COLLEGE OF THE
Holy Cross

Twenty-Fourth Annual Symposium
Dr. Charles S. Weiss
Summer Research Program

September 8, 2017
Hogan Ballroom

Dear Members of the Holy Cross Community,

Welcome to the 2017 Dr. Charles S. Weiss Summer Research Symposium. Now in its 24th year, the symposium is a college-wide event that brings together faculty and students from all disciplines at Holy Cross and provides an opportunity to celebrate their accomplishments over the summer of 2017. It also provides an opportunity for students to witness the breadth of research possibilities both on and off campus, and to open a dialogue with members of the faculty about conducting research during the upcoming academic year and summer. We hope you enjoy the impressive collection of scholarship on display today.

2017 Symposium Organizing Committee

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Stephenie Chaudoir, Department of Psychology
Daniel Bitran, Science Coordinator

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The summer research program was organized by Pr. Daniel Bitran, College Science Coordinator, by Dr. Anthony Cashman, Director of the Summer Research Program in Humanities, Social Sciences, and Arts, and by Pr. Victor Matheson, Director of the Summer Research Program in Economics.

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Poster 1

Investigation of the Sequential Adsorption of Octanethiol and Naphthalenethiol on Au(111)

S. Aravinthan, H. Haddadi, K. McCabe, and L. Avila-Bront
Department of Chemistry, College of the Holy Cross

Multi-component self-assembled monolayers (SAMs) are a subject of rigorous study in modern Chemistry due to potential applications in nanotechnology, medicine, molecular circuitry, and many other applications. Our lab has previously shown the ability to deposit multiple molecules sequentially with alkane and aromatic thiols. Van Der Waals forces and π-π stacking are well researched interactions which have been shown to affect orientation and packing of organic molecules in a multi-component SAM. The mixed monolayers of 2-Naphthalenethiol (2NT) and octanethiol (OT) are studied at the molecular level using scanning tunneling microscopy (STM) in ambient conditions on Au(111). We have adsorbed both compounds onto the surface of Au(111). We are investigating the sequential deposition of 2NT and OT as well as optimizing conditions for the creation of coexisting surface structures on the Au(111) surface. We were able to molecularly resolve OT on the surface of Au(111) and are still working towards optimizing the adsorption conditions of 2NT and characterizing 2NT on the surface of Au(111).

This research was funded by the American Chemical Society Petroleum Fund and by a generous donation made by Wendy R. and Kenneth J. Edwards, M.D. '80, P12 to the Alumni / Parent Summer Research Scholarship Fund.

Poster 2

Inducing β-sheets in Disordered Peptides in α-Synuclein

P. Mon and S. Petty
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Protein misfolding into a conformation rich in β-sheet is associated with neurodegenerative diseases such as Parkinson's and Alzheimer's disease. β-sheet rich structures can aggregate to form amyloid fibril plaques found in the brain tissue of patients with these diseases. In this study, we utilize α-synuclein, a natively disordered protein that can adopt a β-sheet secondary structure and aggregate in the brains of patients with Parkinson's disease. Studies have shown that the deletion of residues 85-94 of the α-syn protein (Δ85-94 AGSIAAATGF) inhibits amyloid formation. Our lab has shown previously that IAAA, a β-sheet rich peptide found in the center of this deletion, can induce beta-sheet formation in GSIA, a disordered peptide found adjacent to it. We were interested in exploring whether IAAA could, therefore, represent the nucleation site for the aggregation of α-syn. A separate study postulated that residues 37-43 of α-syn (VLYVGSK) are involved in early beta-sheet interactions when α-syn aggregates. Hence, in our search for the nucleation site, we have also explored this stretch of amino acids. Peptides were synthesized on a Rink amide–AM resin using the Merrifield solid-phase synthesis with Fmoc chemistry. The peptide's termini were acetylated and amidated in order to eliminate charged termini and mimic their presence in the α-syn protein. The secondary structure was determined through FTIR spectroscopy and analysis of the Amide I band. The peptides were monitored in sodium borate buffer at varying temperatures. Mixing experiments that combined GSIA with IAAA confirmed an increase in β-sheet confirmation. Through isotope edited IR, we have shown that the increase in β-sheet content in IAAA is due to the increase in local concentration of IAAA with the addition of GSIA rather than the adoption of β -sheets by GSIA. We have also found that peptides containing VLY, LYV (residues 37-39 and 38-40) have the tendency to form stable β-sheet.

We thank the Alumni/Parent Summer Research Scholarship Fund for financial support.

Poster 3

Deep Neural Networks for Reconstructing Particle Collisions

J. Stietzel and K. Lannon
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In an effort to better understand the fundamental particles of our universe, scientists at the Large Hadron Collider at CERN collide protons traveling near the speed of light and make observations about their interactions. These collisions occur 40 million times per second and generate petabytes of data annually. Despite the magnitude of data produced by the accelerator, not all of it is of particular interest to researchers. In fact, the most significant collisions only make up a small fraction of those recorded and are difficult to differentiate from less interesting ones. The challenge of discerning meaningful collisions arises because particles of interest, like the top quark and Higgs boson, decay before they can be detected. Scientists are left to use the daughter particles of a collision to to make inferences about the intermediate particles produced. Ambiguity surrounding the measurement of daughter particles in jets, which parent particle they are attributed to, and the inability to detect neutrinos adds further complexity to the problem. Advancements in using deep neural networks for image recognition and natural language processing have proven their ability to handle complicated problems, thus inspiring their application to particle physics. Using these multilayer neural networks could be helpful in accurately reconstructing collisions and distinguishing exotic ones from trivial ones. This project explores hyperparameters for multilayer networks, in particular the number of layers and the number nodes in each layer, to determine which options work best for reconstructing complex collisions.

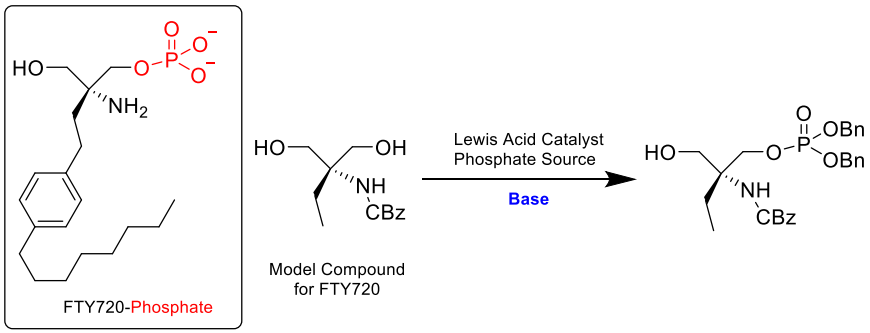
This work was supported by National Science Foundation grant IIS-1560363: “REU Site: Data Intensive Scientific Computing”. I would also like to thank my advisor, Kevin Lannon, the Center for Research Computing, and the University of Notre Dame for their essential roles in facilitating my research this summer.

Poster 4

Exploration of the Role of Base in Selective Phosphorylations

E. Sisko and B. Sculimbrene
Department of Chemistry, College of the Holy Cross

Phosphorus is an element found throughout the earth, especially within the human body. It serves a myriad of purposes in many biological processes, specifically when bonded to oxygen (as in a phosphate). The multiple sclerosis drug FTY720 is inactive until it is phosphorylated by the body into FTY720-phosphate. The Sculimbrene lab aims to perform this same reaction in a laboratory setting. Previous work in our lab has shown that molecules similar to FTY720 can be selectively phosphorylated using a Lewis acid catalyst, pyrophosphate (as the phosphate source) and base. We are currently exploring what effect the base has on the yield and selectivity of this reaction. Different bases, including those similar in structure and those that are unique, were examined along with when and how much base is added to the reaction. Once the phosphorylation has been optimized for the model compound, the selective phosphorylation of FTY720 will be examined.



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Poster 5

Reclaiming the *Iliad's* Scribal Tradition: The Bankes Papyrus and the Venetus A

C. Hanley, Z. Sowerby, J. Spiegel, N. Smith and M. Ebbot
Department of Classics, College of the Holy Cross

The Homeric epics were composed for nearly one thousand years, before being committed to writing. The first centuries in the poem's textual transmission saw a canonical text established. As such, they are critically important for understanding the history of the Iliadic text. We approached this phase in the epic tradition by producing digital, diplomatic editions of both the Venetus A manuscript and the Bankes Papyrus; the Bankes was written around 150 AD, while the scholia from the Venetus A can reach back to the third century BC. These editions, which record every intentional mark on the page, allow us to study the work of the ancient scholars systematically, and recover variations which are elided by the modern critical text. Therefore, our study of the transmission of Iliadic material compares these two editions. Differences in accentuation, textual division, and multiformity provide useful insights into the poem's transmission. For instance, the two sources preserve distinct systems of accentuation, with the Bankes papyrus being closer to the style of the oral epic. In addition, our study of the Bankes alongside the scholia of the Venetus A illuminates the process of correcting the poem's text, and sources used by a second-century scribe. Finally, the comparison of the two editions draws attention to the way scholars across the centuries visually divided the text. Most importantly, this method does not merely allow for anecdotal study; it allows for an automated comparison of two organic wholes.

We appreciate the generous support of the Holy Cross Weiss Summer Research program in the Social Sciences, Humanities, and Arts, as well as the support of the Center Hellenic Studies.

Poster 6

Formation of Peptide Isosteres via Olefin Cross-metathesis

T. Chickering and B. Sculimbrene
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Peptides are an essential building block for many pharmaceutical compounds. However, peptides contain an amide bond that can limit their oral availability as drugs. Alkene peptide isosteres are similar to peptides, but replace the amide bond with a carbon-carbon double bond which does not readily break down in the stomach. Our approach to the synthesis of alkene peptide isosteres utilizes olefin cross metathesis, combining a C and an N termini to create the central alkene bond. Metathesis provides a convergent strategy where two fragments of equal complexity are utilized for the formation of a peptide isostere, allowing a rapid synthesis of potential pharmaceutical compounds. Gramicidin S is a cyclic peptide that has been shown to target the mitochondria. The dipeptide sequence Leu-D-Phe present in Gramicidin S has also been shown to target the mitochondria along with its alkene isostere mimic. Our goal is to develop an efficient synthesis of the Leu-D -Phe alkene peptide isostere using olefin cross metathesis. Two synthetic approaches were examined to determine if the metathesis or the alkylation reaction should be conducted first. We are currently optimizing reaction conditions such as molar equivalents, solvent and time in order to obtain a higher yield.

A special thanks to Wendy R. and Kenneth J. Edwards, M.D. '80, P12, for their generous donation to the Alumni/Parents Summer Research Scholarship Fund.

Poster 7

Analyzing Ballistic Deposition through Graph Theory and the Eigenvalue Spectra of the Laplace Matrix

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Ballistic deposition is the buildup of falling material as it sticks together, effectively creating porous holes, or voids. With applications in material science, one being underground carbon sequestration in sediment, ballistic deposition models random pore networks very well. We generate and analyze closed voids in random depositions through weighted connected graphs using *MATLAB*. These graphs are collections of vertices and edges that lie on the half integer lattice. Our technique involves "pruning" the graphs of each void while simultaneously redistributing edge weights. A final pruned graph's eigenvalue spectrum of the Laplace matrix provides analysis of the voids with which we compare the persistent homology analysis previously employed in Summer 2016. Through eigenvalue analysis and this comparison, we propose that we can characterize the intrinsic nature of void structure in random ballistic deposition.

We thank Dr. Dan Kennedy '68 for his donation to the Alumni/Parents Summer Research Scholarship Fund.

Poster 8

Refugee Artisans of Worcester: Representing Refugees in a Public Anthropology and History Text

M. Umunna and S. Rodgers
Department of Sociology and Anthropology, College of the Holy Cross

Joan Kariko and Ellen Ferrante are the co-founders of Refugee Artisans of Worcester (RAW), a non-profit that works to support socially isolated older refugees in town and assist them in creating artworks that RAW can market and sell for them. Large portions of the proceeds go back directly to the refugee artisan who created the artworks. The artisans are mostly older women not fluent in English. They come from Rwanda, Central African Republic, Democratic Republic of the Congo, Iraq, Syria, Burma, Bhutan, and Nepal. RAW gives them a way to empower themselves, while learning business and marketing skills. Anthropology Professor Emerita Susan Rodgers and I collaborated with RAW to research and write a 32-page booklet about these refugee artisans and their artworks in the summer of 2017. This project involved interviewing the refugee artisans in their homes and writing about their individual biographies as artists (not as "needy refugees"). Using Aihwa Ong's, *Buddha Is Hiding: Refugees, Citizenship, the New America* as a guideline, Rodgers and I ask, how best can writers and researchers like ourselves most accurately represent the artworks and the lives of the refugee artisans, in such a public text? How can we avoid falling into narratives that simply celebrate refugee bravery? And how can we make sure that the artisans' own voices come through our text, which will be used as a free handout by RAW co-creators when they give public lectures around town?

We thank the Holy Cross Weiss Summer Research Program in the Humanities, Social Sciences, and Arts and the Ignite Fund for the financial support of our summer 2017 research project.

Poster 9

A Constitutional Analysis of Solitary Confinement and Brain Scans

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Prelaw Society, College of the Holy Cross

Mr. William DeNolf was found guilty of murder by a jury in the state of Olympus. Olympus law enforcement used a Functional Brain Mapping Exam, also called "brain fingerprinting" to indict Mr. DeNolf. The test was carried out in a medical setting and showed that Mr. DeNolf vividly remembered the crime scene. The validity of the test is not in question, but Mr. DeNolf, the petitioner, alleges his fifth amendment right against self-incrimination has been violated. Supreme Court jurisprudence holds that the 5th amendment clearly protects one from speaking one's own guilt, or being coerced, explicitly or implicitly, into a confession. On the other hand, the Supreme Court has consistently upheld the validity of using physical evidence to assist a state in a criminal investigation. Thus, the fifth amendment question of utmost importance in this case is whether the Functional Brain Mapping Exam constitutes physical evidence, or something worthy of strict fifth amendment protection. Mr. DeNolf also alleges that his thirty-year sentence in solitary confinement violates the eighth amendment's cruel and unusual punishment clause. Judge Fair's sentence was within what the State of Olympus allows, but the Supreme Court has, albeit infrequently, ruled a sentence unconstitutionally long or severe. Supreme Court jurisprudence shows a pattern of upholding prison conditions so long as they are not unnecessarily cruel or blatantly negligent. More fundamental, however, is whether 30 years of solitary confinement is unconstitutional in light of the crime DeNolf committed. The State of Olympus will point to the numerous times the Supreme Court upheld very severe sentences because of the overall belief that the eight amendment does not have an inherent proportionality standard.

We thank the Weiss Summer Research Program in the Humanities, Social Sciences, and Arts for their financial support.

