Project as a Case Study for Religious Community and Context in Medieval Trim, Ireland

Katz, Nora 2016

Authors/Contributors: I worked alone on this research project as a student excavator at the Institute for Field Research and the Irish Archaeological Field School.

Summer 2014

Supervisor: Finola O'Carroll (Irish Archaeological Field School; Trim, County Meath, Ireland)

Geoffrey de Geneville, the Anglo-Norman Lord of Meath and a devout supporter of the Dominican mendicant order, built the Blackfriary in 1263 as an educational and political center for the medieval town of Trim. In addition to the Dominicans, the Franciscan and Augustinian religious orders coexisted in this relatively small town; all three performed parallel goals and supported the political, economic, and cultural development of Trim and its people. This poster presents the Blackfriary in its context as one of three mendicant orders in medieval Trim. The archaeological and literary evidence presented in this poster suggests that these friaries were able to coexist and thrive due to their political importance, cultural status, and religious practice.

**Through Fires and Floods: Burn Severity and Soil Recovery in Lower Fourmile Canyon, Colorado
Kaufman, Omar 2015**

Authors/Contributors: David Dethier (Williams College), William Ouimet (University of Connecticut),
Mary Savina '72 (Carleton College)
Summer 2014

Supervisor: David Dethier (Williams College); William Ouimet (University of Connecticut)

In 2010, Fourmile Canyon, Colorado experienced a large forest fire in the lower portion of the watershed. In the following three years, the canyon experienced annual, large flooding events which mobilized significant amounts of sediment and caused losses of damage. Different areas of the fire were mapped as different burn severity zones: low, moderate, or high. Through sampling soil cores within these zones and in transects across the boundaries, I evaluated whether these burn severity zones were accurately mapped by from satellite data. Using grain size analysis and loss on ignition (LOI) on the <125 micron fraction, I aim to determine how soils in different burn severity zones recover which experiencing annual flooding events.

**Housing Development in Urban Landscapes
Kern, Sondra 2015**

Author/Contributor: Lasondra Kern
Summer 2014

Supervisor: Professor Ross Elfine (Art History); Professor Baird Jarman (Art History)

After WWII, architects sought to design housing in cities that would provide sufficient shelter for a growing urban population, especially those of lower economic status. Over the years, many of these housing projects have been blamed for problems such as poverty, crime, and other anti-social behaviors associated with inner-city communities. Yet, these outcomes were in no way what the architects imagined for their planned communities. To the contrary, architects designed interconnected and multifaceted communities where the housing complexes would serve as centers of community life and foster collaboration and economic growth. My project investigates comparatively how the architects and city planners imagined the housing complexes built in Chicago, Missouri, New York, and London as healthy communities. I examine the intended design and use of these communities and explore the

factors and unanticipated conditions that led to these complexes becoming symbols not of urban vitality but of decay and dysfunction.

Role of LKB1 in the sensitivity of Non-Small Cell Lung Cancer (NSCLC) to Metformin

Khadka, Prasidda 2016

Authors/Contributors: Prasidda Khadka, Dr. Michael Asiedu (Mayo Clinic); Dr. Dennis Wigle (Mayo Clinic)
Summer 2014

Supervisor: Dr. Michael Asiedu (Mayo Clinic); Dr. Dennis Wigle (Mayo Clinic)

LKB1 is a tumor suppressor and a major upstream kinase of AMP-activated protein kinase (AMPK), which is involved in regulating energy homeostasis in cells. It is found to be mutated in about 20% of the NSCLC. In most settings, metabolic stress results in the arrest of cell growth, which is dependent upon AMPK pathway. But in the cells with mutated LKB1 pathway, metabolic stress induces rapid apoptosis. Metformin, which targets mitochondrial complex I, has been found to induce programmed cell death in these mutated NSCLC cells. We found that increase in LKB1 activity increases the resistance of NSCLC cells to metformin, while inactivation of LKB1 increases the sensitivity of NSCLC cells to metformin. Furthermore, the response to metformin is different for different cell context.

Characterization of the ORF7 Protein Involved in the Biosynthesis of ECO-0501

Kingston, Natalie 2016

Authors/Contributors: Professor Chris Calderone (Chemistry), Natalie Kingston
Summer 2014

Supervisor: Professor Chris Calderone (Chemistry)

ECO-0501 is a secondary metabolite produced by the bacteria *Amycolatopsis orientalis* that shows antibiotic properties against several broadly resistant pathogens. Using high performance liquid chromatography (HPLC) we characterized ORF7, a protein involved in the biosynthesis of ECO-0501. Due to a prior genomic scanning of the ECO-0501 biosynthetic cluster, it was predicted that ORF7 is a flavoenzyme and thus it was predicted that OR7 converts the amino acid arginine into either 4-guanidinobutyramide or 4-guanidinobutyric acid. Our results indicated that ORF7 formed neither 4-guanidinobutyramide nor 4-guanidinobutyric acid. Instead, ORF7 converts the arginine amine to a ketone. It is predicted that arginine may need to be methylated prior to interaction with ORF7.

Bragg Holography in Photopolymers via Diffusion from an External Source

Kuenstner, Stephen 2015

Authors/Contributors: Professor Bob McLeod (University of Colorado, Boulder), Josh Noble, Ben Kowalski, Darren Forman
Summer 2014

Supervisor: Professor Bob McLeod (University of Colorado, Boulder)

Bragg holograms are structures that selectively redirect beams of light based on their wavelength and angle of incidence. They can be used to create optical data storage systems, spectroscopic filters, solar concentrators, and tunable diode lasers. Bragg holograms are often created in diffusive photopolymers, which are materials that alter their index of refraction in response to light. Most photopolymers employ a two-chemistry system, where a high-index writing monomer is mixed into a low-index matrix polymer. In this research, we showed that the writing monomer can diffuse into the matrix polymer from an external source, rather than being dissolved into the matrix at the beginning of the sample preparation. Repeating this process more than once would allow holographers to pattern multiple chemical species in separate steps, or overlap more than one hologram in the same volume.

Hyphenated Experiences in the Tibetan Diaspora

Lenzey, Tenzin 2016

Author/Contributor: Professor Adriana Estill (English & American Studies)

Summer 2013-Summer 2014

Supervisor: Professor Adriana Estill (English & American Studies); Professor Bill North (History)

My research focuses on the production of exilic and diasporic literature, prose fiction and poetry written that speak about a specific cultural group in dispersion. Some topics of interest are: nostalgic and contra-nostalgic discourse, the “cultural” writer versus the “universal” writer, the use of the text as a type of “home,” and the different paradigms writers such as Mahmoud Darwish, Jhumpa Lahiri, and Achy Obejas take on issues of displacement and identity politics. This year, I am shifting focus from being mainly a reader of this literature to producing my own poetry and prose related to this topic. The larger goal of this project is to explore identity issues in the Tibetan diaspora through creative writing. This will ultimately allow for a better understanding of the state of the group historically, politically, culturally, and even spiritually.

Transient kinetic studies of post-transfer editing in Escherichia coli alanyl-tRNA synthetase

Livingston, Nate 2016

Author/Contributor: Professor Joe Chihade (Chemistry)

Spring 2014 – Ongoing

Supervisor: Dr. Christopher Francklyn (University of Vermont)

Alanyl-tRNA synthetase (AlaRS) joins its cognate amino acid substrate alanine to the 3'-terminal adenine on tRNA^{Ala} in an ATP-dependent, two-step reaction. The enzyme can also charge non-cognate serine and glycine, ultimately leading to mistranslation. AlaRS uses a separate editing domain to increase translational fidelity. Crystal structures of the AlaRS-tRNA^{Ala} complex show a large structural barrier blocking acceptor stem translocation between the catalytic and editing sites. A likelier editing mechanism requires “re-sampling” by the editing site of another AlaRS dimer. To test this model, we

produced an E. coli AlaRS editing deficient C666A mutant and an aminoacylation deficient F90A mutant. Using L[14C(U)]-Ser-tRNA^{Ala} as substrate, produced in situ with C666A AlaRS, we conducted pre-steady state experiments. The wild-type enzyme exhibited clear editing activity, but the F90A mutation unexpectedly affected both aminoacylation and editing, suggesting that disruption of ATP binding in the aminoacylation active site may inhibit post-transfer editing at a distance.

Mapping Thomas Hobbes' Journey Through the Peak District From His Poetry

Loery, Gordon 2015

Authors/Contributors: Professor Timothy Raylor (English), Wei-Hsin Fu (Environmental Studies), Hsianghui Liu-Spencer
Winter 2013

Supervisor: Professor Timothy Raylor (English)

(Written by Professor Timothy Raylor, with minor modifications by Gordon Loery) Thomas Hobbes is a famous philosopher but a neglected poet. One of his more interesting poems is *De mirabilibus pecci*, a Latin hexameter account of some 540 lines recounting a tour he took in the summer of 1628 in order to visit the Seven Wonders of the Derbyshire Peak District. I have recently written a chapter about the poem, explaining it as a Baconian natural history of the region, and working out the precise route and the location of one of its disputed Wonders. [Gordon] has worked to prepare a prototype for an electronic edition of a contemporary English translation of the poem (1678) that would allow a reader clearly to follow the tour recounted in the text on a map of the region, with annotations and illustrations.