Poster 10

Preparing Novel Amino-Phenol Ligands to Modify the Reactivity of Transition Metals

J. Connor Recio, S. Zaheer, and J. Farrell
Department of Chemistry, College of the Holy Cross

Rhenium (I) complexes have applications as radiopharmaceuticals and can act as effective analogs for current ^{99}Tc based imaging reagents. Complexes were synthesized by combining pentacarbonyl-chlororhenium with novel organic ligands, prepared by Mannich condensations between propargyl amine or 1,1-dimethylpropargylamine and four different 2,4-disubstituted phenols. The substituents on the phenols subtly vary the steric and electronic properties of the resulting Re(I) complexes. Our ligands all contain an alkyne, which has been utilized for copper catalyzed click reactions to add an additional biological targeting site. The preparation and characterization of both the organic ligands and the rhenium complexes will be presented.

We would like to thank Mr. & Mrs. David M. Joy '74 P11 and Mr. and Mrs. John Kirby Bray '79 P10 for their generous contributions to the Alumni/Parents Summer Research Scholarship Fund.

Poster 11

Selective Phosphorylation of Diols

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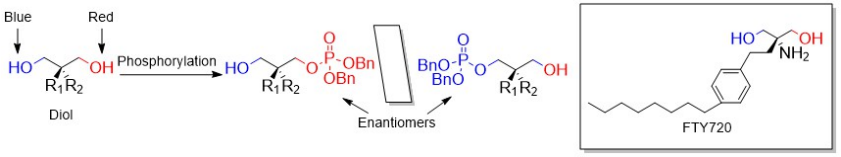
Department of Chemistry, College of the Holy Cross

The phosphate functional group constitutes important molecules of life, whether found in ATP or pharmaceutical drugs. Many molecules remain inactive until phosphorylated, as in case of the Multiple Sclerosis drug FTY720 (a diol-containing two -OH groups). The active form, FTY720-Phosphate, is generated by kinases in the body from the selective phosphorylation of one -OH group in FTY720. We seek to accomplish this same reaction in lab. Previously, the Sculimbrene lab developed reaction conditions for the monophosphorylation of different diols. While the monophosphorylation is achieved in high yield, it was accomplished as a 1:1 mixture of enantiomers (equal phosphorylation of the blue and red -OH. Only one of the enantiomers of FTY720-Phosphate has the desired effect on the immune system and thus the selective phosphorylation of diols is needed. The Sculimbrene lab is currently working to find optimal conditions to favor the formation of one monophosphate enantiomer over the other, using diols resembling the structure of FTY720. We screened diols differing in the groups attached to the central carbon (depicted as R_1 and R_2) to learn what groups aid and impede the reaction. We continue to optimize and screen reaction conditions in order to achieve a selective phosphorylation of the diol FTY720.



We thank the generous contribution made by Mr. and Mrs. Joseph T. Murray ’58 P86,86 to the Alumni/Parents Summer Research Scholarship Fund.

Poster 12

Synthesis of New Unnatural Bioorganometallic Compounds

K. Kelly, A. Kui, and R. S. Herrick
Department of Chemistry, College of the Holy Cross

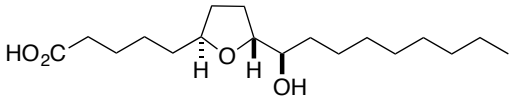
Rhenium compounds provide an opportunity for further studying the applications of technetium-99m, a nuclide which is utilized in nuclear medicine but also lacks any stable isotopes due to its nature as a gamma photon emitter. In addition to cold rhenium nuclides, both ^{186}Re and ^{188}Re are β-emitters and can be used in research to create compounds that are analogous to those of ^{99m}Tc used in cancer diagnostics. This summer, the Herrick Lab synthesized rhenium tricarbonyl chloride compounds with various ligands attached, such as amino acids and chelating agents, for this purpose. Ferrocene has a unique sandwich structure with an iron atom between two cyclopentadienyl ligands. Many groups have studied the intramolecular hydrogen bonding amino acids connected to ferrocene by an amide bond. We are instead examining possible intramolecular hydrogen bonding between amino acids connected to the ferrocene by sulfonamide linkages. The sp^3 sulfonyl sulfur vs. sp^2 carbonyl carbon seems to play a vital role in controlling hydrogen bonding. ^{1}H NMR, IR, and X-ray crystallography were then used to characterize these compounds.

We gratefully acknowledge the National Institutes of Health and the generous donation by Mr. and Mrs. Stephen R. Winslow P14, 16 to the Alumni/Parents Summer Research Scholarship Fund for the financial support of this research. We also thank Professor C. J. Ziegler at the University of Akron and his students for performing the crystallography.

Poster 13

Total Synthesis of (+)-Bovidic Acid

W. R. Cassels and K. J. Quinn
Department of Chemistry, College of the Holy Cross



(+)-bovidic acid

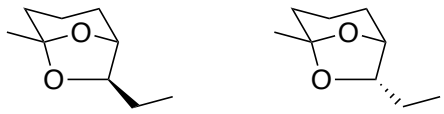
(+)-Bovidic acid is an 18-carbon hydroxyfuranoid acid, which exhibits effective insect repellent activity. This natural product is isolated from the skin of the gaur (*Bos Frontalis*), a bovine native to Southern Asia. We have developed and completed an efficient synthesis of (+)-bovidic acid from readily available (*R,R*)-hexa-1,5-diene-3,4-diol. Formation of the tetrahydrofuran (THF) ring and appendage of the eastern alkyl side chain are achieved in a single step via a tandem, size-selective ring-closing/cross metathesis reaction. The western carboxyl-containing side chain was introduced via stereoselective allylation followed by chemoselective cross metathesis. This strategy provides our target in seven steps, the shortest synthesis to date, and we expect it will be applicable to other THF natural products.

Financial support of this research from a generous donation by Jaqueline and George A. Paletta, Jr., M.D. '84 P15 to the Alumni/Parents Summer Research Scholarship Fund is gratefully acknowledged.

Poster 14

Synthetic Studies on Brevicomin

W. F. Connors, L. M. Howard and K. J. Quinn
Department of Chemistry, College of the Holy Cross



exo-brevicomin endo-brevicomin

We will report our efforts toward the synthesis of the diasteromeric natural products *exo*- and *endo*-brevicomin. *exo*-Brevicomin is an aggregation pheromone of the western pine beetle, and *endo*-brevicomin enhances the response of male southern pine beetles to female attractant pheromones. Our proposed synthesis of *exo*- and *endo*-brevicomin utilizes cross metathesis to construct an acylic keto diol precursor, which we anticipate will undergo rhenium-catalyzed allylic alcohol transposition to produce a cyclic hemiacetal intermediate. A second allylic alcohol transposition is expected to produce the bicyclic acetal skeleton of our targets. Completion of these syntheses would then require only a single hydrogenation step. We will present our preliminary studies on these key steps. If successful our route would provide easy access to these natural products and demonstrate the utility of this double allylic transposition strategy for the preparation of bicylic acetals.

Financial support from the Alumni/Parents Summer Fellowship Program is gratefully acknowledged.

Poster 15

Structural Relationships and Alzheimer's Disease: Quality of Care and Staff Perspectives

B. Pond and R. Beard
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Alzheimer's disease (AD) is one of the most important issues in the field of medicine today. But while the disease continues to be studied from a medical lens, it is also important to consider the social and political aspects of illness. More specifically, our research explored the relationships between residents with Alzheimer's and staff members in order to understand whether and, if so, how structural dynamics in one psychiatric unit impact the quality of care and personal experiences of staff. We analyzed facility health inspection data and conducted a survey with staff members (N= 50). These data revealed several health-related consequences that may be exacerbated by structural problems from the blending of the at times contradictory business and social models of care. Staff reported that organizational obstacles such as low perceived staff appreciation (56%), a perceived lack of fair wages (66%), compassion fatigue (78%), and a lack of support (72%) lead to their increased stress levels and the absence of personal engagement with residents. We also conducted research using the qualitative methodology of participant observation, spending over 250 hours in a specialized care unit for people with Alzheimer's. The observational data support findings from surveys. This data is illustrated on the poster in the form of short excerpts that support themes from the survey, such as compassion fatigue and lack of support. Data suggest that the business model of care perpetuates unequal dynamics of power among different groups of staff members, and may threaten the quality of care for people with Alzheimer's disease.

We thank The Greisch Family Summer Research Fellowships Fund for financial support.

Poster 16

Corruption in Sports Mega-Events

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In the processes required to host a sports-mega event, corruption has been prevalent on numerous occasions, leading to unnecessary costs becoming the ultimate responsibility of a host government's taxpayers. Little progress has been made in the prevention of such behavior. In this paper, we examine the history of corruption in sports mega-events, namely the Olympics and World Cup, to identify parts of the bidding and preparation processes that are vulnerable to illicit behavior. We propose potential solutions to be implemented at various levels in order to prevent further corruption.

I thank the Weiss Summer Research Program in Economics for financial support.

Poster 17

Investigation of Eastern Hemlock in the Riparian Zones of Headwater Streams in the Connecticut Watershed

H. O'Neill, V. Chavez-Molina, and W. Sobczak
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Ten years ago, Professor Sobczak conducted a survey along route 2 in Massachusetts evaluating eastern hemlock mortality. This summer we repeated his survey and further assessed the effects of Woolly Adelgid on hemlock along the riparian zones of headwater streams in the Connecticut Watershed. Through this research, we visited 23 different streams in Massachusetts and Vermont. We gathered important information in macroinvertebrate biodiversity, light intensity, tree abundance, and individual stream substrate compositions. Our results show that over the past 10 years, sites that were initially regarded as healthy are now considered to have high hemlock mortality. Woolly Adelgid has rapidly spread north and is now prevalent in most of Massachusetts and Southern Vermont. Our survey depicts the geographical location of our research sites and the healthiness of hemlock trees along the riparian zones. Each site differed from one other in habitat, elevation and setting (urban, rural or state park). Nonetheless, all were treated under the same healthiness grading for eastern hemlock mortality.

We would like to thank the National Science Foundation and the Macrosystems Biology grant for their financial support.

Poster 18

Eucharistic Adoration as an Extension of the Liturgy

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Department of Religious Studies, College of the Holy Cross

In light of the liturgical renewal after the Second Vatican Council some theologians have criticized the practice of Adoration of the Blessed Sacrament because it divorces the consecrated host from the communal celebration of the Mass and leads to an individualistic spirituality. In response to this criticism, this project demonstrates that Eucharistic Adoration is in fact an extension of the communal celebration of the liturgy. Furthermore, drawing upon the thought of Augustine of Hippo and Dietrich von Hildebrand, it shows how Adoration contributes to the formation of the Christian community in the image and likeness of God. Participants in this practice grow in a receptive disposition toward the Real Presence and acquire a more profound sense of hope in Christ's promises.

We thank the Weiss Summer Research Program in Social Science, Humanities, and Arts for financial support.

Poster 19

The Effect of Concealable Stigmatized Identity Disclosure on Stress Reactivity in College Students

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Previous studies have consistently found that stigma-related stressors, such as racial discrimination, disrupt salivary cortisol reactivity. Furthermore, past research has demonstrated that it can be stressful to disclose concealable stigmatized identities (CSIs), or socially devalued identities that can be hidden from others. To our knowledge, however, no previous work has examined the effect of verbal disclosure of CSIs on stress reactivity. In this study, we invited 1450 students from Clark University, Holy Cross, and WPI to complete a Social Identities Survey, in which they indicated whether they possessed a range of CSIs, such as mental illnesses and LGBT identity. Participants with CSIs completed surveys that measured three types of stigma: anticipated stigma, enacted stigma, and internalized stigma. Those without CSIs completed a measure of cultural stigma, which assessed the degree to which each CSI was stigmatized within the broader sociocultural context of each campus. 149 participants who reported one or more CSIs then participated in an experimental study that assessed the extent to which disclosing a CSI would impact salivary cortisol reactivity. We hypothesized that higher levels of intraindividual and cultural stigma would predict greater cortisol reactivity in the CSI disclosure condition, but not in the control condition. We randomly assigned participants to either the CSI condition, in which they recorded themselves disclosing their CSI to a friend, or the control condition, in which they recorded themselves talking about a time they hurt someone's feelings. Results showed that, contrary to expectations, there was no effect of condition on salivary cortisol reactivity. Cultural stigma was the only stigma variable that was significantly associated with stress reactivity. These findings suggest that regardless of condition or one's perception of stigma, stress reactivity is mainly contingent upon the overall toxicity of the cultural environment.

We thank the National Science Foundation and the Weiss Summer Research Program for their financial support.

Poster 20

Employee Misclassification

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Employee misclassification is the practice of classifying workers as independent contractors who by law must be considered employees. Misclassified employees are denied fringe benefits, minimum wage protection, overtime pay, and reimbursement of business expenses. Our research explored statutory and case law in the various states. State statutes differ as to the characteristics used to define employee status, which we document in a comprehensive table. In the prominent case of *Somers v. Converged Access* (2009), the Massachusetts Supreme Judicial Court (SJC) overturned a lower court ruling that held that the misclassified plaintiff had not suffered any damages because he received more money than he would have made as an employee. In contrast, the SJC ruled that Somers' "contract rate is his wage rate and his 'damages incurred' equal the value of wages and benefits he should have received as an employee, but did not." The SJC ruling was dependent on Massachusetts' strict statutes concerning independent contractor status. Because the *Somers* decision is so reliant on Massachusetts statutory law, no other state has a ruling like it, despite a number of attempts by plaintiff counsel in cases arising outside of Massachusetts jurisdiction.

We thank the Weiss Summer Research Program for financial support.

Poster 21

Homing Endonuclease Activity of Inteins from Extreme Thermophiles

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Department of Chemistry, College of the Holy Cross

Protein splicing is a post-translational modification by which intervening polypeptides, or inteins, catalyze their own excision from two flanking polypeptides, or exteins, concomitant with the ligation of the exteins. Some inteins contain a homing endonuclease domain, which functions as a highly specific enzyme that can cleave double-stranded DNA by recognizing a nucleotide sequence on a target gene that lacks the intein. We studied the activity of homing endonuclease-containing inteins that interrupt the DNA Polymerase II (PolII) from the deep-sea thermophiles *Thermococcus kodakarensis* (*Tko*) and *Thermococcus barophilus* (*Tba*). Previous work with *Tba* and *Tko* inteins suggests that their PolII inteins splice poorly in *E. coli* but can be induced to splice *in vitro* at higher temperatures. It was found that *Tko* inteins splice at lower temperatures and shorter incubation times when compared to the intein splicing activity of *Tba*. This summer, it was found that *Tba* and *Tko* inteins have temperature dependent endonuclease activity. Consistent with previous work on *Tba* and *Tko* intein splicing, *Tko* endonucleases are active at lower temperatures when compared to *Tba* endonuclease activity. Additionally, it was found that the *Tba* intein is enzymatically active at pressures up to 1000 atm. Future work will explore pressure dependence of the *Tko* intein nuclease activity, as well as the relationship between protein splicing and homing endonuclease activity in *Tba* and *Tko* inteins.

This work was supported by the National Science Foundation (grant MCB-1517138) and by the Camille & Henry Dreyfus Foundation.

Poster 22

Effects of Increased Intermittent Reinforcement for Random Sequences on Choice Trials

A. Hasenauer, P. Segura Tobarra, and C. Locurto
Department of Psychology, College of the Holy Cross

Implicit learning, defined as the learning of information without the awareness of what has been learned, is a well-studied human capability. Implicit learning has been interpreted as providing several types of advantages in learning situations, including how humans acquire language, and how non humans learn the paths that might lead to food. In order to recreate implicit learning in our lab, we used an animal model in which pigeons were randomly reinforced during their performance in learning a sequence of visual images presented serially on a touchscreen. The baseline training of trials consisted of a forced choice of either random or pattern sequences. Following the matching law, we expected that since both sequences were equally reinforced, the pigeons should show no preference for one sequence over the other. However, in previous experiments in our lab with intermittent reinforcement, we found that when given a choice, the pigeons choose the pattern alternative 75% of the choices. Our current experiment examined what effect reinforcement had on preference for pattern versus random sequences. We wanted to see whether an increase in reinforcement for random sequences would cause a change in the pigeons' preference for these sequences, and if so, what was the threshold for that preference? We hypothesized that increased reinforcement for random sequences would lead to an overall preference for random sequences over pattern sequences.

We thank the generous contribution made by Mr. and Mrs. Edward J. Burke, Jr. '86 to the Alumni/Parents Summer Research Scholarship Fund.

Poster 23

Screen of *De Novo* Evolved Genes Involved in *D. melanogaster* Male Reproduction

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Department of Biology, College of the Holy Cross
** Institute for Evolution and Biodiversity, University of Münster*

Across diverse animal species, evolutionarily new genes are often expressed in the testes, suggesting that they may have an effect on male fertility. One type of new gene is a *de novo* evolved gene, in which previously non-coding DNA sequence evolves to encode a functional protein. *Drosophila* is an exceptionally good model organism to study these genes due to its fast rate of development and relatively short lifespan. We have previously characterized three *de novo* genes; RNAi-mediated knockdown of each gene significantly reduces male fertility. Using bioinformatic analyses, we identified a list of other putative *de novo* genes to screen. I tested 37 of these genes using RNAi lines and evaluated the knockdown using RT-PCR. Two genes had an apparent effect on fertility compared to controls. In the future, I will do finer-scale experiments in order to both replicate and precisely quantify the decrease in fertility. I will also use confocal microscopy, GFP-tagged sperm, and different cytological staining methods in order to characterize the alterations in the sperm and understand why there is a difference in fertility. In addition, I will create knockout lines of flies for the genes of interest using CRISPR/Cas9 in order to see if the results differ from the knockdown flies. Furthermore, I will create RNAi lines for the genes that are currently lacking lines or that have lines that do not effectively knock down. Our results show that *de novo* genes have important roles in reproduction. Other species have their own *de novo* genes, including related taxa of mosquitoes. *De novo* genes may represent attractive targets for reducing the fertility of mosquitoes, which may help prevent the spread of mosquito-borne illnesses.

We thank the National Science Foundation for financial support.

Poster 24

The *Enkurin* Gene Plays a Conserved Role in *Drosophila* and Rodent Sperm Motility

R. Snow, H. Florman, and G. Findlay*
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Department of Cell and Developmental Biology, UMass Medical School

Sexual reproduction relies on the successful union of sperm and egg. Unfortunately, in some cases of male infertility, the sperm are unable to efficiently reach the site of fertilization, preventing reproduction. One highly conserved gene, *enkurin*, plays an essential role in the male fertility of organisms ranging from mammals to *Drosophila*. Males lacking *enkurin* are severely sub-fertile, suggesting that the enkurin protein is essential for sperm function. Previous work with *enkurin* knock out mice revealed issues with sperm flagella and their ability to properly bend. Given its ease of genetic manipulation, short generation time, and high fecundity, we have developed *D. melanogaster* as an alternative model organism for the study of *enkurin*. Consistent with the mouse mutant phenotype, male *Drosophila* depleted for *enkurin* by RNA interference produce sperm at normal rates and transfer these sperm to females. However, the sperm cells' movement within the female is impaired, and they are largely unable to reach the site of fertilization. Using high-speed microscopy, we observed differences in flagellar beating patterns between knockdown and control males. These experiments revealed an apparent rigidity to knockdown sperm flagella. We are currently using CRISPR/Cas9 to construct flies that carry a null mutation in *enkurin*, which we will use to characterize the defect with greater precision. Functional characterization of the *enkurin* gene may reveal conserved mechanisms of sperm motility across animals and improve understanding of male infertility in humans.

We gratefully acknowledge the financial support of Dr. and Mrs. William F. Crowley Jr. '65 and the Holy Cross Ignite Fund.

Poster 25

Characterization of *Atlas,* a *de novo* Evolved Gene Necessary for *Drosophila* Reproduction

E. Rivard and G. Findlay
Department of Biology, College of the Holy Cross

De novo evolved genes arise from previously noncoding genomic material to become protein-coding and have potential to develop integral functions within a relatively short evolutionary timeframe. Utilizing bioinformatic analyses, we identified 95 testis-enriched *de novo* genes in *Drosophila*. One of these genes, *atlas*, is essential for male reproductive ability, since RNAi-mediated depletion of *atlas* results in nearly complete male sterility. With RT-PCR, we have investigated *atlas* expression in divergent *Drosophila* species in order to better understand the gene's evolutionary origin. We have also undertaken cytological analyses to characterize the fertility defect associated with *atlas* knockdown (KD). Phase contrast visualization of *atlas* knockdown male reproductive tracts revealed the accumulation of morphologically abnormal, yet motile, sperm at the basal end of the testis. Through confocal imaging of GFP-labeled mature sperm heads in *atlas* KD testes, we observed disorganized spermatid bundle distribution. Due to the inability of *atlas* KD males to efficiently produce, organize, and store sperm, they also were unable to transfer many sperm to females. Using DAPI staining, we identified nuclear elongation and bundling abnormalities in the developing spermatids of *atlas* KD males. Additionally, phalloidin staining of actin in these males' testes showed regularly formed investment cones associated with individualizing spermatids, but disorganized actin accumulating in the basal end of the *atlas* KD testis. In the future, we plan to continue functional characterization of *atlas* using the *don juan*-GFP marker to visualize sperm tails. We also will repeat cytological analyses using *atlas* knockout flies generated with CRISPR/Cas9. Eventually, we plan to tag *atlas* and/or use immunofluorescence to study atlas protein localization.

We thank the Holy Cross Biology Department and the NSF for financial support, and B. Wakimoto, J. Steinhauer, and R. Bellin for technical advice.

Poster 26

Co-culture Induced Discovery of Antibiotic Compounds from Soil Bacteria

Y. Hu, J. McKillip, A. Marshall, and E. E. Carlson
Department of Chemistry, University of Minnesota

Since the discovery of the first antibiotics, many pathogenic strains have evolved resistance in large part due to the overuse of these important drugs. New antibiotics are urgently needed, yet the process of discovery is slow and inefficient. Many of the most prolific producers of current antibiotic compounds, soil actinomycetes, possess a wealth of additional biosynthetic genetic potential, but the resulting products remain undiscovered due to the organism's inability to create these molecules under standard culturing conditions. We have developed a platform to elicit production of normally dormant secondary metabolite genes by co-culturing the isolated organisms with competitors. Soil samples obtained from Wisconsin were screened, and from those samples bacteria with actinomycete-like phenotypes or those that inhibited the growth of neighboring species were selected and purified. Amongst 28 isolated bacteria samples, one showed a promising zone of inhibition against *Bacillus subtilis*. Efforts are ongoing to perform comparative mass spectrometry-based analysis on the compounds isolated from this organism to identify the bioactive component.

We gratefully thank the National Science Foundation Summer undergraduate research program and the Carlson Lab at University of Minnesota.

Poster 27

Extracellular Matrix Fibronectin Within the Inflamed Dermis

K. Elacqua, N. Fernandes[1,2], and D. Fowell[2,3]
[1]Department of Biomedical Engineering, University of Rochester,
[2]David H Smith Center for Vaccine Biology & Immunology,[3]Dept. Microbiology and Immunology, University of Rochester Medical Center

Chronic inflammation is central to many major medical conditions, as the accumulation of immune cells in chronically inflamed tissue leads to tissue damage. Present-day therapies are non-specific; they inhibit the activation or infiltration of T cells. As this limits the entire immune system, a targeted therapeutic approach is necessary. In inflamed tissue, the extracellular matrix (ECM) composition changes. It has been suggested that the ECM acts as a scaffold for T cell motility, but little is known regarding the specifics of T cell migration through the microenvironment of inflamed tissue. Utilizing microbially-induced tissue inflammation, we observe increased fibronectin (FN) deposition in the ECM and integrin-dependent T cell motility. We hypothesize that the inflammation-induced changes to ECM composition, specifically regarding FN, are central to the regulation of T cell migration within inflamed tissues. To test our hypothesis, we developed methods to quantify FN assembly and test the efficacy of treatments that block FN deposition. We injected CFA/OVA into dermal mouse ears to induce chronic inflammation, and used western blot analysis to observe that FN deposition increased in the ECM over the three days of inflammation, with FN levels peaking at day 2. We also observed an increase in the mRNA expression of FN, Type I and III collagen, and tenascin C in the inflamed tissue using rtPCR. To manipulate FN in inflamed skin, pUR4, a peptide known to block the assembly of FN into the ECM, was administered intra-dermally. Western blot analysis suggested a decrease in FN deposition in the ear when treated with pUR4 for two days after immunization. Future studies will be conducted to characterize how the manipulation of FN alters the ability of T cells to migrate at sites of inflammation. Targeting FN may be a viable means for treating medical conditions impacted by chronic inflammation.

We thank the Summer Scholars Program at the University of Rochester for financial support.

Poster 28

The Influence of Pressure on the Activity of Enzymes from Deep-sea Extremophiles

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Protein splicing is a post-translational process facilitated by an intervening polypeptide, or intein. The intein catalyzes its excision from the flanking polypeptides, or exteins, concomitant with the ligation of the exteins. We studied inteins that interrupt the DNA Polymerase II from the three different extremophiles, *H. salinarum* (Hsa), *Pyrococcus abyssi* (Pab), and *Pyrococcus horikoshii* (Pho). Intriguingly, all three of these inteins conditionally splice; Hsa splicing is dependent on high salt concentrations while Pab and Pho depend on temperature. Previous research has shown that pressure has the ability to affect activity by disrupting binding interactions and altering protein structure. We hypothesized that since deep-sea extremophiles such as *P. abyssi and P. horikoshii* live under moderate pressures (about 1000 atm), then splicing will be unaffected or perhaps even enhanced under pressure. Alternatively, we hypothesized that inteins from surface dwelling extremophiles like Hsa would not function as efficiently at moderate pressure. Lastly, we hypothesized high pressure (2000 atm and above), regardless of the protein structure, will destabilize, unfold, inactivate or reduce activity. Preliminary results suggest that lower moderate pressure (150 atm) does not affect the splicing efficiency of inteins from Pab and Pho, while moderate pressures may slightly increase activity. We have also found that, the function of Hsa inteins appear to be more reduced by moderate pressure than those from Pab and Pho. The Pab and Pho inteins share 23% residue identity and 39% similarity with the Hsa intein. Structural experiments are currently underway to elucidate what regions of these inteins' structure allow for function under moderate pressure. This will help us better evolutionary understand the intein and its structure, and possibly have significant biotechnological applications.

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Poster 29

In Vivo Plasmid Transformation and Construction of Intein-less DNA Polymerase II Allele in *Halobacterium salinarum*

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Protein splicing is a post-translational process in which two mature proteins can evolve from a single gene. Splicing coincides the excision of an intervening sequence, a polypeptide called the intein, with subsequent ligation of the flanking exteins. Inteins have been found in a species of halophilic archaea, *Halobacterium salinarum* (*Hsa*), and previous work has demonstrated that *in vitro* splicing of the *Hsa* DNA Polymerase II (Polll) intein is salt-dependent under reducing conditions. We initially investigated an *in vivo* PEG-mediated transformation protocol to infect *Hsa* with specific plasmids of interest. Future directions will pursue the transfection of *Hsa* with GFP-linked plasmids to study real-time splicing activity *in vivo*. In addition, we worked to create an intein-less allele of the *Hsa* DNA Polymerase II (PolII) gene. After successful knockout of the *Hsa* PolII intein, studies will be conducted to test the fitness cost of maintaining the *Hsa* PolII intein under varying growth conditions.

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Poster 30

Investigating the Nucleating Region of Protein Misfolding in Alpha Synuclein

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Neurodegenerative disorders, such as Parkinson's disease (PD), are characterized by the onset of ataxia and dementia. The biological mechanism that causes these symptoms remains unknown, however, the mis-folding of the protein α-synuclein offers a promising lead. α-Synuclein is a natively disordered (unfolded), however, in individuals with neurodegenerative disorders the new conformation it adopts contains the secondary protein structures β-sheets and α-helices. These structures are thought to form from the exposure of the hydrophobic core of the protein. Furthermore, the presence of these structures causes α-synuclein proteins to aggregate, forming the amyloid fibrils associated with the onset of PD. In previous research, we determined that specific disordered peptides from the hydrophobic core of α-synuclein can disrupt β-sheets, offering insight into possible therapeutic treatments for PD. The goal of our research was to continue identifying which peptides from α-synuclein can disrupt β-sheets. In our experiment we analyzed the ability of disordered peptides from the β-2 hydrophobic region of α-synuclein to disrupt β-sheets, specifically in the ordered peptide VTAV found in α-synuclein. Peptides were synthesized using a standard solid state synthetic technique. The peptide's secondary structure was analyzed with FTIR spectroscopy. If the peptide was disordered a broad peak would be present at 1650 cm^{-1}. However, if they formed antiparallel β-sheets a peak would appear at 1615 cm^{-1}. The results of our experiment indicated that disordered peptides do not disrupt the β-sheets formed by VTAV. However, the peptide VTAV is capable of inducing β-sheet formation in natively disordered peptide, specifically in TAV and VAQ. This finding suggests that the amino acid sequence VTAV could be a nucleating site for the creation of β-sheets between α-synuclein proteins, and therefore amyloid fibril formation.

The authors thank Patricia McGovern Hill '82 and Peter J. Hill '82 Family Summer Research Scholarship for funding this project.