Grasping the Gay: The Politics of Collective Identity in Pink Dot SG

Loh, Chee Leong 2016

Authors/Contributors: Yvonne Yap Ying Ying (Sociology + Liberal Studies + University Scholars Programme'17, National University of Singapore & Waseda University (joint programme))
Spring 2014

Supervisor: Dr. Manjusha Nair (Sociology, National University of Singapore)

Singapore's gay-rights rally, Pink Dot, marks a milestone within the country's history, owing to its high visibility and scope of participation. Drawing upon structuralist and collective-identity frameworks in social movements scholarship, this paper examines the structural-discursive conditions which have shaped the movement's approach towards garnering support for gay people, and discusses the shifting possibilities that Pink Dot has brought to the gay community. We demonstrate that Pink Dot is geared towards bridging conflicting conceptions of the gay persona, while shifting the articulative voices of the gay identity increasingly towards heterosexual actors, consequently altering salient aspects of the political imaginations of the gay community. We then reflect on the political possibilities that participation-oriented social movements can generate under authoritarian conditions.

Geodetic Modeling of Fault Slip Rates Near the San Bernardino Mountains

Longchamp, Max 2016

Authors/Contributors: Max Longchamp, Sally McGill (California State University, San Bernardino)
Summer 2014

Supervisor: Sally McGill (California State University, San Bernardino)

The San Andreas Fault is one of many active faults that make up the transform plate boundary between the Pacific and North American plates. Site velocities of fixed benchmarks arrived at via GPS monitoring over time in Southern California allow us to estimate the bending of the tectonic plates along each fault. Our elastic modeling assumes parallel faults and uses fault locking depths at the 95th percentile of earthquake depth along each fault modeled. It includes original data we collected from sites in the San Bernardino Mountains, as well as previously published velocities from other sites distributed along a transect perpendicular to the plate boundary. The best fitting of the 4.05 million models tested has an Eastern California Shear Zone slip sum of 14mm/yr. It estimates the San Andreas and San Jacinto faults both slipping on average 10.0mm/yr and the total slip is estimated to be 46.0mm/yr across all faults.

Characterizing soy isoflavone metabolism in the human gut

Maini Rekdal, Vayu 2015

Authors/Contributors: Vayu Maini Rekdal, Nitzan Koppel, Dr. Emily Balskus (Harvard University)
Summer 2014

Supervisor: Dr. Emily Balskus (Harvard University)

The human gastrointestinal tract harbors a large and complex microbial community that closely influences human physiology. Gut microbes can change the bioavailability and bioactivity of a vast number dietary components ingested by humans; however, the specific bacteria and enzymes involved are often unknown. Here we use bioinformatics and chemical biology methods to probe gut microbial metabolism of daidzein, an isoflavone abundant in soy foods; this transformation produces metabolites implicated in preventing a range of human diseases. We find a putative metabolic pathway that may be involved in metabolism of isoflavones. In addition, we find that this metabolism can promote growth of particular organisms, indicating that dietary transformations can carry evolutionary benefits for gut microbes. Our study not only provides novel insight into host-microbe interactions, but also sheds light on the role of gut microbes in regulating human nutrition.

Re-Mapping the Digital Divide: Technology and Information Poverty among Immigrant Communities in the U.S.

Martinez, Nayely 2016

Authors/Contributors: Professor Amy Csizmar Dalal (Computer Science)
Summer 2014

Supervisor: Professor Amy Csizmar Dalal (Computer Science)

In the past two decades, the concept of a “digital divide” has sprung up to highlight the gap in access to and knowledge of information and communication technologies due to economic and social inequalities. Among non-English speaking immigrant communities living in the U.S. in particular, lack of affordable access to learning resources in immigrants’ native language is increasing this technological divide between the digital “haves” and “have-nots” and fueling information poverty among immigrant communities in the U.S in regards to technology. Even as electronic communication tools and technologic resources — smartphones, tablets, online websites, etc. — have become more financially affordable over the past decade, the “digital divide” is quickly becoming an issue of user inaccessibility and information gaps rather than an issue of physical inaccessibility to technology. This intermediate report includes findings based on initial background research into current studies and projections of the “digital divide” in the U.S.

Challenges in Mexican Eldercare: Looking at Socioeconomic Status and Gender

Martinez, Olgaby 2016

Author/Contributor: Professor William North (Histoy)

Summer 2014

Supervisor: Professor Liz Raleigh (Sociology/Anthropology)

The elder population is a growing demographic in the United States, and with increased Latino immigration into the U.S., especially from Mexico, this population will be increasingly Latino. Thus far, scholars have focused on the impact of different levels of acculturation and education on elder care in Mexican American families. Likewise, current scholarship emphasizes familism and the emotional and physical burden in Mexican families as key components in elder caregivers’ and caretakers’ experiences. Building on these studies, my research examines two factors that have yet to be explored: the impact of gender and socioeconomic status on the provision of quality eldercare. To investigate whether gender roles and SES play an important role in Mexican-American eldercare, I will use snowball sampling, interviews, and field observation with the goal of producing an ethnography of eldercare in San Jose, CA.

Amyloid Fibrils Ameliorate Paralytic Symptoms in Animal Models of MS

Matsuda, Emily 2015

Author/Contributor: Michael P. Kurnellas, Lawrence Steinman, C. Garrison Fathman, Dr. Jonathan Rothbard (Stanford University)

Summer 2014

Supervisor: Dr. Jonathan Rothbard (Stanford University)

Amyloidogenic peptides spontaneously form fibrils resembling the extended β-pleated sheets that proteins form in a variety of neurodegenerative disorders such as Alzheimer’s disease and Multiple Sclerosis. Surprisingly, when injected into mice with experimental autoimmune encephalomyelitis (EAE),

paralytic symptoms are reduced due to the immunosuppressive activity of the fibrils. Immunosuppression occurs as a result of the induction of Type 1 interferon (JEM) and IL-10 produced by B-1a lymphocytes through the highly conserved Toll like receptor 4 (TLR4) signaling pathway.

History at Carleton: Strong House

McBride, Madison 2016

Authors/Contributors: Professor Cliff Clark (History and American Studies), Adron Mason
Summer 2014

Supervisors: Minnesota Historical Society; St. Olaf College

Reverend James W. Strong served as the first president of Carleton College. For 28 years, he lived to help students at Carleton and the greater community. His legacy still stands at his home built on the corner of 2nd and College Street. Though Strong House has undergone many changes, it has also preserved Carleton's character, creating a symbol of the school's sense of community and morality. This research is a part of an ongoing project that is funded by the Minnesota Historical Society. With the help of St. Olaf and Carleton students, staff, and faculty, we are creating an app that allows users to read specific stories about different parts of Carleton and Northfield. We hope to create a new, interactive way to learn more about local history.

Fluvial response to the Paleocene Eocene Thermal Maximum

McLellan, Katherine 2015

Auditors/Contributors: Dr. Brady Foreman (Western Washington University); Dr. David Fox (University of Minnesota)
Summer 2014

Supervisor: Dr. Brady Foreman (Western Washington University); Dr. David Fox (University of Minnesota)

The Paleocene-Eocene Thermal Maximum (PETM) was a period of global warming ca. 56 Ma. The Bighorn Basin of Northwest Wyoming likely experienced decreased precipitation and increased seasonality during this period. These changes are thought to have generated an anomalously thick and laterally extensive fluvial sheet sandstone (the "Boundary Sandstone"). This study examines the timing of the cross-basinal fluvial response to the PETM in the Bighorn Basin by comparing a new carbon isotope record to an existing record. In the new record, the Boundary Sandstone occupies the stratigraphic level of the onset of the PETM, when atmospheric pCO₂ was increasing. In an isotope record ca. 7 km to the northwest, the sandstone occurs within the PETM's main body, when pCO₂ was elevated but stable. This discrepancy sheds light on the question of whether fluvial systems respond to a climate threshold or in-phase with a changing climate.

Metallicity Analysis of the spiral galaxies in the Local Group

Mehta, Shail 2015

Authors/Contributors: Professor Cindy Blaha (Physics and Astronomy), Edgar Garcia
Summer 2014

Supervisor: Professor Cindy Blaha (Physics and Astronomy)

We present the results of the Local Group Galaxy Emission-line Survey of H- α emission regions in M31 and M33. Using data from the Local Group Galaxy Survey, we used continuum-subtracted H- α emission line images to define emission regions with a faint flux limit of 10-17 ergs-sec-1-cm-2 above the background. We have obtained photometric measurements for roughly 6500 H- α emission regions in M31 and M33. Using these regions, with boundaries defined by H- α emission flux limits, we also measured fluxes for the continuum-subtracted [OIII] and [SII] images and constructed a catalog of H- α fluxes, region sizes and [OIII]/ H- α and [SII]/ H- α line ratios. For M31 and M33, the average [SII]/ H- α and [OIII]/ H- α line ratios, plotted as a function of galactocentric radius, display a linear trend with shallow slopes consistent with other studies of metallicity gradients in these galaxies.

Using Cation to Anion Proton Transfer to Investigate Proteins in the Gas Phase

Munger, Nora 2015

Authors/Contributors: Professor Kenneth J. Laszlo (University of Washington, Dept. of Chemistry);
Professor Matthew F. Bush (University of Washington, Dept of Chemistry)
Summer 2014

Supervisor: Professor Kenneth J. Laszlo (University of Washington, Dept. of Chemistry); Professor
Matthew F. Bush (University of Washington, Dept of Chemistry)

Biomolecules adopt a variety of structural conformations that correspond to their functionality and biochemistry. Proteins, peptides, and other biomolecules are routinely studied in clinical and research settings by mass spectrometry (MS), which separates gaseous ions according to their mass-to-charge ratio and offers a fast, sensitive, and selective analytical technique. A fundamental understanding of the relationship between gas-phase charge state and ion structure applies to how biophysical science interprets MS data and design experiments. This study couples Mass Spectrometry with Ion Mobility to understand size and shape of ions. This study also used a new technique Cation to Anion Proton Transfer Reactions (CAPTR) to manipulate charge states prior to ion mobility and mass spectrometry. This study used small proteins (ubiquitin) to study the relationship between charge state and structure of gas-phase ions. We hypothesize that gas-phase ion structure relates significantly to its gas-phase charge state, rather than its solution structure.