Poster 31

Preventing Aggregation in Peptides Derived from β-sheet Rich Sections of α –synuclein

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Buildup of amyloid fibrils is a cause of certain neurodegenerative disorders. One such disorder is Parkinson's disease (PD), caused by the misfolding and aggregation of α-synuclein. PD is characterized by a loss of motor function in patients with the disease. α-synuclein is a pre-synaptic protein involved in the release of neurotransmitters. This protein normally adopts a random coil structure but contains a hydrophobic core that has a propensity to form β-sheets. Once β-sheets are formed the protein can aggregate into Lewy Bodies that are found in the brains of PD patients. The mechanism of this aggregation is unknown but prior research has identified five regions that could contain the nucleation side for β-sheet formation. Our lab is working to identify this region by determining the β-sheet propensity of various stretches of the protein. GGA is a naturally disordered tri-peptide found in one of the five regions of α -synuclein theorized to be the nucleation site of β -sheet formation. The deletion of the residues 67-71 that contains the tri-peptide GGA has been shown to reduce amyloid formation in the complete protein. GGA and other tri- and tetra- peptides from this sequence were synthesized using solid-phase peptide synthesis techniques. Using FTIR spectroscopy, interactions between GGA and the other peptides of the Δ67-71 region were studied. FTIR spectroscopy to differentiate random coil, parallel β-sheet and anti-parallel β-sheet secondary structures, allows us to see the effects GGA has on other peptides. GGA disrupted β -sheet formation in peptides that naturally take on a β-sheet secondary structure.

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Poster 32

Reacting to the Past: The Diverse Art of Latin America

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Reacting to the Past (RTTP) is an active-learning pedagogy consisting of elaborate role-immersion simulations in which students transform into characters within the context of a pivotal historical situation. Assessment data point to hallmark characteristics that have made RTTP a successful pedagogical strategy in undergraduate settings: student-centered, high rate of student-led learning, and collaborative peer-to-peer knowledge building. During the multi-session games between 10-30 players debate complex ideas using the information and core texts provided in the Gamebook. Instructors serve as Gamemasters, aided by a separate Instructor Manual with information, handouts, and guidelines for keeping the class on track. Publications in the RTTP series have focused largely on Europe and the U.S.; however, in 2016, Franco created a pilot RTTP game called "The Prado Museum's Second Expansion: The Diverse Art of Latin America" which explores the complex topic of modern and contemporary Latin American artwork. Unlike most RTTP games, "The Second Expansion" is played in English or Spanish. We brought the pilot game's materials into alignment with the official RTTP publication templates, incorporating modifications based on prior playtests of the game and editing both the Gamebook and the Instructor Manual. We created new characters, modified the existing character sheets, integrated more bilingual primary source documents (such as art manifestos), fine-tuned the ways in which the characters interact with one another, and polished the game narrative and "big ideas" debates. Our research, conducted through traditional library resources as well as interviews with local museum curators and conversations with RTTP veterans, resulted in the improved balance of the diverse geographic, thematic, ideological and aesthetic representations found in 20th and 21st century Latin American art. We plan to use "The Second Expansion" in an upcoming course and to publish our findings for broader dissemination.

We thank the George I. Alden Trust for its financial support.

Poster 33

Development of Novel Polymers from Lignocellulosic Biomass: synthesis and polymerization of 2-naphthol based structures

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Developing methods to produce commodity chemicals and polymer co-products concomitantly with biofuels is a key piece of creating the not yet realized bio-economy. Polycarbonates are a class of strong, moldable thermoplastic polymers with numerous commercial applications, and are primarily synthesized from petroleum-derived chemicals such as phenol. Catalytic fast pyrolysis (CFP), which converts biomass to fuels and small molecules, produces value-added chemicals that show promise as polymer precursors, thus providing a potential route to sustainable polymer production. Our study aimed to use the CFP product napthalen-2-ol (2-naphthol), a molecule not commonly found in petrochemical processes but which has a structural resemblance to phenol, to produce unique polycarbonates. Synthetic strategies were employed to design dimerized 2-naphthol structures containing methyl, ethyl and propyl bridges. Condensation reactions of 2-naphthol and either formaldehyde or acetaldehyde were attempted under both acidic and basic conditions, yielding mixed results. The most effective bridging reaction formed 1,1'-methylenebis(naphthalen-2-ol), which was then used as a monomer for polymerization via transesterification with diphenyl carbonate. Varying melt polymerization reaction conditions produced novel polycarbonate materials. Analysis by gel permeation chromatography (GPC) and differential scanning calorimetry (DSC) showed the formation of polycarbonates up to 4790 g/mol in mass and with glass transition temperatures as high as 208 ºC.

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Poster 34

Density Variations in a MOT & Search for Atomic Diffraction

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Using laser-cooling, a magneto-optic trap (MOT) can produce gas samples of ultra-cold atoms, moving on the order of a few cm/s, one ten-thousandth their typical room-temperature speeds. According to quantum theory, at speeds this small the (DeBroglie) wave-like properties of the atoms become significant and effects like diffraction can be observed under the right conditions. To look for evidence of atomic diffraction, we used our MOT to produce a cloud of ultra-cold rubidium atoms and dropped these atoms 50 mm onto a permanently magnetized surface with a periodic magnetic field (or magnetic diffraction grating) which has a period of 0.47 μm/cycle. While we were able to recapture some atoms reflected off the magnetic grating, their spatial distribution was very broad, inconsistent with expectations from our theoretical modeling. We present fluorescence signals showing the reflection of atoms, with a peak near the expected bounce time due to gravity. During the process of improving the trap laser alignment, we discovered a striped pattern in the initial density of the MOT atomic cloud, whose spatial period varies in a predictable way with the misalignment angle. While this has been observed by other researchers, surprisingly there is no published study with significant data; we present such data here. Lastly, we report key technical improvements: (1) software to automatically measure size and temperature of the initial cloud using time-of-flight; and (2) construction of a square electro-magnet. The magnetic field of the latter will be used to optically pump atoms into the proper initial quantum state for optimum diffraction and to keep atoms in that state ("adiabatic following") as they reflect off of the magnetic diffraction grating.

We thank Richard B. Fisher '47, P79 for his generous contribution to the Alumni/Parents Summer Research Scholarship Fund.

Poster 35

Anti-reflective Coating of Laser Diodes

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In previous atomic physics experiments done using an Extended Cavity Diode Laser system, we have observed that the laser sometimes shows a detrimental instability in the frequency of output light. Other research has shown it is possible to reduce the instability by lowering the reflectivity of the laser diode chip. This summer we have developed an effective procedure for the process of coating the front facet of the laser chip with a thin anti-reflection layer of silicon monoxide. Inside a vacuum chamber, SiO granules are held in a tantalum "boat" which is heated by passage of a large current. The SiO heats up to ~1200°C, evaporates, and is deposited onto the laser diode chip mounted above. A crystal thickness monitor is placed nearby to determine how much material is deposited. Several key technical steps were accomplished to render this process effective. We tested three different boat types and determined how the rate of deposition varies with the following factors: the heating current, the boat type, and the amount of SiO. We found that the boats require a gradual heat up and cool down to avoid cracking from thermal expansion. To operate and monitor the laser diode chip during the deposition process, we added electrical feedthroughs into the chamber. We also created a computer-control system to automatically track the change in the laser threshold current and other parameters during coating. In the end, we successfully deposited SiO in a controlled manner and saw the expected gradual change in laser diode functioning due to lowering the reflectivity. However, we seek a better understanding of how the deposition parameters (especially thickness monitor readings) relate to the achieved reflectivity and on improving the reproducibility of the process and durability of the coatings.

We thank the Weiss Summer Research Program for financial support in this research.

Poster 36

Performance of a Diode Laser with an Anti-Reflective Coating

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A laser system typically requires two reflectors to form an "optical cavity" for light amplification. An external grating adopted in our laser diode system acts as a reflector and enables us to tune the laser light frequency as desired. Yet when the grating is applied, the front facet of laser diode becomes an unnecessary third, middle reflector. The light wave reflected from the front facet interferes with that from the grating, sometimes making the laser frequency unstable and difficult to tune. Our work this summer has aimed to stabilize laser's output by applying an anti-reflective (A/R) coating to its front facet, and more generally to study the effect of coating on the laser's behavior. The A/R coating itself is a thin layer of silicon monoxide deposited by vacuum evaporation. To understand the relationship between reflectivity and thickness of silicon monoxide, we built a mathematical model through existing optical theory: when the thickness of the coating layer is a quarter of wavelength, destructive interference is maximized, which optimizes the effect of the A/R coating. After coating the laser diode with silicon monoxide, how do we know if the reflectivity has actually decreased? The reflectivity directly affects the threshold current value (the turn-on point for laser amplification). By taking measurements of threshold current, we infer how the reflectivity changes with thickness. We have coated several laser chips with different thicknesses and we will present results from them in terms of reflectivity and laser tuning behavior. We see evidence of reduced "mode hopping" instability for a laser chip with a low-reflectance coating.

We thank the Weiss Summer Research Program for financial support.

Poster 37

Characterizing Trial-to-Trial Variability in MEG Data

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Magnetoencephalography (MEG) allows for non-invasive measuring of brain activity. The brain is likely to react slightly differently to individual trials in an experiment, but MEG data contains so much noise that it is difficult to analyze how trial-to-trial variations occur and how they may relate to behavior. For example, in order to measure how a subject learns a task across multiple trials, averaging all trials or subsets of trials together would improve the observable response but weaken or remove the change that occurs between trials (the actual learning). Furthermore, in order to statistically model single-trial evoked responses, we need a way to characterize how large these variations are. Single trial analysis is a fairly new idea in MEG with no dominant method, so we explore and modify methods for isolating single- or few-trial evoked responses while characterizing variability between trials. Focusing primarily on trial latencies, we use a modified cross-correlation method along with detection of outliers to align trials and remove variation. From there, we are better able to obtain estimates for both latency and amplitude variation for further modeling of single trials and to characterize the types of trial-to-trial variation present in MEG data.

This project was funded by the National Institute of Health and sponsored by the Center for the Neural Basis of Cognition.

Poster 38

North Atlantic *Sargassum*: An Assessment of Health and Molecular Phylogenetics

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Within the North Atlantic Subtropical Gyre lies the Sargasso Sea, where *S. fluitans III, S. natans I*, and *S. natans VIII* are the most abundant forms of the holopelagic seaweed *Sargassum*. This study aimed to assess the relationship between the percent epibiont coverage on *Sargassum* and plant health, quantified by percent new growth region. It also aimed to elucidate phylogenetic relationships through the amplification and analysis of a region of the Cox3 marker gene, using a novel set of primers. It was hypothesized that: the percent epibiont coverage would positively correlate with plant health, the established phylogenetic relationships would be confirmed, the number of single nucleotide polymorhpisms (SNPs) between forms of *Sargassum* would increase and new alleles would be discovered as a result of building upon past studies. After collecting *Sargassum* via Neuston net tows and opportunistic dip-netting, it was found that percent epibiont coverage had no relationship with percent new growth region upon morphological analyses. Genetic sequences for 17 samples with representatives from four forms of *Sargassum* (*S. fluitans III, S. natans I, S. natans VIII, and S. fluitans other*) were assembled and aligned. It was found that *S. fluitans other* was most closely related to *S. natans VIII* than to any of the other forms. The hypotheses were not supported, as no new SNPs were found and no new alleles were discovered.

We thank the Sea Education Association for financial support.

Poster 39

Copper-Catalyzed Reactivity of Ketenimines

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Ketenimines are reactive synthetic intermediates that can engage with nucleophiles, electrophiles and radicals. We applied the recently discovered ‘click chemistry’ that utilizes copper as a catalyst to generate desired ketenimines from the reaction of an alkyne with tosyl azide. In a one-pot copper-catalyzed process, the acyclic substrate is transformed into a 1,4-disubstituted 1,2,3-triazole that spontaneously decomposes to the ketenimine intermediate, which can then be engaged by a nucleophile at the electrophilic carbon. A limited number of nucleophiles are known to react with the electrophilic carbon of the ketenimine. We sought to expand the substrate scope of nucleophiles that can engage with the ketenimine. We tested ethynyl ethers in an intramolecular fashion to synthesize various beta-lactam precursors. Beta-lactams are important synthetic intermediates as they make up the core structure of various antibiotics. In the Isaacs lab, we performed experiments that effected a cascade reaction where the ketenimine was engaged in an intramolecular fashion with an appended nucleophile. This work features an all-carbon framework, attained in two steps from alkylidene malonates.

We thank the Research Corporation and the generous contribution made by Dr. and Mrs. William C. Goggins '88 to the Alumni/Parents Summer Research Scholarship Fund for financial support.

Poster 40

Peter Weaver's Golden Journey: A Transcontinental Route to the California Gold Rush

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My great great great great grandfather, Peter Weaver, was a gold miner in Dahlonega, Georgia, the site of America's first major gold rush. Nearly two decades later, Peter had married and fathered five children when the word of gold in California made its way to Dahlonega. Peter left in 1848 for California, and I believe that seven months after his departure, Peter’s wife died, causing two of the children to move in with an uncle, one to move in with a family friend, and the two boys to move in with their grandfather, but seven months after that, the grandfather died as well. According to one family legend: the oldest boy, William P, who was fourteen at the time, had no where to live, so he decided the best way to resolve the situation was to travel by himself across Antebellum America and bring his father home in order to reunite his separated children. My research on this family legend involved multiple visits to national trail archives, trail museums, Georgia court houses, and even a trip to Independence, Missouri, and a trip to Coloma, California. The result of my research was a 131-page autoethnography in which I explained my journey to discover information about Peter, a historical fiction short story based in antebellum Georgia, and a presentation to the Lumpkin County Historical Society in Dahlonega, Georgia.

We thank Mr. Stephen P. Skinner '77 and Ms. Nancy Savage Skinner '79 for their contribution to the Alumni/Parents Summer Research Scholarship Fund that made this project possible.

Poster 41

Creating Amines using Cyanates and Carbamates

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In the world of organic chemistry, there are number of different ways to synthesis primary amines. However, the conditions that these reactions require can be incompatible with other existing functional groups. Amines are found in amino acids, protein structures, and many other natural organic compounds making them relevant to a number of different scientific fields. The aim of our research was to develop a way to synthesis amines from primary, secondary and tertiary halides under gentle and timely conditions. We have focused on creating isocyanates and carbamates as intermediate products because they can later be turned into amines. Once the synthesis of carbamates has been optimized, then our research will focus on different carbamates that can act as protecting groups. A nitrogen group is fairly reactive due to its lone pair of electrons, so protected nitrogen groups that could easily be converted into an amine are attractive synthetic targets.

We thank the Alumni/Parents Summer Research Scholarship Fund for making this research project possible.

Poster 42

Identifying Financial Market Breakdown Using Probabilistic Change Point Analysis

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In regression analysis, change points help divide long datasets into smaller and more manageable subsets. There are a variety of approaches used in identifying change points in datasets. Yet, few of the approaches give uncertainty bounds on both the number and locations of change points at the same time. Using Bayes' Rule, we created a probabilistic model to analyze three different financial datasets, and we were able to detect the exact number and locations of change points among thousands of data points. To improve the accuracy of our probabilistic model, we also introduced Cochrane-Orcutt estimation to adjust for serial correlation in the error term. This adjustment gave us an even more reliable and accurate model. The change points we identified in the S&P 500, oil and gold prices accurately match the market breakdowns we expected.