Comparison of Pulsed Super-Continuum Laser Excitation Versus Continuous Laser Excitation of Fluorophores

Nelson, Brandon 2016

Authors/Contributors: Dr. Maria Mills (National Institutes of Health)

Summer 2014

Supervisor: Dr. Keir C. Neuman (National Institutes of Health); Dr. Maria Mills (National Institutes of Health)

TIRF (Total Internal Reflection Fluorescence) microscopy using fluorophore tags to track the movement of individual molecules is a powerful tool in studying complex biological processes. Choosing the appropriate laser source to excite these tags is no simple task as each has characteristic benefits and losses. My summer project was to create a performance comparison between standard continuous wave lasers and pulsed white light supercontinuum lasers in exciting fluorophore tags for TIRF microscopy. By tracking intensity profiles of individual fluorophores imaged by TIRF microscopy over time I was able to compare intensity outputs and photobleaching times associated with each laser excitation source. I concluded from my investigation that the white light laser's broad spectral density makes it a convenient choice for exciting fluorophores of different excitation frequencies, however the pulsed firing of the laser yields a lower output signal making it a less efficient excitation source.

Thermal Infrared Imaging (TIR) of debris surface temperature and spatial variation in melt of the debris-covered Emmons Glacier, Mt Rainier National Park, Washington

Nelson, Leah 2015

Author/Contributor: Jayne Pasternak

Summer 2014

Supervisor: Dr. Pete Moore (Iowa State University)

Emmons Glacier, located on Mount Rainier in Washington, is debris-covered in its lower third. The debris is sourced from multiple landslide events, resulting in a mix of lithologies and variable debris thicknesses. This variably thick debris layer (0 cm to 44 cm) insulates in some places, while increasing ablation in others due to variations in albedo and thermal diffusivity. Thermal infrared (TIR) imaging maps the debris surface temperature. As many debris-covered glaciers are inaccessible, TIR images taken remotely are useful in measuring the debris surface temperature, and ablation and energy balance calculations. The correlation of TIR images with directly measured surface temperature and ablation trends, could determine if TIR measurements are suitable proxies for direct measurements of the debris surface temperature.

PATCH: Refining Document Classification Through Mathematical Comparison

Newman, Grace 2015

Author/Contributor: None

Summer 2014

Supervisor: Dennis McQuerry (Pacific Northwest National Laboratory); Scott Dowson (Pacific Northwest National Laboratory)

The necessity of improving a pre-existing hierarchical classification of Department of Energy patents provided a unique challenge due to both the vague legal language of patent applications and the need to follow an established structure. In order to measure document similarity, the patents were treated as vectors with dimensions of statistically distinguishing words and entries of standardized occurrence probabilities. These vectors were then compared using mathematical notions of distance including distance covariance, Mahalanobis distance, and cosine distance. Using these metrics and an error analysis set, the existing classification was analyzed. Patents were reclassified using methods such as k nearest neighbors classification, hierarchical clustering, and iterative clustering (adapted k means). All methods were compared and analyzed, and a system relying on multiple representation is currently being implemented.

Synthesis of Aryloxo-Modified (Imido)vanadium(V)-Alkyl Complexes for the Use in Ring-Opening Metathesis Polymerization (ROMP) of Norbornene: Exploring Reaction Chemistry of Vanadium(V) Alkyls with Phenols

Ngamnithiporn, Fa 2015

Author/Contributor: Professor Kotohiro Nomura (Tokyo Metropolitan University, Tokyo, Japan)

Summer 2014

Supervisor: Professor Kotohiro Nomura (Tokyo Metropolitan University, Tokyo, Japan)

This project focuses on the synthesis and reaction chemistry of (imido)vanadium(V)-alkyl and alkylidene complexes, a new type of catalyst widely known to exhibit notable catalytic activities in ring-opening metathesis polymerization (ROMP). (Imido)vanadium(V)-trialkyls were reacted with various phenols to generate aryloxo-(imido)vanadium(V)-dialkyl complexes. All reactions were monitored by ^1H and ^{51}V NMR spectra. We found that the rate of the reaction is highly dependent on the nature of both the imido ligand and phenol used; reaction with 2,6-di-tert-butylphenol did not take place, although ordinary early transition metal alkyls are sensitive toward protic functionality. An electron-withdrawing group on the imido ligand increases the reaction rate while steric bulk in the phenoxy substituent prevents the coordination step. The synthesized complexes were subsequently used in ROMP of norbornene; $\text{V}(\text{N}-2,6\text{-Me}_2\text{C}_6\text{H}_3)\text{-(CH}_2\text{SiMe}_3)_2\text{(OC}_6\text{F}_5)$, was found to exhibit the highest catalytic activity [as measured by turnover number (TON) and turnover frequency (TOF)].

**Synthesis and Characterization of Ruthenium(II) Complexes with Hydrosilyl Pincer-Type Ligands
Nguyen, Binh 2016**

Authors/Contributors: Binh Nguyen, Professor Matt Whited (Chemistry)

Summer 2014

Supervisor: Professor Matt Whited (Chemistry)

As part of our big project to devise novel late-metal systems for cooperative small-molecule activation and catalysis, we have prepared and characterized a series of ruthenium(II) complexes with tridentate bis(phosphine)/hydrosilyl ligands. Ligands and metal complexes were synthesized in an inert atmosphere and characterized by infrared and multinuclear NMR spectroscopies as well as X-ray crystallography. Several ruthenium complexes were synthesized reproducibly and preliminary reactivity was investigated, including several processes leading to modification of the silyl donor or ruthenium center. Current efforts are directed at understanding these transformations and developing new reactivity with small molecules such as H₂ and CO₂.

**Synthesis of Ambiphilic Nickel-Silyl Complexes for Cooperative Small Molecule Activation
Olivares, Christian 2015**

Author/Contributors: Professor Matt Whited (Chemistry)

Summer 2014

Supervisor: Professor Matt Whited (Chemistry)

Multiple bonds between silicon and late transition metals (metal silylenes) are promising platforms for cooperative small molecule activation due to the combination of strong σ - and weak π -bonding leading to highly reactive, adjacent Lewis-acidic and -basic sites. We have prepared several nickel silyl species stabilized by tridentate pincer ligands as possible precursors to reactive silylenes and useful precatalysts for a variety of transformations. Our recent results regarding the formation and reactivity of these complexes, including the role of base in promoting hydrosilyl versus halosilyl formation, will be presented. We will also present preliminary results toward abstracting the halide from nickel as well as abstracting the hydride from silicon in order to reach the nickel silylenes.

**Platinum Extended Linear Chain Materials
Oliver, Devin 2015**

Authors/Contributors: Devin Oliver, Peter Downie, Professor Steve Drew (Chemistry)

Summer 2014

Supervisor: Professor Steve Drew (Chemistry)

Vapochromic Platinum (II) extended linear chain materials are self-assembling crystalline materials that selectively uptake gases, resulting in a change of crystal color. This makes them ideal sensors. Professor Drew's research aims to create a Platinum (II) extended linear chain material that would serve as a

sensor for benzene gas, a known carcinogen and common byproduct of petrochemical industries and combustion engines. Past groups have investigated the benzene sensing properties of the n-Butyl and tert-Butyl derivatives of cis-Pt(CN)₂(CNC₃H₇)₂, but since neither compound exhibited a color change both reliably and reversibly, the search continues for a more ideal sensor. This summer we focused on synthesizing the iso-Butyl derivative of cis-Pt(CN)₂(CNC₃H₇)₂, with the eventual aim of determining its benzene sensing capabilities.

Explorations in Greece and Washington: Archaeology, Geophysics, and Glaciers

Pasternak, Jayne 2015

Authors/Contributors: Professor Mary Savina '72(Geology), Professor Nancy Willkie (Classics)

Summer 2014

Supervisor: Professor Mary Savina '72(Geology)

I reviewed and summarized the results of geophysical surveys (magnetic susceptibility and electrical resistivity) that were conducted in the summers of 1988, 1989, and 1993 at eighteen archaeological sites in the nomos (county) of Grevena, Greece. This preliminary work at Professor Mary Savina's side continues to develop into my senior comprehensive project. I intend to more closely examine three of those archaeological sites, focusing on the role that the results of geophysical surveying can play in answering questions of human history in the region, particularly when considered within the greater context of all relevant data (geomorphological, soils, archaeological, etc.) collected at each site. I also spent three weeks as a field assistant to Carleton alum Peter Moore '98 (Iowa State University), collecting ablation rate and temperature data on the debris-covered Emmons Glacier of the northeastern slope of Mt. Rainier, WA. Ablation (melt) of debris-covered glaciers is of particular interest when considering paleo- and modern climate change.