We thank the Weiss Summer Research Program for financial support.

Poster 43

Using Drosophila as a Model for C9orf72 ALS

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Amyotrophic Lateral Sclerosis (ALS) is a selective neurodegenerative disorder that ultimately leads to neuromuscular dystrophy, asymmetric weakness, and death. Only 5-10% of people who suffer from this disease live longer than ten years from their date of onset, and most patients die within four years. While the majority of cases are sporadic, there also exists a significant population of familial, hereditary cases. The most common cause of familial ALS involves a hexanucleotide repeat expansion (G_4C_2) in the C9orf72 gene, and this mutation is present in roughly 7% of sporadic cases as well. Using an upstream activating sequence (UAS) of the G_4C_2 hexanucleotide expansion, C9 ALS can be modeled in Drosophila. In C9 ALS, one proposed underlying mechanism involves disruption of nuclear-cytoplasmic transport. KPT-350 is a SINE (selective inhibitor of nuclear export) compound, already being clinically tested, that has shown efficacy both in the suppression of nuclear export and the survival of neural cells. Therefore, it can be considered a potential drug treatment for ALS, especially when considering that it has been shown to have very few side effects. The primary goal of our experiments was to test the efficacy of KPT-350 on flies possessing the model C9 ALS mutation. We showed that KPT-350 can rescue both fly lethality (using an OK371-Gal4 driver coupled with the hexanucleotide expansion UAS) and an eye degeneration phenotype (using a GMR-Gal4 driver with the UAS). In addition to nuclear-cytoplasmic transport deficits, we also studied genetic modifiers of the disease for eye degeneration and locomotor activity.

We thank the NIH and Target ALS for financial support.

Poster 44

Don't Be Salty: Protein Splicing of Salt-dependent Inteins from *Haloquadratum walsbyi*

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Protein splicing is a self-catalyzed, post-translational process in which an intervening polypeptide sequence, or an intein, catalyzes its removal from two flanking polypeptide sequences, or exteins, as well as the ligation of the exteins. We are interested in the splicing capabilities of two inteins that interrupt the cdc21 protein from *Haloquadratum walsbyi* (*Hwa*). *Hwa* is a halophilic archaeon found in high salt environments such as the Red Sea. For this reason, we hypothesize that protein splicing may be salt dependent. We are interested in studying the splicing capabilities of both inteins separately and when expressed as part of the same protein. The first intein, Cdc21a, does not splice on overexpression in *E. coli,* but can be induced to splice *in vitro* on incubation with 2.5 M sodium chloride at 28°. The second intein, Cdc21d, splices *in vivo,* and can be induced to splice further with higher concentrations of salt. When expressed in the same precursor fusion protein, the inteins continue to show differential activity conditional on salt concentration, which could lead to alternative spliced products.

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Poster 45

Efforts Toward the Total Synthesis of Rubesanolides A & B Via a Nucleophile-Promoted Michael-Aldol-β-Lactonization

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Rubesanolides A and B are tetracyclic diterpenoids isolated from the *Isodon rubescens*, a medicinal plant indigenous to southern China traditionally used to treat respiratory and gastrointestinal bacterial infections. Their structure is unique not only because they contain a β-lactone subgroup but also because they are the first isolated natural product to contain fused rings in a chair, boat and twist-chair conformation. We attempted to access the tetracyclic core of these natural products via a nucleophile-promoted Michael-aldol-β-lactonization, an organocascade process developed by the Romo group that allows for the rapid formation of structurally complex molecules. We report efforts involving both acyclic and cyclic substrates as well as the effect that the tertiary amine nucleophile has on the outcome of the reaction. In addition, analysis of the organocascade process by Reaction View IR spectroscopy further substantiates the intermediacy of an α,β-unsaturated acylammonium salt and its proposed participation in the Michael-aldol-β-lactonization pathway.

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Poster 46

Copper-Catalyzed Reactivity of Ketenimines

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Ketenimines are reactive synthetic intermediates that can engage with nucleophiles, electrophiles and radicals. We applied the recently discovered 'click chemistry' that utilizes copper as a catalyst to generate desired ketenimines from the reaction of an alkyne with tosyl azide. In a one-pot copper-catalyzed process, the acyclic substrate is transformed into a 1,4-disubstituted 1,2,3-triazole that spontaneously decomposes to the ketenimine intermediate, which can then be engaged by a nucleophile at the electrophilic carbon. There is a limited knowledge on the reactivity of this electrophilic carbon on the ketenimine intermediate. We sought to expand this knowledge of the reactivity by comparing the yields of ketone and ester substrates in these 'click chemistry' reactions. By utilizing multiple known nucleophiles that react with the electrophilic carbon, not only was the synthesis of new compounds discovered, but also data was collected on how efficiently this intermediate reacted with a ketone and an ester substrate on an otherwise identical reaction. We also looked to broaden the knowledge of nucleophiles capable of attacking ketenimines by utilizing alcohols, alkyl silanes and cyclic amines which allowed for the synthesis of compounds previously never formed.

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Poster 47

Discerning Developmental Windows of Larval Feeding Structure Plasticity

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As sea urchin larvae develop and grow post-fertilization, they produce a series of ciliated, skeleton supported "arms" that are used for feeding and swimming. Research has demonstrated that the size of these food-collecting structures trades off with the size of the primary food processing structure, the larval stomach. The magnitude and variability of the food treatment can also affect the magnitude of expression of these structures. Most studies of this phenomenon rear larvae in a single food treatment for the duration of the larval period, which larvae are unlikely to experience in nature. As such, we understand little of how dynamic larval growth can be in response to changing environmental conditions. We aim to discern the patterns of expression associated with the magnitude and plasticity of larval feeding and food-processing structures among larvae that are regularly switched from low to high food conditions and vice-versa. We are conducting a series of experiments to this effect using larvae of the common sea urchins *Lytechinus variegatus*. We report here the preliminary results of our experiments in progress and seek input to refine our approach and design of future studies.

We thank the generous contribution made by Marion and Samuel E. Krug, Ph.D. '65 to the Alumni/Parents Summer Research Scholarship Fund.

Poster 48

Patterns of Nervous System Growth Associated with Larval Feeding Structure Plasticity

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Sea urchin larvae been studied to understand the expression and evolution of the phenotypic plasticity of feeding structures. Larvae reared in low food conditions grow longer ciliated, skeleton-supported "arms" that are used for feeding, than their genetically similar counterparts reared in high food conditions. Sea urchin larvae are also classic model organisms for the examination of developmental processes and mechanisms. Some research has begun to elucidate the molecular mechanisms underlying the plastic expression of larval arms during the initial hours to days of development. However, no research has explicitly examined morphological changes or trade-offs associated with nervous system structure and development between low and high fed larvae reared throughout the entire larval period. These changes are to be expected, as nervous systems are notoriously plastic, forging and breaking connections among neurons and effectors in response to a host of internal and external factors. We are examining morphological differences in the nerves of the feeding arms and gastrointestinal regions of larvae of the sea urchin *Lytechinus variegatus* using fluorescent staining and confocal microscopy. From these experiments, we anticipate finding differences in nervous system lengths and axonal girths in arm and gastrointestinal regions. The results will elucidate the effects of plasticity in invertebrate nervous system development in response to external food resources. These data will also shed light on the patterns of nervous system development and growth that larvae may experience throughout the duration of the pre-metamorphic larval stage.

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Poster 49

Factors influencing Cognitive Control to Food-Related Cues in Clinical and Nonclinical Populations

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Individuals with eating disorders exercise remarkable control over their eating behavior, engaging in extreme dieting and resisting food-related temptation in situations where others cannot (Brooks et al., 2011). Some researchers have suggested that such extreme measures may come at a cognitive cost. We recently conducted a pilot study (Hayaki et al., under review) using the antisaccade paradigm, a measure of cognitive control in which participants are instructed to look away from a suddenly appearing visual stimulus. The task requires participants to suppress the automatic response to look toward a stimulus; when participants fail to suppress this response, their error represents a breakdown of cognitive control. In our study, undergraduate women and men were instructed to look away from healthy food, unhealthy food, and neutral cues. Participants made significantly more errors toward healthy food cues than toward non-food cues. In addition, the severity of self-report eating disturbance and body dissatisfaction predicted errors toward unhealthy, but not healthy, food cues. Our preliminary findings thus suggest that nonclinical young adult women and men may exhibit some deficits in cognitive control toward food cues. Further research is necessary to determine whether such cognitive control deficits exist in persons with clinical levels of eating disturbance. This study aims to investigate cognitive control using the antisaccade task in (a) women undergoing treatment for eating disorders and (b) female healthy controls. Results will allow us to analyze differing levels of cognitive control in both clinical populations of women with eating disorders and their nonclinical counterparts when presented with visual images of healthy food, unhealthy food, and neutral stimuli.

We thank the Alumni/Parents Summer Research Scholarship fund for financial support.

Poster 50

Rubrene Single Crystals: Morphology and Characterization

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The aim of this work was to set up and optimize an apparatus for growing high quality organic single crystals via a vapor-transport method, together with the systematic characterization of the crystals obtained in such a way. The samples grown in this study where rubrene single crystals, a material that is currently of interest for unique characteristics such as high efficiency singlet exciton fission and triplet exciton fusion, and a large triplet exciton diffusion length. Crystal growth was studied as a function of parameters such as sublimation-temperature and flow-rate — which were optimized towards obtaining different crystal geometries — and the quality of the crystals was validated by determining their photoluminescence spectrum, particularly in view of avoiding an artifact that has plagued the crystals grown by other groups. The crystals we obtained where confirmed to be of pristine quality. In addition to obtaining their photoluminescence spectra, we also conducted a study of the triplet exciton diffusion length by observing the luminescence caused by triplet-triplet annihilation in several crystals. In this way we confirmed that the triplet diffusion length in the crystals we grew reaches the same relatively long value of 4 micrometers that was previously determined in samples grown by other groups.

I would like to thank the National Science Foundation grant PHY-1359195 for financial support of this project.

Poster 51

Molecular Systematics of Cave Trechine Beetles in Eastern North America

G. Gabro and K. Ober
Department of Biology, College of the Holy Cross

Conserving biodiversity keeps intact the complex relationship between organisms and the environment. An understanding of the evolution and diversity of organisms in vulnerable habitats is critical to our ability to preserve and protect them. The caves of the Appalachian region of the United States supports an impressive diversity of cave-specialized beetles belonging to the ground beetle tribe Trechini. The genus *Pseudanophthalmus* alone includes ~ 250 species. The exceptional species diversity of North American cave trechine beetles makes their lineage uniquely valuable to the study of speciation processes in cave insects. This work used DNA sequence data from the nuclear 28S ribosomal gene to reconstruct an evolutionary tree of cave beetle species and populations. The methods of this investigation involved DNA extraction from beetle specimens, PCR amplification, gel electrophoresis, and subsequent DNA sequencing. Results of this study show the evolutionary relationships of cave beetle species largely match the current taxonomy of species and species groups, and closely related beetle species share the same river basin. Molecular evolutionary analysis of *Pseudanophthalmus* shows the remarkable diversification of this cave beetle genus.

We thank the Alumni/Parents Summer Research Scholarship fund for providing financial support.

Poster 52

Evolution of the Opsin Gene in Eyeless Cave Beetles

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Vision and light sensing in beetles and other types of insects are controlled by two opsin genes, UV and LW opsins. For cave-dwelling beetles, living in total darkness, eyes are often completely absent. In the blind, cave beetle *Pseudanophthalmus robustus*, opsin genes may no longer be under selective constraint and could be evolving via other mechanisms, such as genetic drift, compared to related surface-dwelling species with eyes. In blind cave beetles, opsin genes may have accumulated loss of function mutations, or opsin genes may serve an alternative function and may be conserved. To test this hypothesis, we worked to compare the DNA sequence of the UV and LW opsin genes in eyeless *Pseudanophthalmus robustus* and eyed *Amphasia interstitialis*. We extracted total genomic DNA from the beetle specimens and we isolated cDNA from both the head and body of fresh specimens of both beetles. Using conserved PCR primers designed from other insect opsin sequences, we PCR amplified the genes, followed by gel electrophoresis, a technique used to sort DNA based on size. We then cloned the gene fragment in a bacterial plasmid and sequenced the gene fragment plasmid insert. Results from DNA sequencing indicated the gene fragment amplified and cloned was not a beetle opsin gene, but instead a beetle cyctochrome P450 gene. In the future, we hope to evaluate the evolutionary mechanisms at play by comparing the opsin DNA sequences between the two types of beetles. Based on the number and placement of changes in the DNA sequence we will determine both what type of evolution is acting on these opsin genes as well as how strong those evolutionary pressures are.

We thank the generous contribution made by Mr. and Mrs. Domenic J. Dinardo '75 P21,17,06 to the Alumni/Parents Summer Research Scholarship fund.

Poster 53

The Mathematics of Heart Disease

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College of the Holy Cross

For decades, heart disease has been the leading cause of death in the United States for both, men and women. The oddity of this phenomenon is how heart disease is considered the most preventable disease around. Doctors and nutritionists have a lot of theories on what is causing this epidemic; theories from these professionals correlate poor diet and exercise for being the major factor into the development of heart disease. After learning how to code in the statistical analysis software, R, I analyzed a dataset from the Cleveland V.A. medical center that included 297 patients with heart disease. The dataset contains 14 different attributes of each patient, including each individual's sex, age, cholesterol level, level of chest pain, etc., attributes which may or may have not been important in the development of heart disease for that specific individual. This summer, I created several models that allowed me to identify which attributes were the most influential in the development of heart disease for the dataset I used. In the frequentist setting, stepwise regression combined with the AIC criteria can be used to identify the 'best' model. On the other hand, a Bayesian approach to logistic regression allows one to quantify the uncertainty associated with the 'optimal' model. The Metropolis-Hastings algorithm was used to explore the set of potential models with the likelihood of each possible model determined by using Monte Carlo integration. The Metropolis-Hastings algorithm was run for 143,000 iterations with a burn-in of 10% and a lag of 3 to help reduce the correlation between successive observations. In the end, we identified both the most probable model and several viable alternatives. My most accurate model was 84% accretive, while the other two were 83% and 81% accurate. There were clear differences between Bayesian Logistic Regression and Stepwise Regression, with Bayesian Logistic Regression providing a more accurate model.

We would like to thank the National Science Foundation for their support of this project (DMS-1407670).