The effects of rock type and landscape position on solution chemistry of soils in the Biosphere 2 Desert Site of the Santa Catalina Mountains Critical Zone Observatory

Penprase, Shanti 2016

Authors/Contributors: Shanti Penprase, Nate Abramson (Department of Hydrology, University of Arizona), Kelsie Lasharr (Department of Soil, Water and Environmental Science, University of Arizona), Dr. Jon Chorover (Department of Soil, Water and Environmental Science, University of Arizona)

Summer 2014

Supervisors: Nate Abramson (Department of Hydrology, University of Arizona); Kelsie Lasharr (Department of Soil, Water and Environmental Science, University of Arizona); Dr. Jon Chorover (Department of Soil, Water and Environmental Science, University of Arizona)

The interaction of soil water with surrounding rock plays a crucial role in determining the chemical composition of biogeological systems. However, how and why soil pore water chemistry fluctuates based on localized conditions such as rock type and landscape position is not fully understood. This

study examines the role these two factors play in altering soil water chemistry by analyzing samples collected from schist and granite field sites within the Biosphere 2 Desert Site of the Santa Catalina Mountains Critical Zone Observatory. We hypothesized that soil water from the schist site would have higher solute concentrations because schist is more susceptible to chemical erosion. We also hypothesized that soil water from convergent positions would have higher solute concentrations than divergent positions due to a longer upgradient flow path. An analysis of major and trace cations, anions, pH, and organic and inorganic carbon for each sample proved consistent with these hypotheses.

Dominant Grasses and Species Richness in Restored Prairies

Perez, Corina 2015

Author/Contributors: Corina Perez, Laura Freymiller, Robert Harris, Julia Reich, Professor Daniel Hernandez (Biology); Professor Mark McKone (Biology)

Summer 2014

Supervisors: Professor Daniel Hernandez (Biology); Professor Mark McKone (Biology)

Restored prairies are dominated by C4 grasses and have lower diversity than native remnant prairies. Although the mechanism behind grass dominance is unknown, it is thought that changes in the microbial community as a result of agricultural conversion persist even after the prairie is restored. We examined the effects of grass dominance and microbial community inoculation from native prairie remnants on plant community composition in a long term restoration experiment. The experimental design consisted of 48 plots in which dominant C4 grasses (*Andropogon gerardii* and *Sorghastrum nutans*) and soil microbe inoculants from native prairies were either excluded or added. Insight on the effect of dominant C4 grasses on subordinate species and species richness can inform management practices for restored prairies.

Developing Methods to Explore Trophic Linkages Between Phytoplankton and Salmon Prey in the Columbia River

Peterson, Liza 2016

Author/Contributor: Claudia Tausz, MS student (Oregon Health and Science University)

Summer 2014

Supervisors: Dr. Tawnya Peterson (Oregon Health and Science University); Dr. Joseph Needoba (Oregon Health and Science University)

Since the installation of dams in the Columbia River, there has been a drastic reduction in salmon populations. Due to their importance to the ecosystem, this decline has prompted monitoring programs to increase populations of these endangered salmon. My project this summer focused on trying to understand if dams caused a shift from a macro-detritus based food web to a phytoplankton based food web. I developed two methods for examining the gut contents of Chironomids, which contribute to 65% of the juvenile salmon diet, and determined Chironomid dependence on phytoplankton as a food source. Nitric acid digestion is demonstrated as a viable method for qualitative observation of

Chironomid gut contents. Genetic analysis of Chironomid guts is promising but requires further optimization.

Progress Towards Controlling Quantum Chaos

Pokharel, Bibek 2015

Author/Contributor: Professor Arjendu Pattanayak (Physics)

Summer 2014

Supervisor: Professor Arjendu Pattanayak (Physics)

The aim is to control the chaotic behavior of quantum trajectories of an open quantum non-linear oscillator. Ott-Grebogi-Yorke protocol allows feedback control of classically chaotic trajectories and we have achieved control of a classical non-linear oscillator using this method. We have further reproduced the semi-classical approximation of the quantum-trajectories using stochastic differential equations. We are exploring where the semiclassical approximation is quantitatively valid so that we can use it to estimate the feedback needed to control the quantum system.

Aerosol Chemistry in Northfield

Polania-Gonzalez, Ernesto 2017

Authors/Contributors: Ernesto Polania-Gonzalez, Aurora N. Janes

Summer 2014

Supervisor: Professor Deborah S. Gross (Chemistry)

This project explores a comprehensive understanding of the chemical composition of the aerosols present in Northfield, MN using an Aerosol Time-of-Flight Mass Spectrometer (Gromit). An ATOFMS samples particles directly from the air and generates a mass spectrum. To analyze the data, we clustered the particle mass spectra by minimizing the Euclidean distance between the particles using the program Enchilada. We determined the cluster source by comparing with commonly known peaks and online weather data.

Solar Irradiance Forecasting Based on the National Digital Forecast Database Guidance

Polasky, Drew 2015

Author/Contributor: Dr. Randall Ellingson

Summer 2014

Supervisor: University of Toledo

We report on the development of a medium-term solar-irradiance forecast model, based off of data from the National Digital Forecast Database (NDFD). Using the predicted values of sky cover, dew point, and temperature as inputs we created empirical and semi-empirical models for predicting irradiance up to 51 hours in advance. Validation against ground measured irradiance values has shown moderately

good correlations for both of our models. However, while well correlated, the variability in the measured irradiance values is poorly captured in the models, and leads to limited forecast viability.

Novel Reaction Pathways for Rhodium(I) Silylamides

Qiu, Lisa 2016

Authors/Contributors: Professor Matthew T. Whited (Chemistry), Alex J. Kosanovich, and Daron E. Janzen
Summer 2014

Supervisor: Professor Matthew T. Whited (Chemistry)

Metal amide complexes, which contain a covalent metal-nitrogen single bond, often give interesting reactivity and have great potential in catalysis. For this project, we are interested in exploring the reactivity of silylamides with stable molecules such as CO₂, CS₂, and CO, since the silicon-nitrogen bond provides an additional reactive unit to the metal amide. We have successfully synthesized a rhodium(I) silylamide complex that is supported by a sterically bulky and electron donating diphosphine ligand and have shown that it can cleave strong carbon-element double and triple bonds in heteroallenes (e.g., CO₂) and carbon monoxide. We will present this series of new and unusual reactions as well as mechanistic studies detailing how they occur.

Religious Diversity in Minnesota Initiative: Faribault High School

Ragde, Zuki 2016

Author/Contributor: Professor Shana Sippy (Religion)
Summer 2014

Supervisor: Professor Shana Sippy (Religion)

This project explores the nuances of Minnesota's complex religious landscape coupled with the challenges of public scholarship in a web-based format. Ragde focused on structuring and synthesizing fieldwork-based projects on the Somali Muslim community of Faribault High School, with an emphasis on issues of First Amendment Rights, religion and public education, and prayer in a secular context. In addition, questions about how to engage community partners and the greater public through online technology were explored in collaboration with academic technologists, including navigation, organization, and accessibility.

Characterization of the Unusual Emission of Pulsar J0901-4624 Using Data from the Parkes, Australia 64-meter Radio Telescope

Raithel, Carolyn 2015

Authors/Contributors: Dr. Simon Johnston, Dr. Matthew Kerr and Dr. Ryan Shannon (Australia Telescope National Facility)

Summer 2014

Supervisors: Dr. Simon Johnston and Dr. Ryan Shannon (Australia Telescope National Facility)

Pulsars are small, extremely dense, rapidly spinning neutron stars. Almost all information that we have on pulsars comes from the radio signals they sweep across the Earth as frequently as hundreds of times per second. These pulses are constant when integrated over long timescales but vary considerably at the single pulse level. Despite intensive study over the last several decades, little is known about how pulsars actually produce these signals or what causes the single pulse variations. This project studied the single pulses of PSR J0901-4624, which were observed to vary sporadically in intensity. We found that the flux of 0.5% of the pulses exceeded the average pulse flux by over five times. These bright pulses do not fit current models of variable emission. Examples of unusual emission allow us to better probe the plasma environment of the pulsar and to ultimately gain a better understanding of the pulsar emission mechanism.

Moral Baseline for NPC's

Raph, Zach 2016

Author/Contributor: Professor Sarah Jansen (Philosophy)

Summer 2014

Supervisor: Professor Sarah Jansen (Philosophy)

Working from a Kantian moral starting point, I combine theories of immersion with theories related to how we engage with are in order to find what the moral worth of NPCs are. Ultimately I concluded that we do owe consideration to NPCs as moral beings, but that amount is far less than that we owe to more traditional rational beings (humans and higher order animals).

Online Information Behaviors During Disaster Events: Roles, Routines, and Reactions

Reeder, Harrison 2015

Author/Contributor: Harrison Reeder

Summer 2014

Supervisors: Dr. Tyler H. McCormick (University of Washington); Dr. Emma S. Spiro (University of Washington)

Social media and Internet-based messaging are increasingly important platforms for risk communication. A global audience turns to these tools to seek, and disseminate time-sensitive, event information during periods of crisis. Moreover, emergency responders report adopting these tools to augment their typical public information functions. Here, we use unsupervised machine learning methods and text analysis to explore online communications of state and Federal emergency management-related organizations over a 15 month period. We compare communication during routine, non-event periods with communication during disaster events in order to evaluate differences

in the roles these organizations play. Findings indicate that communications from organizations align based on functional roles during routine situations, but during crisis events communication strategies converge on a mutual objective.

**Technique for Developing Accurate, Inexpensive Bathymetric Maps on Shallow Bodies of Water
Reeves, Ian 2015**

Author/Contributor: Professor Mary Savina '72 (Geology), Clint Cowan (Geology), Wei-Hsin Fu (Environmental Studies)

Summer 2014

Supervisor: Professor Mary Savina '72 (Geology)

In the summer of 2014, I developed an inexpensive technique for creating bathymetric maps on small and shallow bodies of water. This technique combines the use of a commercial fishfinder sonar device with integrated GPS and ArcMap GIS software to produce highly accurate bathymetric maps at a low cost. I applied this methodology to two stormwater retention ponds in Northfield MN. A cross section measured by hand with a telescoping rod confirmed the water depths measured by sonar within 20 cm. Sonar results suggest specific sedimentary and geomorphic features, and these features have been confirmed by sediment cores. This methodology can be especially useful for shallow water bathymetric studies with limited resources.

**Microbial Response to Flooding, Nitrogen Deposition, and Invasive Species Presence in the Upper
Mississippi River Floodplain, La Crosse, WI**

Reich, Julia 2015

Authors/Contributors: Professor Daniel Hernandez (Biology), Laura Freymiller, Corina Perez, Robert Harris III

Summer 2014

Supervisors: Professor Daniel Hernandez (Biology); Nathan DeJager (USGS); Whitney Swanson (University of Wisconsin - La Crosse)

Floods associated with rapid, early snowmelt from increasingly warmer winters and springs along with agricultural land use change alter nutrient deposition and biotic interactions, especially in floodplain ecosystems. I measured extracellular enzyme activity in the Upper Mississippi River floodplain in La Crosse, WI. Plots were arranged to investigate common anthropogenic impacts (flooding, invasive species presence, and nitrogen deposition) along an elevation gradient. Plots were split into two vegetation types (silver maple forest invaded by *Phalaris arundinacea* vs. non-invaded silver maple forest) and nitrogen deposition treatments (NH_4NO_3 fertilized vs. control). Soil samples were collected monthly July-September 2014 and assays were run on six carbon, nitrogen, and phosphorus-acquiring enzymes. Microbes and the enzymes they produce catalyze the initial rate-limiting step of decomposition and nutrient mineralization in their surrounding environments. Therefore, understanding

how anthropogenic influences affect microbial activity is key in predicting how nutrient cycling and decomposition will affect ecosystems as a whole.

Algo es Algo: Locals Support Medical Voluntourism in Guatemala

Rodriguez, Luisa 2016

Authors/Contributors: Professor Jay Levi (Anthropology), Professor Constanza Ocampo-Raeder (Anthropology)

Summer 2014

Supervisor: Professor Jay Levi (Anthropology)

In medical voluntourism, in which students travel to developing countries to volunteer in medical settings. As it grows more popular and becomes an industry, scholars have documented and criticized the questionable motives and practices of the volunteers. These studies focus primarily on the perspective of the volunteers and consistently neglect that of the local population which is directly affected by the voluntourism. Through interviews and participant observation conducted in Ciudad Vieja, Guatemala, I investigated the perceptions of medical voluntourism by its beneficiaries. Contrary to assertions constructed in the literature, beneficiaries expressed a high degree of support for the voluntourists, reporting that more benefits than losses derived from the voluntourism. This suggests a need for a more nuanced discussion of the degree to which medical voluntourism is acceptable.

A Simplified Expression for Calculating the Gravitational Field of a Cylinder Through Numerical Integration

Rohde, Max 2017

Author/Contributor: Professor Bill Titus (Physics)

Summer 2014

Supervisor: Professor Bill Titus (Physics)

Calculating the gravitational field of three-dimensional objects is an important computation in physics and geophysics. Applications include using test masses to measure the universal gravitational constant and using gravimetric data to infer mass densities below the surface of the earth by solving the inverse problem. We consider the case of a semi-infinite cylinder with constant mass density and derive numerical results for the radial and vertical fields through surface integration. The case for the finite cylinder is then obtained through superposition. Our integrands are composed of elementary functions and thus are a simplification over past expressions in the literature. We compare our expressions to others in the literature with regard to accuracy, computational speed, and range of applicability, and find that they are comparatively effective in all three measures.

Floating Treatment Wetlands: Viability as a Best Management Practice for Lyman Lakes & the Spring Creek Watershed

Salberg, Lauren 2015

Author/Contributor: Professor Mary Savina '72 (Geology)

Summer 2014

Supervisor: Professor Mary Savina '72 (Geology)

Floating Treatment Wetlands (FTWs) are man-made structures that mimic natural wetland processes and have gained recent attention for their function as an environmentally friendly water pollution management solution. For instance, these structures have been known to reduce concentrations of total nitrogen up to 87% (Floating Islands International, 2011). Lyman Lakes have been the subject of study for a number of years due to high concentrations of nitrates, phosphates, turbidity and algal mats. These man-made lakes are primarily sourced by Spring Creek, a watershed that covers an area of 6,660 acres in southern Minnesota, running through a variety of domains including agricultural, urban and recreational land, picking up various nutrients and sediments along the way (Kruggel, 2013). This study will examine the feasibility of installing a FTW in Lyman Lakes in order to improve water quality taking into consideration the health of the watershed, cost and aesthetics.

Intimate Transgressions at the U.S/Mexico Border: Identity Practices, Queer Space and Militarism

Sanchez, Victoria 2015

Author/Contributor: Victoria Sanchez

Summer 2014

Supervisor: Professor Adriana Estill (English and American Studies)

In post Anzaldúan Chicano/a literature, Mexican-American writers such as Ana Castillo and Cherrie Moraga, began to incorporate Gloria Anzaldúa's metaphor of the borderlands to expand the notion of intersectionality, which reflected the daily reality of negotiating social, religious, linguistic, and cultural spaces, but failed to take into account the gendered and sexual dimensions of those spaces. Using Chicano/a literary aesthetics as the underlying groundwork for my ethnographic fieldwork, my research seeks to examine the relationship between the lived experiences of queer, sexually non-conforming Chicano/as in El Paso, Texas and the militarization of the United States border. My research seeks to advance discussions of Latino/a gender and sexuality by not only inserting their narratives into social science research, but also by showing how specific geographies of sexuality intersect with institutional and historical formations at highly militarized zones. Drawing off of the in-depth interviews I conducted with 14 sexually non-conforming Mexican-American men and women ages 18-50, I explore the following question: How has the U.S/Mexico border become more militarized post 9/11 and how do the material and ideological manifestations of militarism structure the lives of vulnerable bodies such as queer (LGBTQI) Latino/as in El Paso?

Daily Life in Indaw Village, Burma

Sang, Peter 2017

Authors/Contributors: Professor Tun Myint (Political Science), Anna Schmiel, Jackson Bahn, Kathryn Phillips, Nick Lorenz
Summer 2014

Supervisor: Professor Tun Myint (Political Science)

The purpose of this research was to document daily life in Indaw Village, Burma, and to see to what extent the state influences rural life. Throughout the course of our 6-week research, we discovered that many aspects of the rural life are not influenced by the state. However, we noticed the presence of the state through education and religion. Our documentation includes written notes, pictures, and videos concerning aspects of daily life in Indaw. We also conducted interviews with certain members of the village asking them about their daily life in terms of agriculture, religion, food, community, and education.

Daily Life in Indaw Village, Burma

Schmiel, Anna 2017

Authors/Contributors: Professor Tun Myint (Political Science), Peter Sang, Jackson Bahn, Kathryn Phillips, Nick Lorenz
Summer 2014

Supervisor: Professor Tun Myint (Political Science)

The purpose of this research was to document daily life in Indaw Village, Burma, and to see to what extent the state influences rural life. Throughout the course of our 6-week research, we discovered that most aspects of rural life are not influenced by the state. However, we noticed the presence of the state through education and religion. Our documentation includes written notes, pictures, and videos concerning all aspects of daily life in Indaw. We also conducted interviews with certain members of the village asking them about their daily lives in terms of agriculture, religion, food, community, and education.

UNC-4 and Hox Transcription Factors Interact to Influence Identity of Sex-Specific Neurons

Schmitt, Georgia 2017

Authors/Contributors: Georgia Schmitt, Terese Nelson, Emily Kolenbrander, Professor Jennifer Wolff (Biology Department)
Summer 2014

Supervisor: Professor Jennifer Wolff (Biology Department)

The ventral cord neurons of *Caenorhabditis elegans* nematodes are sexually dimorphic. Previous work in our lab has demonstrated that loss of the transcription factor UNC-4 causes hermaphrodites to express

a male-specific marker in their ventral cord neurons, suggesting that UNC-4 is involved in sex-specific development. Additional experiments indicated an interaction between UNC-4 and the Hox patterning genes *mab-5* and *lin-39*. Using fluorescence microscopy, we are examining the role of UNC-4 and its interactions with *lin-39* and *mab-5*, looking specifically to characterize ways in which changes in UNC-4 expression alter the sexual fate of the ventral cord neurons in different genetic contexts.

Crystallization and Cooling History of Sanak-Baranof Belt Plutons of Southwest Alaska Schneider, Emma 2015

Authors/Contributors: : Professor Cameron Davidson (Geology); Dr. Peter Reiners (University of Arizona), Stuart Thomson, Sidney Hemming, Uttam Chowdhury, Erin Abel, Alexis Ault
Summer 2014

Supervisor: Professor Cameron Davidson (Geology); Dr. Peter Reiners (University of Arizona)

The unusual location of plutons in the Sanak-Baranof belt of the Chugach-Prince William terrane are emplaced in an accretionary wedge due to forearc magmatism that occurred between 61-50 Ma along the along the Pacific margin, most likely due to subduction of a mid-ocean ridge. I processed samples from seven of these plutons and collected U-Pb Zircon and (U-Th)/He Zircon and Apatite dates. The crystallization dates followed the established younging trend eastward along the Pacific margin, supporting the hypothesis a migration of a triple junction. The (U-Th)/He Apatite dates show evidence of exhumation from 6.08-3.34 Ma in the east. The (U-Th)/He Zircon dates show that plutons in the west cooled earlier and more slowly than eastern plutons.