Poster 54

Relevance of East-West Philosophy on Depression

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Depression, a disorder which is becoming ever more prominent in the global sphere, is primarily treated and researched utilizing the biomedical model. This model holds that biological factors cause mental illness, the symptoms of which create both the social stigma and warrant for the treatment of a patient. This is an approach which ignores the legitimacy of certain psychological symptoms, the presentation of which differs greatly between cultures. Given that there isn't one globalized understanding when it comes to a disease or disorder, can the singular biomedical model be utilized world-wide? By warranting the use of the same medical model, we often marginalize the underpinnings of understandings that cultures have of 'health', which can be traced back to the philosophical ideals of different traditions. Comparing the philosophical ideas of Mencius and Aristotle, I show how they agree that human flourishing is not only bound up with the health of an individual's mind, but with the socio-cultural, economic, and political conditions in which an individual lives. Consequently, reliance on the biomedical model alone is insufficient for understanding depression as it ignores the psychosocial factors. Exploring Mencius's and Aristotle's philosophies of human flourishing reveals that at the bases of Eastern and Western philosophies lie both similarities and differences in regard to psychosocial conditions which impact human well-being. Focusing on the differences in Mencius's and Aristotle's understanding of such psychosocial conditions will have implications for a better understanding of depression across cultures.

We thank the Weiss Summer Research Program in the Humanities, Social Sciences, and Arts for financial support of this project.

Poster 55

Zycie w Ameryce: Life in America

B. Cotter and S. Yuhl
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My project explores the history of the Polish-American community of Worcester, Massachusetts centered on the parish of Our Lady of Czestochowa on the slopes of Vernon Hill and how its members responded to the forces of Americanization between 1940 and 1980. Polonian identity, composed from the strands of Polish nationalism, a distinct vein of Roman Catholicism, and American patriotism, was and is one that encouraged strong communal ties. Like many ethnic groups new to America, however, Polish-Americans and Polish immigrants in the twentieth century faced pressure to conform and depart from their cultural traditions and community in exchange for social mobility and acceptance in American society. Over eight weeks, I conducted research in area archives such as the Worcester Historical Museum, the Worcester Public Library, and at Our Lady of Czestochowa's rectory and its parish school of Saint Mary's. I also conducted a dozen oral history interviews with past and longtime members of the community to test the assumption that the story of Worcester's Polish community is one of decline. Certainly, Worcester's Polish community adapted where it had to, as seen in the choice of some families to discourage their children from learning the Polish language in the early years of the Cold War. However I also found that Polish-American efforts to preserve their group identity proved to be particularly resilient in Worcester. The resilience of Worcester's Polish-American community against full Americanization ensured the preservation of this distinct and enduring ethnic culture that today makes up a corner of the cultural mosaic that is Worcester. The findings of my project have resulted in a research paper as well as an historical display at Saint Mary's High School.

I would like to thank the George I. Alden Trust for financial support.

Poster 56

Pulse-Shunt Concept Teaching Modules

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Department of Biology, College of the Holy Cross

It is important to teach science through relevant, engaging, and dynamic methodologies. Educators and students alike benefit from course material that is thoroughly interactive, demonstrative, and purposeful. My research into STEM education and freshwater ecology of the primary scientific literature and educational resources lead to the creation of teaching modules for high school and college-level courses. Each module incorporates and encourages active-learning under the broader umbrella of the MacroSystems Pulse-Shunt Concept National Science Foundation grant. These modules are designed with learning goals and outcomes in mind, student assessment methods, necessary materials, and potential collaborators. For illustration, one module is entitled, "Freshwater Macroinvertebrates: Identification and Importance." The learning goals include identifying major macroinvertebrate functional feeding groups using a key, understanding the role and importance of various functional groups in freshwater systems, and evaluating the relationship between macroinvertebrates, stream qualities, and stream health through mathematical application. The learning assessment consists of a case study in which students identify photos of macroinvertebrates by their order and functional feeding group, and based upon macroinvertebrate assemblage and ratios, predict various features and the health of a model stream. Ultimately, students learn how to assess a freshwater ecosystem using mathematical procedures, while also appreciating the role insects play in stream productivity, respiration, and health, organic matter composition, channel stability, and predator-prey interactions. Beyond this, students are asked to think broadly and critically about the impact of humans and large storm events on freshwater systems. My research culminated in the creation of a website to house the teaching materials, which will be accessible for use by educators around the world.

We thank Dr. Robin L. Vannote for financial support.

Poster 57

Helminth Infection Protects Against High Fat Diet-Induced Obesity via Induction of Alternatively Activated (M2) Macrophages

C. Su, C. Chen, Y. Li, S.R. Long, D. V. Kumar, W.J. Massey II, W. A. Walker, and H. Shi
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Massachusetts General Hospital and Harvard Medical School

Evidence suggests that obesity is accompanied by chronic low-grade inflammation in adipose tissues, mainly due to the accumulated inflammatory cells. A Type 2 response driven by helminth infection has been linked to the amelioration of some Type 1 inflammatory responses characteristic to obesity. We sought to investigate the relationship between helminths, host immunity, and obesity, as well as to delineate mechanistic aspects of how helminth infection may confer protection against obesity. We induced obesity in mice with a high fat diet (HFD). Mice were fed HFD with the intestinal nematode parasite *Heligmosomoides polygyrus.* We adoptively transferred the helminth-induced macrophages into HFD-fed mice to elucidate the functional capacity and contribution of macrophages in obesity. Mice fed with HFD gained significantly more weight than mice on a control diet. In sharp contrast, *H. polygyrus* infection results in a significant reduction of body-weight gain in HFD-fed mice. These infected, HFD-fed mice have altered expression of key genes involved in lipid metabolism. *H. polygyrus*-induced Type 2 responses and enhanced M2 macrophage polarization suppressed HFD-associated production of Th17 and IFN-g and M1 responses. Adoptive transfer of helminth-stimualted macrophages results in a significant amelioration of HFD-induced obesity. Our results suggest that *H. polygyrus* protects against obesity by promoting a Th2 response and M2 polarization. These responses contribute to the observed attenuated HFD-induced obesity.

I thank the National Institute of Diabetes and Digestive and Kidney Diseases for financial support this summer.

Poster 58

From Bach to Schoenberg through Mathematics

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Since the time of the Ancient Greeks, scholars and philosophers, from Pythagoras to Hofstadter, have sought to understand the connection between music and mathematics. More recently, much research has been done about the connection between JS Bach and 20th-century composer Arnold Schoenberg. While these two composers write in vastly different styles, our goal was to broadly demonstrate how the mathematics behind Bach's music is parallel to the mathematics of serialism, the latter a musical style fathered by Schoenberg in the early 20th-century more than 150 years after Bach's death. We first looked for documentation of Schoenberg's admiration for Bach's compositions. Then we analyzed Bach's Fugue in B Minor (BWV869) and Schoenberg's Op. 11, No. 1 using pitch class set theory and mathematical tools from group theory and combinatorics. Building on this, we next expanded our approach to include the general compositional techniques of these two composers and found that even though tonal and atonal music are drastically different, the fundamental concepts of both styles can be connected through mathematical analysis.

We appreciate the support of the Robert J. Stransky Foundation.

Poster 59

Contributions to Plug in Vehicle Success in the Midwest: Matching Charging Technologies and Desired Markets

D. Santini, M. Yu, Y. Zhou, K. Vazquez, and M. Rood
Argonne National Laboratory

Factors determining success of battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) in a sample of 125 counties in the seven Midwest EVOLVE states are examined through statistical regression analysis for 2015. Midwest EVOLVE project is one of three U.S. Department of Energy funded Plug-In Electric Vehicle Showcase projects. This is a follow-up study of our 2014 PEV market analysis. Comparison between statistic results for 2014 to 2015 shows that the expansion of technical capability of certain BEV models to use DCFC was associated with rapid expansion in sales of these BEV brands at a time when PHEV sales declined. In the statistical models developed for the Midwestern states it is shown that the newly provided accessibility was one statistically significant factor in the success of those brands of PEVs. For the mid-market PHEV category ─ a very unique "one-off" case for which DCFC could be used by the longest electric range PHEV available ─ this was the most important determinant of 2015 success in the Midwest. DCFC was not estimated to be a factor in success in the BEV mass market, but was in the total market and luxury market. The most important charging infrastructure, consistently estimated to be positive and significant across seven of the eight PEV market segment regressions, was SAE "level 2" charging.

We thank the U.S. Department of Energy for financial support.

Poster 60

The Many Faces of Adoption

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We oftentimes believe that adoptions are of the classic fairytale sort. It is considered that the adoptee is plucked from a less fortunate place and brought into a world filled with opportunities and ease. However, the misconception of the fairytale is that adoption is neither as simple as we would like it to be, nor is it as definitive as it sounds. There have been adoptions taking place from all over the world, such as all parts of the United States and several countries like China, South Korea, the Philippines, and even South Africa. We tend to generalize adoptions to fit into one category: the adoptee is given new chances that they would not have had elsewhere, but we forget that the adoptee is a human and humans suffer from the unknown. As people, our history is tied within the way we identify ourselves; where we come from helps define the way we see ourselves and who we want to present ourselves as. It's difficult to identify yourself if you know nothing about your history, whether that is as broad as genetics, or simple as not knowing who gave you life and why they decided to give you up. As part of humanizing adoption, it's crucial that we understand adoption to be as much of a blessing as it is a curse filled with many unknowns. These several portraits help demonstrate the complications of adoption.

We thank the Weiss Summer Research Program for financial support.

Poster 61

The Response of Herbivores to Induced Volatiles and Inbreeding Effects in *Mimulus guttatus*

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Plants give off chemical signals to their environments that provide information about their status and stresses and can be either attractive or deterrent to insect herbivores. Different types of herbivores may respond differently to the same signals from any given plant species, depending on their host plant breadth. Using a series of Y-tube preference tests, this study looked at the response of generalist and specialist herbivores to induced volatiles and effects of inbreeding. The subjects of the tests were two types of larvae: the generalist corn earworm, *Helicoverpa zea*, and the specialist common buckeye, *Junonia coenia*. We found that *H. zea* showed a significant preference for undamaged plants while *J. coenia* showed no significant preference for damaged or undamaged plants, but in total chose damaged plants more often. Neither herbivore showed a significant preference for damaged inbred vs. damaged outbred plants. These results can help explain plant-herbivore interactions and the selective pressures on *Mimulus guttatus* as a result of herbivory. Our results suggest that while induced volatiles may be helpful in deterring generalists, they have minimal effect in discouraging specialists from feeding on plant tissue. Although inbreeding reduces resistance and tolerance to herbivory, it does not seem to affect overall host plant attractiveness to either generalist or specialist herbivores.

Many thanks to the National Science Foundation for funding this REU project and to Blandy Experimental Farm for use of their facilities.

Poster 62

Studies of a Confocal Fabry Perot Cavity

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In charge transfer collisions, a beam of atoms and a beam of ions collide, causing the atom to transfer an electron to the ion. These types of collisions occur in plasmas and their study allows physicists to interpret the properties and behavior of plasmas such as those found in nuclear fusion devices and in astrophysical environments. Here we describe research using a stabilized He-Ne laser to investigate the properties of a confocal Fabry-Perot cavity. This cavity will be used in an experimental system to determine the density of an atom beam used in charge transfer collision experiments. The cavity is composed of two, highly reflective, curved mirrors housed in a low thermal expansion structure. One of the mirrors can be moved over a distance of about a micron to allow the cavity to be made resonant with the He-Ne laser light. Cavity finesse, cavity length, and alignment of the input laser beam and its reflection from the cavity were examined to obtain the optimum resonance condition and minimum alignment drift over time. Including an optical isolator into our setup allowed the input and reflected beams to be more closely aligned while avoiding destabilizing the He-Ne laser with the reflected beam. We measured the stability of the cavity on timescales of 10 seconds and over many hours. Over a 10 s period the resonant frequency of the cavity drifts by less than 2 MHz, corresponding to a change in the cavity length of about 4 parts per billion while the hourly drift is approximately 45 MHz/hour. These measurements were taken after adding a thermally insulated enclosure around the cavity. The measured drift rates are consistent with prior work, and are sufficiently small for the cavity to be used in the experimental system to determine the density of a neutral atom beam.

We wish to thank Mr. Jack D. Rehm Jr. ’88 P20, 18, 16 and Ms. Kathleen Millard Rehm ’89 P20, 18, 16 for a generous contribution to the Alumni/Parent Summer Research Scholarship Fund, Pr. Roach for advice and equipment loans, and Dick Miller for machining expertise.

Poster 63

Melasmós

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Melasmós was a summer poetry project for which I composed blackout poems from four novels written in Ancient Greek. In writing blackout poetry, the poet removes words from a source-text by crossing them out or marking over them until the remaining words form a short, carefully constructed poem. I chose as my source-texts four novels from the first three centuries CE written in Ancient Greek. Since most blackout poetry is written in English, porting the technique to Greek posed several challenges: to name one, whereas many English words derive their part of speech from context (e.g. "fair" can be a noun or adjective, and "was" can be a verb on its own or constructed with another verbal word like "running"), many Greek words change based on their function in the sentence. As a result, Greek words are much harder to divorce from their context, which makes successful blackout poetry that much more difficult - and that much more rewarding. My final poetry collection was my way of translating the relatable themes of romance and adventure from the ancient novel into the twenty-first century. A major goal of my work was to provide current and future students of ancient languages with a way to create with the texts and words they have studied, and to this end I kept a blog tracking my progress and struggles with this endeavor, which can be reached at melasmos.tumblr.com/about.

We thank Deborah C. and Timothy W. Diggins '80 for making a generous donation to the Alumni/Parent Scholarship fund.

Poster 64

Hepatitis C/HIV Co-infection Prevalence: Chart Review of an Inner City Hospital-Based Infectious Disease Clinic

C. LaForest-Roys, P. Srivastava, C. Vergara, A. Lombard, S. Thompson, R. Garcia, and J. Ross
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Hepatitis C remains the most common blood-borne pathogen in the United States, however, many have not been identified and treated. We performed a point-prevalence epidemiologic investigation for five weeks from June-July 2017 investigating the Hepatitis C (HCV) prevalence in the HIV population in the Brownstone Clinic. We discovered that 95% of the HIV patients have been tested for HCV and 43% are co-infected with HIV and HCV. Of the 163 patients who were eligible for treatment, 69 were treated and 53 of those achieved SVR. As for the 94 patients who were not treated, the vast majority had discussed HCV treatment with their provider however for various reasons, they did not qualify for treatment. In the future, this study will continue to track the treatment cascade for the 94 patients who have not been treated. We will also be interested to see if methadone maintenance programming is an effective prerequisite to HCV treatment for co-infected individuals

I thank the Department of Medical Education at Hartford Hospital for funding this research.