Baseline Performance of a Home Wireless Network Testbed Shack, Emily 2015

Authors/Contributors: Professor Amy Csizmar-Dalal (Computer Science), Yanshan Guo
Summer 2014

Supervisor: Professor Amy Csizmar-Dalal (Computer Science)

Self-healing networks, or computer networks that can detect existing or potential pathologies and mitigate them with minimal human intervention, are particularly attractive in the home networking space, as home networks are heterogeneous and are typically configured and maintained by non-experts. Home networks greatly benefit from the ability to independently detect and mitigate issues with minimal user intervention. In this work in progress, we propose a proactive framework for a self-healing home network that detects and mitigates network pathologies that may lead to reduced application QoE. Our current software collects both application-level and network-level data from the home network. We also have performed extensive baseline testing with the goal of establishing guidelines for assessing the current “health” of the home network. Future work will apply a set of heuristics to determine the best course of action to take when presented with a set of network conditions.

Experimental Precipitation of Apatite as Liesegang Bands Associated With Microbial EPS

Sheline, Erica 2015

Authors/Contributors: Chris Crosby and Dr. Jake Bailey - University of Minnesota

Summer 2014

Supervisor: Chris Crosby (University of Minnesota)

Multiple lines of evidence indicate microbial influence on the precipitation of marine apatite. We studied apatite precipitation in a two double diffusion setups with ion solutions of the stoichiometry of fluorapatite. Liesegang bands (L-bands) are a precipitation feature observed in such systems due to the interactions of diffusing ion fronts. One setup included a string of microbial extrapolymeric substance, EPS, running the length of the gelatin plug. After 13 days, we analyzed mineralogy by XRD, morphology by ESEM, and chemistry by EDS. We conclude that: 1) L-banding impacts the density of, and possibly the structural morphology of, apatites precipitated on EPS; and 2) the presence of EPS may impact ion concentrations of the moving front, leading to differences in the precipitates of the second L-band.

Effect of heat stress on *Arabidopsis thaliana* root development

Shrestha, Sofia 2015

Authors/Contributors: Sofia Shrestha, Tom Felton, Andy Rodgers, and Professor Jalean Petricka (Biology)

Summer 2014

Supervisor: Professor Jalean Petricka (Biology)

To survive and reproduce, plants must respond to environmental changes, such as increasing global temperatures. *Arabidopsis thaliana* is a widely-used model organism for the study of plant development and environmental response. To investigate the effect of heat stress on root development in *A. thaliana*, Columbia ecotype plants were exposed to varying lengths of heat stress to determine the time point where basal heat shock caused a significant phenotypic effect on primary root development and lateral root production. Cellular changes resulting from this heat stress exposure were then examined in primary roots by staining with crystal violet and evaluating developmental zones by microscopy. Our characterization of root development in response to heat stress will facilitate a screen of an EMS mutagenized plant population for potential thermo tolerant mutants and elucidation of the molecular pathways underlying heat stress in *A. thaliana* roots, which might foster future engineering of heat-tolerant crops.

Function of novel transcription factor B15 in Wnt signaling pathway

Shui, Bing 2016

Authors/Contributors: Bing Shui, Harvard Stem Cell Institute: Willy Lensch, Bill Anderson, Maureen Herrmann; Boston Children's Hospital: Xi He, Seong-Moon Cheong, Yannik Regimbald-Dumas, Maorong Chen, Yinyuan Wu, Bryan Macdonald, Xinjun Zhang, Rongyang Dai, Jieqiong Tan; Dr. Xi He (Boston Children's Hospital, Harvard Medical School)

Summer 2014

Supervisor: Dr. Xi He (Boston Children's Hospital, Harvard Medical School)

Wnt signaling pathway is one of the most important signaling pathways that regulate cell proliferation and differentiation. Based on functional screening, Wnt signaling pathway appeared to be regulated by transcription factor B15. With a knockdown of B15 in colorectal cancer cells, cell proliferation was inhibited. My project mainly focused on using virus introduce B15 overexpression in cell culture and organoid culture to test if rescue assay can be accomplished.

Phase Transition Effects of Pd(acacCN)₂Ag(MeOH)ClO₄ and Pd(acacCN)₂Ag(MeOH)BF₄
Si, Runze 2015

Authors/Contributors: Runze Si, Professor Ullrich Englert (RWTH Aachen University), Mrs. Qianqian Guo (RWTH Aachen University)

Summer 2014

Supervisor: Professor Ullrich Englert (RWTH Aachen University); Mrs. Qianqian Guo (RWTH Aachen University)

This project focused on the phase transition effects of coordination polymers Pd(acacCN)₂Ag(MeOH)ClO₄ [acetylacetonate] and Pd(acacCN)₂Ag(MeOH)BF₄. Ligand HacacCN and building blocks Pd(acacCN)₂ were first synthesized. AgClO₄ and AgBF₄ were then used to synthesize the coordinate polymers. Single-crystal x-ray diffraction techniques were used to characterize these coordination polymers and to measure the phase transition temperatures. The phase transition temperature of Pd(acacCN)₂Ag(MeOH)ClO₄ was determined to be 198K while that of Pd(acacCN)₂Ag(MeOH)BF₄ was determined to be between 220K and 225K. Synthesis of a coordination polymer containing both silver salts was attempted. Infrared spectra and powdered x-ray diffraction techniques were used to characterize the product. Future work will involve manipulating phase transition temperatures by varying the proportion of the two silver salts and replicating the experiment using nickel instead of palladium.

The Molecular Basis of Brain Aging
Si, Runze 2015

Authors/Contributors: Runze Si, Dr. Jing Bi (Liaoning Medical University)

Winter 2014

Supervisor: Dr. Jing Bi (Liaoning Medical University)

Previous studies focused on specific diseases. The overall goal of the project was to examine the implications of one key neurotransmitter in the process of brain aging. Preparatory work was done in the preliminary portion of the project to set the stage for later studies. Brain from rats of 3, 6, 9, 15, 18, and 24 months old were isolated and extracted. Hematoxylin and eosin (HE) stain technique was used to study the change in nuclei distribution. Nissl stain and western blot techniques were used to study the concentrations and distributions of Nissl bodies and proteins among the various rats. The data would

later be used as control groups to compare the concentration and distribution of the implicated neurotransmitter in the brain aging process. Upon request from the research group, I cannot name the specific neurotransmitter under study.

**Analysis of Lipid Compositions in Interventions and in Typical US Background Diets for the Neuroimaging Omega-3 Reward in Adults with ADHD (NORAA) Trial
Silverman, Pombie 2017**

Authors/ Contributors: None

Summer 2014

Supervisor: Dr. Joseph Hibblen (National Institutes of Health)

The purpose of this study was to determine the effects of omega-3 fatty acid dietary intervention on ventral striatal activation in adults with Attention Deficit Hyperactivity Disorder (ADHD) by measuring BOLD activation through the use of fMRI. In July, Silverman was responsible for testing the fatty acid profile in intervention agents through the use of Folch extractions and the LePage and Roy method. Human subjects were then introduced into the research trial starting in August 2014.

**Conducting time-dependent psycholinguistics research with Amazon Mechanical Turk
Slote, Joseph 2016**

Authors/Contributors: Joseph Slote, Professor Julia Strand (Psychology)

Summer 2014

Supervisor: Professor Julia Strand (Psychology)

Amazon Mechanical Turk (AMT) is a global online labor market for short tasks. Due to its distinct advantages in participant availability, diversity, and cost, social scientists have begun to explore the viability of using AMT as a research platform. An important part of that exploration is determining whether online experiments can support methodologies that require robust timing capabilities. Prior research has suggested that browser-native timing could result in faithful replication of classic psycholinguistics results, but the question has yet to be directly addressed. Using a cutting-edge timing mechanism provided by the Web Audio API, the present study successfully replicated classic phenomena in spoken word recognition. These include frequency and phonological neighbor effects as well as identification and lexical decision accuracies as measured in a parallel in-lab study.

**Mast Flowering in Multiple Species in a Native Prairie Remnant
Smirnoff, Dimitri 2015**

Authors/Contributors: Dimitri Smirnoff, Professor Mark McKone (Biology)
Summer 2014

Supervisor: Professor Mark McKone (Biology)

We have been monitoring annual flowering rate in six prairie species 2001. We found that flowering was highly variable among years within sites, but not synchronized between sites less than 250m apart. Fire played a role in some but not all cases. Such asynchrony on a small spatial scale is relevant to evaluating competing hypothesis for the adaptive advantage of mast flowering.

**Executive Functioning Interventions for Children Raised in Foreign Orphanages
Somppi, Laura 2017**

Authors/Contributors: Laura Somppi, Dr. Megan R Gunnar, Elisa Esposito, Meg Bale, Bonny Donzella, Natalie Ottum, and Colleen Doyle
Summer 2014

Supervisor: Elisa Esposito (University of Minnesota, Institute of Child Development)

Due to the poor conditions of certain foreign orphanages, children in these institutions may suffer developmental delays. For example, post-institutionalized children often exhibit deficits in executive functioning skills. These skills help children focus and hold their attention, a skill valuable both in the classroom and life. Although little research has been conducted with this population, the International Adoption Project of the University of Minnesota is currently conducting several neurobehavioral developmental interventions with post-institutionalized children in order to ascertain if these attention training programs can help post-institutionalized children improve executive functioning skills at the neurological and behavioral level. I conducted post-intervention executive functioning tests as part of a larger study in which we measured children's progress with EEGs from pre- and post-intervention event-related potential (ERP) attention tests and parent behavior questionnaires. I also helped in the ERP data abstraction process, and results from the ~170 participant study are expected in Spring 2015.

Analyzing the Efficiency of Imaging in Diagnosing Pediatric Cervical Spinal Injuries in a Level 1 Trauma Center

Somppi, Laura 2017

Authors/Contributors: Laura Somppi, Dr. Anupam Kharbanda '93 (Children's Hospitals and Clinics of Minnesota)
Summer 2014

Supervisor: Dr. Anupam Kharbanda '93 (Children's Hospitals and Clinics of Minnesota)

Pediatric Cervical Spine Injuries (CSIs) are rare injuries which are difficult to diagnose. However, pediatric CSIs have high morbidity rate, with many resulting in death or neurological deficits. Suspected CSIs are often x-rayed first; however, due to cervical x-ray's poor sensitivity, ED physicians often obtain cervical CTs as well. During these scans, the thyroid gland receives a dose of radiation that has been shown to increase rates of hard tissue cancer in pediatric patients, and this radiation has been attributed to 10-70 new cancer cases per 10 000 scans. Given this information, I analyzed Children's Hospitals and Clinics of Minnesota's Minneapolis pediatric Level 1 Trauma Center's CSI prevalence in the pediatric trauma population and compared this rate with imaging rates intended to diagnose these injuries. With this information, I intend to provide clinicians with concrete information with which to compare the risks of cervical CT radiation against the risk of a CSI.

"Dirty Feet": How Thai Advertisers Localize Global Brands

Soonthornsawad, Joe 2015

Authors/Contributors: Joe Soonthornsawad, Professor Bill North – (History); Professor Constanza Ocampo-Raeder (Mellon Mays Advisor)
Summer 2014

Supervisor: Professor Bill North – (History); Professor Constanza Ocampo-Raeder (Mellon Mays Advisor)

Both the public and scholars struggle to explain global consumerism, a phenomenon rapidly reshaping cultural identity. Although often understood through simplifications — as a symbol and effect of Western imperialism or a site for localization — such understandings rely on outdated theory and are often based on case studies in a small set of countries. During two months of fieldwork in Bangkok, Thailand, I studied how a global advertising agency localized international brands. Thai advertisers are intent on making brand messages “Thai,” yet often cannot drastically alter campaigns tailored for larger markets. Though advertisers study consumers closely, they often use anecdotal evidence and stereotypes of Thai culture when creating campaigns, further complicating the relationship between global and local cultures in global consumer networks.

Investigating the Effects of Pharmacological JAK/STAT3 Inhibitors on Human Natural Killer Cells

Tran, Phuoc 2015

Authors/Contributors: Phuoc Tran, Neda Dastgheyb (University of Texas M.D. Anderson Cancer Center), Prasad V. Phatarpekar (University of Texas M.D. Anderson Cancer Center), Dean A. Lee (University of Texas M.D. Anderson Cancer Center)
Summer 2014

Supervisors: Neda Dastgheyb (University of Texas M.D. Anderson Cancer Center); Prasad V. Phatarpekar (University of Texas M.D. Anderson Cancer Center); Dean A. Lee (University of Texas M.D. Anderson Cancer Center)

Natural killer (NK) cells play crucial roles in cancer surveillance and antiviral responses by killing "altered" and infected cells. Several molecules important for NK proliferation and function employ the

JAK/STAT3 pathways for signaling. However, activation of STAT3 is implicated in promoting cancer survival, differentiation, and progression; several JAK/STAT3 inhibitors are thus being developed as potential anti-cancer drugs. Here, we investigated a panel of JAK/STAT3 inhibitors to determine whether they had an unintended negative effect on NK cells. We stimulated human NK cells with IL-21 and feeder cells, and found that proliferation of NK cells were severely hindered in the presence of JAK/STAT3 inhibitors. Interestingly, NK cells with decreased proliferation killed cancer cells more effectively. They also had less CD160 expression on the surface; yet this protein's function is undetermined. Additionally, though STAT3 was previously reported to modulate the activating receptor NKG2D expression, we didn't find any change between treatments.

Differential subcellular localization renders HAI-2 a matriptase inhibitor in breast cancer cells but not in mammary epithelial cells

Tseng, Ted 2015

Authors/Contributors: Ted Tseng, Dr. Michael Johnson (Georgetown University Medical Center), Dr. Chen-Yong Lin (Georgetown University Medical Center), Hsiang-Hua Chang, Yuan Xu, Hong-Yu Lai, Xiayu Yang, Chun-Che Tseng, Ying-Jung Lai, Yu Pan, Emily Zhou, Jehng-Kang Wang,
Summer 2014

Supervisors: Dr. Michael Johnson (Georgetown University Medical Center); Dr. Chen-Yong Lin (Georgetown University Medical Center)

Matriptase is under tight control primarily by the actions of the integral membrane Kunitz-type serine protease inhibitor HAI-1. Growing evidence indicates that HAI-2 might also be involved in matriptase inhibition in some contexts. Here we showed that matriptase inhibition by HAI-2 depends on the subcellular localizations of HAI-2, and is observed in breast cancer cells but not in mammary epithelial cells. HAI-2 is co-expressed with matriptase in 21 out of 26 human epithelial and carcinoma cells examined and is also a more potent matriptase inhibitor than HAI-1 in solution, but in spite of this, HAI-2 inhibition of matriptase is not observed in all contexts where HAI-2 is expressed, unlike what is seen for HAI-1. This matriptase-HAI-2 complex may be a possible drug/imaging target.

Human Cancer Cells Retain Modest Levels of Enzymatically Active Matriptase Only in Extracellular Milieu following Induction of Zymogen Activation

Tseng, Ted 2015

Authors/Contributors: Ted Tseng, Dr. Michael Johnson (Georgetown University Medical Center), Dr. Chen-Yong Lin (Georgetown University Medical Center), Li-Ling Chu, Yuan Xu, Jie-Ru Yang, Yi-An Hu, Hsiang-Hua Chang, Hong-Yu Lai, Chun-Che Tseng, Hue-Yu Wang, Jehng-Kang Wang,
Winter 2013

Supervisors: Dr. Michael Johnson (Georgetown University Medical Center); Dr. Chen-Yong Lin (Georgetown University Medical Center)

Matriptase, a serine protease (that degrades protein) attached to the cell membrane via a type two transmembrane domain, is responsible for the integrity of epithelium and its terminal differentiation. It is broadly expressed in human carcinomas and hematological cancers and thus is a potential target of drugs and imaging probes. We assessed the fate of active matriptase following induced matriptase zymogen activation. In some human cancer cell lines, robust matriptase activation induced by acidosis is inhibited by HAI-1 rapidly. No enzymatically active matriptase was detected because cancer cells rapidly shed some active matriptase to the extracellular milieu. Shedding only occurs after activation, suggesting that matriptase activation and shedding are coupled kinetically. Rapid shedding allows some active matriptase to survive HAI-1 inhibition. Our study suggests that active matriptase on cell surface is scarce and might not be an effective target for in vivo imaging and pharmaceuticals.

The Comprehensive Guide to Composting and Recycling at Carleton

Van Fleet, Jackson 2015

Authors/Contributors: Jackson Van Fleet, Patti Sabrowski (Custodial Services, Carleton College), Audrey Lothspeich, Peter Barron, Raul Guzman, Caitlin Gardner
Summer 2014

Supervisor: Patti Sabrowski (Custodial Services, Carleton College)

In support of Carleton's institutional commitment to sustainability, the Custodial Services Department provides a system for solid waste comprised of three separate "waste streams:" compost, recycle, and landfill. One of many resources available to students, observation suggests that this system is viewed with apathy or may simply elude students; egregious rates of cross-contamination among the waste streams is well documented. In particular, landfill receptacles have higher rates of contamination than do compost or recycling receptacles, suggesting that students underestimate the capacity of the compost and recycle streams to capture virtually all of their most common waste items. This comprehensive guide is designed to educate Carleton students about composting and recycling while drawing attention to the decision-making process associated with segregating different types of waste. By summarizing and illustrating a complex set of information, this guide establishes a standard for responsible conduct that can be readily integrated with campus culture.

Absent Voices? Problematizing the Debate Over Belgium

Van Wienen, Nathaniel 2015

Authors/Contributors: Nathaniel Van Wienen, Dr. Corinne Torrekens (Université libre de Bruxelles), Professor Shana Sippy (Religion), Professor Noah Saloman (Religion), Professor Lori Pearson (Religion), Kathleen Caenen (Vesalius College - Vrije Universiteit Brussel), Kathleen Caenen (GERME - Université libre de Bruxelles)

Autumn 2012 through Summer 2014

Supervisor: Dr. Corinne Torrekens (Université libre de Bruxelles)

In Brussels, I investigated the national debate over face-coverings worn by certain Muslim women. Belgian Parliament voted overwhelmingly to publicly ban such coverings in 2011, in spite of unanimous opposition from international human rights authorities. As research associate at Belgium's Centre for Equal Opportunity, I spoke with members of another community ignored by Parliament: that of Belgian Muslims. Five appeals were brought before the Constitutional Court (all five were dismissed as I finished my last interviews), yet most Muslims remained silent in the debate. Although many agreed that the ban stigmatizes the entire religious community, politically-oriented Muslim organizations in Belgium are few, and hesitate to advocate on behalf of such a rare minority. Individuals who did speak out were widely denounced as extremists. My research sought out these underrepresented voices in an effort to understand why, in a debate so obsessed with Muslim visibility, Muslim perspectives themselves were all but invisible.