Poster 65

How Exosomes Influence Breast Cancer Risk and Treatment

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Exosomes are small extracellular vesicles that are detected in many body fluids. They carry a variety of proteins, lipids, carbohydrates, DNA, mRNA, and miRNAs. If released from a cancer cell, the exosome carries tumor-specific genetic material. Because exosomes are integral to cell-to-cell communication, the information packaged in the vesicle has enormous ability to manipulate the functional and pathological characteristics of the recipient cell. For this reason, exosomes play an important role in cancer progression. We specifically focused on exosomes found in body fluids and their influence on breast cancer risk, diagnosis, and treatment. We hypothesized that various body fluids, outside of those strictly found in the breast, may provide biomarkers that could be useful in detecting breast cancer risk and progression. We looked at breast milk, nipple aspirate fluid, cerebrospinal fluid, urine, and blood as possible fluids that contain exosomes that could be useful in detecting biomarkers for breast cancer. In the research literature, we found that there are certain proteins and miRNAs in various body fluids that are abnormally expressed in breast cancer patients. The current publications show that body fluids containing exosomes provide a promising future for risk assessment and diagnosis. Current research is underway on optimizing purification and drug-loading of exosomes that can be used in cancer therapy. Because miRNAs tend to be abnormally expressed in cancer, research is also being done to use exosomes to control the expression of those miRNAs that may influence progression of breast cancer. The field is interested in using exosomes to restore tumor suppressor miRNAs or inhibit oncogenic miRNAs. However, there are many obstacles that surround using exosomes in cancer therapy, including targeting specific tissues, sourcing and purifying the exosomes, and understanding their biogenesis and signaling pathways. Our review on exosomes in body fluids shows that they may provide useful diagnostic and therapeutic tools, however, significant research is still needed for their use in breast cancer.

We thank Hartford Hospital for sponsoring and supporting this research.

Poster 66

An Exploratory Use of Machine Learning Algorithms: Modeling Metabolic Outcomes and Symptom Severity Based on Genetic Risk Factors in Patients with Schizophrenia

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Antipsychotic medications currently prescribed to treat schizophrenia have severe metabolic side effects, contributing to the observed shortened lifespan in this population. It is unclear whether metabolic risk genes established in the general population are also associated with poor metabolic outcomes among antipsychotic-treated patients. Furthermore, this established comorbidity raises the possibility of shared genetic vulnerability pathways. These hypotheses were explored by using Classification and Regression Tree (CART) and ensemble methods to model both metabolic outcomes and schizophrenia symptom scores based on genetic, clinical and demographic covariates. As compared to the standard CART algorithm, ensemble methods improve predictive accuracy but lose interpretability. Overall, genetic risk factors emerged as important predictors in analyses, suggesting that genetic screening may prove useful for personalized decision making in treatment that manages both metabolic risk and symptom severity.

We thank the generous contribution made by Dr. and Mrs. Timothy J. Babineau '82 to the Alumni/Parent Summer Research Scholarship Fund.

Poster 67

Investigation of Drug Combination Therapy on Primary Mantle Cell Lymphoma Cells

J. Branch, J. Kozachuk, L. Shopland, and A. Curtis
Eastern Maine Cancer Center Translational Research Laboratory

Mantle cell lymphoma (MCL) is a subtype of B-cell non-Hodgkin's lymphoma with a median survival of 3 to 4 years, accounting for 3-6% of all lymphoid neoplasms. Ibrutinib is a drug used to treat patients with relapsed or refractory MCL. Median overall survival of patients who relapse after ibrutinib treatment is a mere 8 months on salvage therapy. Scientists at the EMMC Cancer Care Translational Research Laboratory have predicted that targeting MCL cancer cells using both ibrutinib and olaparib, a drug used to treat BRCA mutated ovarian cancer, might reduce the progression of ibrutinib resistance. Experiments performed on two MCL cell lines suggest an additive and even synergistic effect with this drug combination therapy. Characterizing and validating such cell lines is imperative to fully understanding the implications of these experiments. I performed western blots to quantify proteins in MCL cell lines that are likely to be affected by ibrutinib and olaparib. I hypothesized that I would find equivalent protein quantities in both cell lines. Two proteins were detected, poly ADP ribose polymerase (PARP) and Bruton tyrosine kinase (BTK)—the targets of olaparib and ibrutinib, respectively. Interestingly, PARP was only visible in one of the two cell lines, Z-138, indicating weaker or perhaps nonexistent protein levels in the other cell line, Granta-519. In the future increasing protein extract during the gel electrophoresis step might yield more promising results regarding the three undetected proteins. I also performed combination therapy experiments on primary MCL cells to investigate drug effects using a more realistic model. Results show a response different from that observed in the MCL cell lines, suggesting that the genetics of every MCL individual may cause variable in vitro responses. Performing combination experiments on a much larger assortment of primary cells possessing a swath of MCL mutations would shed more light on the effectiveness of this treatment.

We thank Eastern Maine Medical Center Cancer Care for financial support.

Poster 68

A Dynamical Systems Approach To Climate Modeling

C. Donovan and G. Roberts
Department of Mathematics and Computer Science
College of the Holy Cross

In this project we used low-dimensional mathematical models to better understand current climate, historical climate and the drivers of climate change. Is it possible that we could transition into Snowball or Hothouse Earth with our current climate conditions? By modeling climate with simple Energy Balance Models, certain parameters can be isolated to discern their effect on the temperature of the Earth's surface. In 1968, Mikhail Budyko developed one of the first Energy Balance Models, a differential equation that expresses the global average surface temperature of the Earth as a function of latitude. Budyko incorporated several relevant climate parameters into his model such as albedo (reflectivity of Earth's surface) and the greenhouse gas effect. The latitude of interest in trying to model climate conditions of the past and present is the latitude of the ice line. Using an extension of Budyko's model by Ester Widiasih that tracks the movement of the ice line, we can see how the ice line moves when varying one or more of the parameters. Climate scientists refer to bifurcations, qualitative changes in the equilibrium solutions, as tipping points because they often indicate major shifts in the climate system. So far, we have produced several bifurcation diagrams for different parameters to discern the possibility of extreme climate conditions in both the Neoproterozoic Era and the current climate state. We discovered that albedo is a driving factor of drastic climate change. Additionally, our model supports the theory of Snowball Earth and a subsequent ice-free state in the Neoproterozoic Era.

We thank Dr. Dan Kennedy '68 for a generous contribution made to the Alumni/Parent Summer Research Scholarship fund.

Poster 69

Behavioral Synchrony and Functional Networks in the Brain

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People engaged in social interactions exhibit natural, unintentional coordination of their body movements. Although intense efforts have been made to localize behaviors in human brain activity, little is known about the functional networks that underlie human social interaction. We are interested in how social behavioral synchronization corresponds to functional networks in the brain and generally how the brain behaves in situations of social coordination. To this end, we analyzed electroencephalograph (EEG) activity from an experiment involving participant pairs swinging pendulums in different interpersonal coordination conditions (in-phase, anti-phase, unintentional, and intentional). EEG activity was recorded at 64 electrode locations on the scalp. We are interested in the brain areas which have relative enhancement and suppression of the EEG activity specific to the performed mode of coordination. Our initial analysis considered power values in selected frequency bands across the collection of trials of ten participants. Further analysis focused on the weighted phase lag index (WPLI) of the Fourier transformed time series data in selected frequency bands. Using methods of computational topology, we are able to construct functional networks and cliques based on pair-wise coherence of the WPLI between electrodes. Initial results indicate differences in network structure between different interpersonal coordination conditions in different frequency bands. In future work, we will apply these novel network analysis techniques to evaluate the social brain networks in adolescents with Autism Spectrum Disorder (ASD) since one of the suggested effects of ASD is social disconnection.

We thank the National Institutes of Health (Grant R01GM105045) for financing this research and we acknowledge the Child and Adolescent NeuroDevelopment Initiative (CANDI), UMass Medical School.

Poster 70

Creating Amino Alcohols from Anhydrides

M.Mannara and B. Linton
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Amino alcohols are used in countless syntheses and studies of protein structures, making them relevant to a number of different scientific fields. The aim of our research was to create a direct and selective synthesis of amino alcohols from anhydrides in a time efficient, inexpensive, and high yielding manner. We have focused on using hydride reagents, specifically borohydrides due to their more selective nature, to selectively reduce our anhydrides. NMR analyses are performed and studied to determine the reactivity and overall success of our performed reactions. Once the synthesis of amino alcohols has been accomplished and optimized, our research will focus on different anhydride starting materials that may also undergo this selective reduction.

We thank Mr. and Mrs. David M. Joy ’79 for their generous contribution to the Alumni/Parent Summer Research Scholarship Fund.

Poster 71

Economic Literacy and Stock Market Participation: Evidence from Forty Years of Data

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Department of Economics and Accounting, College of the Holy Cross

Is economic literacy linked with greater stock market participation and investment? We exploit the inflation, unemployment, and interest rate expectations questions of the Michigan Survey of Consumers to measure economic literacy in a population of 500 households. Using original literacy indices to measure respondents' average forecast error for these economic variables, we find that economic literacy correlates positively with stock market participation and amounts invested in the stock market after controlling for demographic information on the household.

I thank the Weiss Summer Research Program in Economics for financial support.

Poster 72

Wage Reporting and Explanatory Power in Wage Prediction

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"Mincerian" factors, named after labor economist Jacob Mincer, are used as variables in the creation of wage regressions. When determining an individual's predicted income, there are several Mincerian factors that are typically considered: education, gender, race, marital status, and many others. However, an additional component that contributes to predicted wages is wage reporting. Survey respondents are paid hourly, monthly, or annually; how that is expressed has varying influence on the dependent variable. This measurement error can also speak to the uncertainty of the marginal product of labor. The research will determine how much the reported wage time unit explains the predicted wage.

I thank the Weiss Summer Research Program in Economics for financial support.

Poster 73

Econphiles

S. Vrountas, J. Svec, and R. Baumann
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Unbiased information is crucial for a well-functioning democracy. This summer, we created four videos to be uploaded to the YouTube channel econphiles, a channel devoted to understanding current events from the perspective of economics and economic research. Three of these videos examined the policies chosen to help the economy recover from the Great Recession of 2008. As part of these videos, we detailed both what the policies were intended to do and the economic research on what impact the policies had in reality. In the other video, we examined the economic arguments behind whether local and state governments should subsidize stadium construction for wealthy team owners.

We thank the Weiss Summer Research Program in Economics for financial support.

Poster 74

Somerville School Assessment: Exploring Alternative Ways of Measuring School Performance

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Does standardized testing accurately assess school performance? By solely measuring individual academic performance, standardized testing fails to measure other components of school quality such as teacher and student behavior, and access to resources. This study explores alternative ways of assessing schools to quantify the degree of performance with respect to these other factors. We analyze Likert scale survey data from 56 teachers in Somerville, MA throughout the school year on various questions relating to school climate. We find no statistically significant trends in school climate over the course of the school year.

I thank the Weiss Summer Research Program in Economics for financial support.

Poster 75

Electronic Circuits for an Ion Beam Profile Monitor

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Collision experiments involving ion beams require knowledge of the size and shape of these beams. Otherwise, these experiments are inefficient and prone to systematic errors. We have designed and partially built and tested an ion beam profile monitoring system to determine the size and shape of the ion beams involved in these experiments. The system involves four main components: the physical monitor consisting of 16 wires which the ions strike generating currents, an array of 16 IVC circuits which convert the currents into voltages, a set of master timer circuits which control the integration periods of the IVC circuits, and a data acquisition card which reads the voltages from the IVCs into a computer and displays the horizontal and vertical profiles of the ion beam. The work done this summer focused on the IVC, master timer, and data acquisition portions of the monitor system. Some IVC circuits have been initially tested and shown to reliably behave as predicted. The IVC circuits still must be physically soldered into a circuit array and the input current-to-output voltage conversion factors measured. All 16 master timer circuits have been completed and preset for five different choices of integration times for the IVC circuits, chosen based on the initial testing of the IVCs. The timers can be tuned to the most appropriate integration time for each IVC circuit once the amount of current generated by the corresponding wire on the physical monitor is known. The data acquisition portion has been tested and accurately displays the voltage values needed to determine the ion beam profile. Once the IVC circuits have been completed and their conversion factors measured, the data acquisition system will be able to accurately display the horizontal and vertical profiles of the ion beam.

We thank the Alumni/Parent Summer Research Scholarship Fund and Dick Miller for machining expertise.

Poster 76

The Whorfian Hypothesis—A Quest for Meaning

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Benjamin Lee Whorf, a scholar in the field of linguistics, investigated the relationship between human language and human thinking more so than many other researchers. He first proposed that language could shape our innermost thoughts. Speakers of different languages, Whorf contended, ought to perceive their surroundings in different ways, based on the language they spoke. This belief—that language is influential of thought—is now referred to as the Whorfian Hypothesis, or the Principle of Linguistic Relativity. To many, this contention is quite fascinating, as it suggests that our native languages predetermine abstract cognitive processes. Some believe that the question "Does language shape thought?" prompts an affirmative response, yet others give a negative explanation. As such, the Whorfian Hypothesis, originally dismissed as banal and insignificant, has been discussed in linguistic circles for several decades. We have compiled empirical findings of the Whorfian Hypothesis and grammatical gender into the form of a paper, and hope to add to the discussion of linguistic relativity by collecting and analyzing data from adolescent bilingual speakers in the Worcester area. The notion that certain cognitive processes *do* rely on our understanding of language is an idea that can be traced back to other principles in philosophy, anthropology, and the social sciences. Ideas pertaining to linguistic relativity can even be found in writings from as early as the seventeenth and eighteenth centuries. It is difficult to establish with which author the language-thought relationship first originated. Nonetheless, we can conclude that these ideas were only able to reach their full fruition after the work of Benjamin Lee Whorf had been published. What follows from the Whorfian Hypothesis is the belief that our world may be filled with more diversity in thought than we can imagine. The goal of our paper, therefore, is not to definitively answer the question "Does language shape thought?" but to instead demonstrate that Whorf's views must be researched more deeply.

We thank the Weiss Summer Research program for financial support.

Poster 77

Development of a Joint Model for Bivariate Longitudinal Data

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College of the Holy Cross

The development of viral resistance mutations among HIV-infected patients is the primary cause of the antiretroviral treatment failure, which is observed clinically by a rebound in viral load and a decrease in CD4 cell counts. Here, we develop a tree-based method to determine the viral genetic mutation patterns associated with poor response to treatment. Such a model might prove extremely effective in guiding treatment decisions for physicians treating HIV-infected patients. Tree-based methods, such as CART, have been developed to model a univariate outcome measurement observed a single time point. We extend the CART framework to accommodate a joint model for bivariate longitudinal data, which will allow us to simultaneously model patients' viral load and CD4 response trajectories. Application of this method to data from the ACTG 398 clinical study revealed distinct mutation patterns from different classes of drugs.

We thank the Alumni/Parent Summer Research Scholarship Fund for financial support.