A Novel Method to Analyze Fiber Type Clustering in the Context of Sarcopenia

Vasdev, Amrit 2017

Authors/Contributors: Amrit Vasdev, Dr. Sarah M. Greising (Mayo Clinic), Dr. Carlos B. Mantilla (Mayo College), Dr. Carlos B. Mantilla

Summer 2014

Supervisors: Dr. Sarah M. Greising (Mayo Clinic); Dr. Carlos B. Mantilla (Mayo College)

Sarcopenia is the age-related decline of skeletal muscle function. It likely comprises muscle fiber denervation and re-innervation. We hypothesized that sarcopenia results in clustering of muscle fibers of the same type (defined by MyHC isoform). Fiber type specific immunofluorescence histology was used to quantify fiber clustering in murine diaphragm muscle (n=15) at 6 and 24 months. With age, fiber type clustering is shown by fiber type specific changes in the distances between fibers of the same type. There was a 14% decrease to the closest fiber for type I and a 24% increase for type IIx and/or IIb fibers ($P < 0.001$). Additionally, a 34% increase to the 3 closest type IIx and/or IIb fibers was found ($P < 0.001$). This novel method of analyzing fiber type clustering may be useful in examining pathophysiological conditions of motor unit loss.

Chemical and Mineralogical Analysis of Bronze Age Pottery Sherds from Grevena, Greece

Viesselman, Jacob 2015

Authors/Contributors: Jacob Viesselman, Professor Mary Savina '72 (Geology)

Summer 2014

Supervisor: Professor Mary Savina '72 (Geology)

Pottery sherds from seven sites in the prefecture of Grevena, Greece show promising similarities in terms of chemical and mineralogical traits. Sherds from Megaro Sileo North have nearly identical qualities in terms of matrix percentage, quartz to feldspar ratio, and inclusion size. Sites Karpero Aghios Athanasios and Monachiti Tsiani share two pairs of unique sherds, which provides further evidence that the two sites may be connected. Dasohori Niziri requires an additional thin sections for analyzing as one

thin section is insufficient in establishing a trend. Additional evidence for sherd similarities will be sought through chemical analysis using a scanning electron microscope. Similarities among sherds are evidence of a mobile human presence in the Bronze Age.

Aerosol Chemistry in Northfield: Portable and Mobile Measurements

Villarreal, Abraham 2015

Authors/Contributors: Abraham Villarreal, Professor Deborah Gross (Chemistry)

Summer 2014

Supervisor: Professor Deborah Gross (Chemistry)

The sophomore FOCUS students at Carleton College participate in a year-long Colloquium in which they undertake a Civic Engagement project which involves authentic research. In the 2014-2015 academic year, their project will involve making air quality measurements (particulate matter, CO, and NO_x) at the local Middle School. This school serves as the bus hub for Northfield schools, and it also has twice-daily lines of cars dropping off/picking up students. Typically, the majority of these vehicles idle their engines, and the students in the FOCUS Sophomore Colloquium will investigate whether this has an impact on the air quality at the school. Results will be reported to the school personnel. This project had the goal of ensuring that the instrumentation and measurement plan are ready for the Colloquium students.

Mechanistic Studies of Catalytic Enantioselective Reactions

Wang, Xiaodi 2015

Author/Contributors: Xiaodi Wang, Professor David Alberg (Chemistry), Professor Gretchen Hofmeister (Chemistry), Connor Hodges, Katie Blise

Summer 2014

Supervisors: Professor David Alberg (Chemistry); Professor Gretchen Hofmeister (Chemistry)

Enantioselective organocatalysis, potentially cheaper and more practical than organometallic and enzyme catalysis, is an important method of asymmetric synthesis. This is important to the pharmaceutical industry, where the efficient preparation of chiral molecules is critical. To improve the enantioselectivity of the asymmetric desymmetrization (ASD) of cyclic anhydrides, our group focuses on studying the mechanism of this reaction. Based on previous mechanistic results, we have identified suitable transition state analogues for the ASD reaction. This work has primarily focused on the synthesis of a TSA and its resolution into individual enantiomers by fractional recrystallization. After successful resolution of the enantiomers, we will study the catalyst-substrate interactions and determine binding constants using NMR spectroscopy.

Examining the Effects of Intervention Gameplay and Intranasal Oxytocin for the Treatment of Autism Spectrum Disorders

Wasserburg, Lucy 2015

Author/Contributors: None

Summer 2014

Supervisors: Dr. Suma Jacob & Dr. Sunday Francis (University of Minnesota)

Oxytocin, the hormone associated with social bonding, has been shown to be present in lower levels in people with Autism Spectrum Disorders (ASD). Intranasal administration of Oxytocin has shown promise in previous clinical trials in alleviating certain social deficits that are characteristic of people with ASD. My primary project this summer was to begin a clinical trial that examined the efficacy of a combination therapy for adolescent boys with ASD involving intranasal oxytocin, along with a series of computer games called Facestation. The Facestation interface has seven arcade-style games designed to enhance facial perception and recognition skills. This study is still taking place, and the data will be analyzed once all subjects have been run.

Investigating Polymer Lens Formation Using Interfacial Liquid Surfaces

White, Mason 2016

Author/Contributors: Mason White, Professor Marty-Elizabeth Baylor (Physics), Professor Charlotte Zimmerman (Physics)

Summer 2014

Supervisor: Professor Marty-Elizabeth Baylor (Physics)

We examine the profile of polymer lenses formed by dropping hydrophobic, photo-curable monomer onto liquid substrates, and then solidifying the monomer through exposure to a UV light source. The intermolecular forces acting on the monomer at the interface of these two substances mold the floating monomer into a specific shape. This geometry is maintained as the polymer cures, thus indicating that these intermolecular forces determine the structure of the lens. By manipulating these forces, we can create polymer lenses of different curvatures. We can change the force at the interface by altering the temperature, density, and ion concentration of the substrate, as well as the container in which the curing process occurs. We will present data for the height to width ratio of the lenses with respect to these variables, with the ultimate goal of finding a mathematical equation that describes the lens shape as a function of these parameters.

Why is There Order in the Purple Membrane?: A Biological Application of Super-resolved Raman Imaging

Wilhelm, Kiera 2015

Author/Contributors: Kiera Wilhelm, W. Ruchira Silva, Dr. Renee R. Frontiera (University of Minnesota)
Summer 2014

Supervisor: Dr. Renee R. Frontiera (University of Minnesota)

Super-resolved stimulated Raman imaging is a label-free technique that will allow biological samples to be imaged at the nanometer spatial and femtosecond time resolutions. Such resolutions will allow changes in a single transmembrane protein and its local environment to be imaged on the time scale of chemical reactions, providing insight into the mechanisms of signal transduction and other fundamental processes that occur at a cell surface. The protein I studied, bacteriorhodopsin, is a photoactivated proton pump found in crystalline patches in the purple membrane of halobacteria. It is not known why such crystalline patches are formed. Using super-resolved stimulated Raman imaging, we will be able to understand how the local crystalline cellular environment affects the proton-pumping efficiency of bacteriorhodopsin.

Investigating the role of SNX1 in plant endosomal trafficking of FLS2 pattern recognition receptor (PRR)

Wilson, Ellie 2015

Author/Contributors: Ellie Wilson, Noriyuki Hatsugai (University of Minnesota), Fumiaki Katagiri (University of Minnesota)
Summer 2014

Supervisor: Noriyuki Hatsugai (University of Minnesota), Fumiaki Katagiri (University of Minnesota)

Basal plant immunity provides a first line defense against environmental challenges. Scientists have shown that various pattern recognition receptors (PRRs) comprise a sophisticated surveillance system at the cell's plasma membrane (PM), detecting molecular "danger signals" on microbes. Current research is studying how plant cells regulate delivery and distribution of these receptors. Intracellular trafficking on one important PRR in Arabidopsis Thaliana, FLS2, is currently in question. Sorting nexin proteins, traditionally thought to mediate protein degradation pathways, may be playing a yet unidentified role in the recycling pathway of FLS2 between the PM and endosomal compartments. Using *snx1* mutant lines, we looked at the plant's ability to detect an extracellular "danger signal" (flg22) and trigger immune responses to clear routine bacterial infections. We found *snx1* mutants had compromised basal immune responses in comparison with WT plants, suggesting an essential role for SNX1 protein in trafficking FLS2 immune receptor to the PM.

Rethinking Theater in a Multimedia Culture

Yu, Phoebe 2016

Author/Contributors: None

Summer 2014

Supervisor: Professor Roger Bechtel (Theater & Dance)

The principal characteristic of theater is often considered to be its “liveness.” Film and video production, in contrast, are considered mediatized. Yet, more and more theater productions incorporate film and video projection not just as ‘scenery,’ but as an important part of the performance. This trend is a call to both theater and film professionals to rethink the boundaries and natures of these two mediums. This project examines filmic projections on stage but narrows its scope to focus only on theater productions that incorporate both live performance and mediatized filmic projections. Through performance analysis and interviews with artists, this project will provide an answer to the key question — what happens to theatrical liveness when live and mediatized performances are combined on the same stage.

Understanding the nature of the experience of multimedia performance will help to redefine theater’s liveness.