Poster 78

Mixed Metal Alkoxide Precursors for Direct Write of Complex Ceramic Oxide N-inks

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Currently, several 3D printing strategies exist for various plastic inks, however there is limited research into using ceramic inks, and even less research concerning the development of mixed metal ceramics. Mixed metal ceramic inks are of interest because the mixed metals can have novel electronic properties that single metals do not have. This project's focus was on synthesizing mixed metal ceramic precursors for nanoscale-inks (N-inks) which will be used in aerosol jet 3D printing. The precursors were synthesized using the tridentate ligand 6,6'-(((2-hydroxyethyl)azanediyl)bis(methylene)) bis(2,4-di-*tert*-butylphenol), termed H_3-AM-DBP_2. Previous research indicated that the H_3-AM-DBP_2 ligand modified Group 4 metal alkoxides which form both mono- and di-nuclear compounds. This research was expanded on in an attempt to synthesize mixed metal di-nuclear complexes, with a special focus on Group 13 metals and first row transition metals. Finally, the effect of the H_3-AM-DBP_2 ligand on nanoparticle synthesis of single metals was investigated, including how the ligand affects the size, shape, and distribution of the nanomaterials. Three mixed metals precursors were synthesized, one verified by single crystal x-ray diffraction, and two, after being thermally treated, by powder x-ray diffraction (PXRD). For single metal complexes, nanoparticles were synthesized from both ligated and parent materials and compared. Initial PXRD tests show that the nanoparticles were amorphous for both ligated and non-ligated samples. TEM images will confirm any differences.

We thank the University of New Mexico REU program for financial support.

Poster 79

Stravinsky's Symphonic Synthesis

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Igor Stravinsky's *Symphonies of Wind Instruments* is a unique piece written for woodwinds and brass published in 1920 and revised in 1947. The shrill interjections, contrasting folk-like melodies, and dense chords make it hard to find any clear continuity within the music. An analogy to describe this apparent discontinuity is scene cutting in films, where multiple plots are fragmented and intertwined. However upon analyzing portions of the music within the *Symphonies* it is clear the chaos is intentional and very much controlled. This analysis looks at the finer details of the pitch content within each section, as certain pitches and scales are central to the respective recurring fragments. On the larger scale this analysis especially focuses on how specific fragments of music contrast in character, but ultimately work together like building blocks to create even larger recurring forms.

We thank the Weiss Summer Research Program for financial support.

Poster 80

The Rise of the AfD

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In nationwide elections on September 24th, Germany will be tested on whether it can resist the startling wave of far-right movements that has swept across Europe and the United States. The *Alternative für Deutschland* (AfD) has grabbed international headlines as being the political equivalent of the "little engine that could'—rising from a helpless fringe party to a force that has shocked the German political system in several state elections. But how big of a national threat does the party pose? Pinpointing the exact cause of the AfD's rise is challenging, because the reasons for the party's accession are diffused across history and time, and are not concentrated merely at the present; however, there are factors that have contributed more than others. After analyzing the AfD's campaign literature and dissecting their platform, I have reached the conclusion that the Syrian Refugee Crisis has risen as the main cause of the AfD's recent electoral success. Using xenophobia as its weapon, the AfD will likely propel its way into German Federal Parliament in the upcoming fall elections. What does this mean for the future of German politics? Although the AfD shocked the German political system, my research has shown that it is in a weak position to do major damage in the present. Like the reasons for its rise, the potential reasons for the party's fall are equally expansive. However, the rise of Trump has attenuated the AfD's bid for major influence—quelling the attraction of political change and bolstering the desire for a maintained status quo. Furthermore, Angela Merkel's adroit domestic policy and her ability to adapt her policy to public opinion have reduced any opposition her party faces. Finally, increased infighting within the AfD has split the group into a radical and pragmatic branch—launching an inner party struggle that is largely parasitic. Although the AfD is not an existential threat at the present, will it be in ten or fifteen years?

We thank the Weiss Summer Research Program for financial support.

Poster 81

The Relationship between Land Cover and Water Chemistry in the Fallkill Watershed in Dutchess County, New York

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The Cary Institute of Ecosystem Studies

The relationship between land cover and water chemistry is something that is often observed on a topical level by many while driving by a lake or walking on a bridge over a stream. It is characterized by how the physical use of the land surrounding a body of water affects the concentrations of ions found within that body of water. The Fallkill Watershed in New York's Mid-Hudson Valley is one such body of water that's chemistry is affected because of how the land around it is being used. In this project, water was sampled from 16 street/stream crossings within the Fallkill Watershed and was tested for Nitrate, Chloride and Conductance levels. Land use shifts from low density residential in the upper watershed to highly urban nearer the mouth. It was discovered that the Chloride levels and conductance levels can be explained solely through Land Cover. In graphs of Chloride Concentration vs. miles upstream and Specific Conductance vs. miles upstream, the P-values of both slopes were well under 0.05 and a regression accounted for 41% and 40% of the variance in chloride and specific conductance respectively. The Nitrate was not related to local land use possibly because the source was atmospheric deposition or small scale changes in geology. Point sources within the WS might include waste water and septic systems. These differing relationships with local land use suggest quite different sources of Chloride vs. Nitrate in this watershed in the form of rain, snow, and other types of precipitation.

I thank the Cary Institute of Ecosystem Studies for making this research possible.

Poster 82

Diadumene lineata: Environmental Cues Used by Sessile Organisms for Locomotion

S. Aljeboure and A. Swafford
Shoals Marine Laboratory

Sea anemones and their relatives are sedentary benthic invertebrates--most of which are live firmly attached to the seafloor as adults. These organisms usually settle on surfaces as planulae larvae or juvenile polyps, metamorphose and then remain in place for their entire lives. However, some species such as *Diadumene lineata,* an intertidal sea anemone that is native to the northwest pacific ocean, locomote post-settlement more frequently than one might assume for a sessile organism. Previous studies have not studied the signals that sessile organisms use in their environments in order to resettle, or change position, successfully. Therefore, I examined what environmental cues *D. lineata* use in order to guide their movement towards favorable conditions. I hypothesized that *D. lineata* uses light as a cue to assist their movement. I conducted a phototaxis experiment to quantify and compare the direction and the distance *D. lineata* travel with and without the presence of a light cue. My results demonstrated that *D. lineata* respond to light with negative phototaxis. The results from this research project will help to illuminate how human activities may impact sessile invertebrates' communities, such as the impact that light pollution may have on the success, behavior, and distribution of these organisms.

Special thanks to Shoals Marine Laboratory for financial support.

Poster 83

Effects of E2F Inhibition by E2F Inhibitory Drug in a Quiescent Cell Model

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Rb is an important tumor suppressor protein that regulates activity of the E2F complex at the G1-S checkpoint. E2F is a family of cell proliferation transcription factors that form a complex with DP in order to regulate the expression of cell proliferation genes. Many types of cancers implicate a loss of function in *Rb*, which causes a misregulation of E2F activity. *Drosophila melanogaster DP* mutants were used to eliminate the function of the E2F complex in vivo. Among E2F's many targets is ATM, a key regulator in DNA-damage response and a direct target in *Drosophila* quiescent endocycling fat body cells. In wild type endocycling fly fat bodies, the cell cycle is stopped by E2F's down regulation of ATM. In in the *DP* mutant, ATM levels rose, and endocycling cells showed signs of mitosis and cell cycle progression. The goal of our research is to apply these results in a human cell model. E2F inhibition may be used to stop proliferation of cancer cells, but there may be unforeseen negative effects on non-replicating, quiescent cells. For our research, we studied E2F in quiescent cells to verify if E2F inhibition is a viable candidate for cancer therapy. Since it is difficult to obtain mammalian endocycling tissue, we induced quiescence in differentiated cell through serum starvation. E2F activity was eliminated by treatment with a known E2F inhibitory drug. Results showed that while the E2F inhibition treatment did maintain and further induce quiescence in our serum starved quiescent cell model, ATM expression was not up-regulated in these cells. However, it was up-regulated in asynchronous, non serum starved cells, which suggests that ATM may have a different regulation mechanism in quiescent mammalian systems.

We thank the American Cancer Society, the Fuller Family, and the MGH Cancer Center for the resources and financial support to make this research possible.

Poster 84

Epictetus and Zhuangzi on End of Life Care

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Epictetus, a Western philosopher who espouses Stoicism, and Zhuangzi, an Eastern philosopher who represents Daoism, agree about viewing one's life as a part of a larger whole that is governed by their respective first principles: reason in the former, and the *Dao* or Way, in the latter. Since each person's "fate" is to be construed in the context of a larger whole, Zhuangzi and Epictetus both offer that death is nothing to be feared. Cross-cultural comparison between Epictetus and Zhuangzi offers insights about living a life that is free from deep attachments to a self and to living a long life. In today's modern medicine, groundbreaking technological advances such as life support systems have led medicine to adopt a "life at all costs" attitude, in which people are willing to go to extremes to avoid death. Examining Epictetus's and Zhuangzi's views on the meaning of life and death offers fresh perspectives for reevaluating current practices of end of life care.

We thank the Weiss Summer Research Program for financial support

Poster 85

Exploring a Brain Region with Inhibitory Neurons that Controls Bladder Behavior in Mice

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Studying neural pathways that control micturition, has significant relevance to lower urinary tract symptoms (LUTS). Understanding the mechanisms that regulate voiding will allow for potential therapies targeting neural control of voiding and maintaining continence. Recent advances have identified groups of neurons in the Pontine Micturition Center (PMC) that become activated with micturition events. The purpose of this project was to study the role of inhibitory GABAergic neurons on the continence in mice, promoting inhibition onto PMC neurons. To determine axonal projection patterns from an inhibitory brain site to the PMC, transgene vGAT ires Cre mice underwent stereotactic surgery to receive a microinjection of an (adeno-associated virus; AAV) axonal tracer; mCherry. We hypothesized that specific laser light stimulation of the neuron terminals would disinhibit the GABAergic tone and stimulate the void reflex. Once the exact location of upstream neurons sending projections to the PMC was established, these brain coordinates were used to inject, a virus carrying a light dependent proton pump, in the Periaqueductal Gray (PAG) region of the brain. During this surgery, optical fibers were also implanted above the terminal field of the GABAergic (PAG) projection neurons. Three weeks later, behavior trails were recorded on a non-invasive technique called Micturition Video Thermography (MVT). While the mice were moving freely in the cages with filter paper flooring, patch cords connected the optical fiber to a laser. All recordings were captured with a thermal-sensitive camera and ResearcherIR software and were analyzed post hoc. Finally, the animals were cardiac perfused, brains were dissected, cut, and immunohistochemistry was performed on the brain slices. We confirm that there are inhibitory neuronal projections between the PAG and the PMC, but more studies are needed for established a functional role for his connection.

We thank the financial support from National Institutes of Health.

Poster 86

Applying Tumor Treating Fields to Diminish Primary Brain Tumor Cell Growth

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Advancements in the treatment of glioblastoma (GBM) have been made in recent years. GBM treatment options have included microsurgical tumor resection, radiation therapy, and drug treatment with the chemotherapy drug temozolomide (TMZ). Due to the common occurrence of this type of tumor and its aggressive effects, a new treatment option using alternating electric fields, tumor treating fields (TTFields), has been developed and approved by the FDA to treat GBM in conjunction with tumor resection and TMZ. Using the previous work of applying TTFields to inhibit GBM growth, it was hoped that TTFields can also treat meningioma tumors. In the study, patient-derived high-grade meningioma cell lines were used. Harvested cells were plated 5000 cells per coverslip and allowed to attach to the coverslip in the TTField-generating dish overnight. The dish was then placed in the baseplate of the TTField-generating device. Cells were incubated at 37 ºC with an electrical frequency of either 100, 200, 300, or 400 kHz and placed in a refrigerated incubator at 17 ºC and 5% CO_2, applying TTFields at a field strength of ~1.7 V/cm. A control set of cells was incubated at 37 ºC and 5% CO_2 while not in the presence of a generated TTField. XTT cell proliferation assay after 7 and 12 days as well as clonogenic assay, and LAT1 immunostaining following the experiment were used to determine the efficacy of TTFields relative to the control. Although preliminary results of the experiment have shown to be inconclusive, it is hoped that after further experiments with different meningioma cell lines the effect of the TTFields treatment can be determined.

I thank the Wayne State School of Medicine Summer Neuro-Oncology Research Fellowship for providing funding, and members of the Mittal Lab for their help and support throughout the internship.

Poster 87

Portable Cosmic Ray Telescope Array Measurement of Average Muon Density

C. Goessling, A. Corrigan, and T. Narita
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Cosmic Rays are currently being studied by large cosmic ray telescope arrays consisting of up to 500 telescopes. Most of these telescopes are built to detect cosmic ray induced muon showers, but they cannot be moved to a different location. Our portable cosmic ray telescopes allow us to record events in different areas across large distances and elevations. Each telescope is run individually with its own GPS unit and its own timer. If an event is detected in two or more telescopes within a time window, we record that as a cosmic ray shower. We used an array of four telescopes looking for coincidence events. Other groups and computer simulations have shown that the density of muons in a shower decreases with distance from the central axis. By analyzing the number of two, three, and four coincidence events over time we calculated an average muon density of cosmic ray showers arriving at an incident angle of 45 degrees.

We thank the Alumni/Parent Summer Research Scholarship Fund for their support of our research.

Poster 88

Effect of Earth's Magnetic Fields on Muon Flux

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Cosmic rays are high energy, ionized nuclei that travel from beyond the solar system to Earth at speeds close to the speed of light. When the primary cosmic rays reach our atmosphere they interact with the atmospheric nuclei and produce secondary particles, pions. These pions eventually transform into leptons, such as muons, electrons and neutrinos through additional interactions with atmospheric particles or through decay processes. We were primarily concerned with the effect of Earth's magnetic field on muon flux at sea level. Most muons have a backwards spin as a result of the pion decay process and therefore have angular momentum and a magnetic moment. Earth's magnetic field may affect the trajectory of the charged particle as a result of the muon's magnetic moment. To test this we set up one telescope facing magnetic north/south and another facing east/west. The muon telescopes were constructed using scintillation plastic and photo-multiplier tubes which were mounted on a PVC pipe frame. All telescopes were initially set up vertically but then rotated at varying degrees from the zenith towards their respective directions. In addition, we made our telescopes and data analysis processes more accurate and efficient by reducing dead time for our circuit boards and accurately determining the solid angle and the threshold voltage to run each of our telescopes. Using these new processes we have found that the muon flux rates may be slightly larger in the north direction. To continue this work, we will continue taking data to ensure more accurate results.

We thank the generous contribution made by Drs. Daniel J. Wasser and Dr. Karen Randall P15 to the Alumni/Parent Summer Research Scholarship Fund.

Poster 89

Evaluation of Polymer-Coated Plastic Dosing Devices to Retard Loss of Volatile Preservatives from a Pharmaceutical Cream

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Pfizer Global Supply, Analytical Sciences

Pfizer is evaluating a new plastic dosing device for one of its pharmaceutical cream products. In one device type, product has shown good stability except for the loss of more than 50% of benzyl alcohol (BA) preservative. BA loss was due to volatilization and/or absorption into the plastic parts. A new study was initiated to examine use of different devices and a polymerized coating to minimize this loss to within current specification limit of NLT 80% of label claim. Two types of plastic dosing devices (A and B) were manufactured with polymer coatings. The devices along with control uncoated devices were filled with drug product and placed into 30°C storage for an accelerated 3-month study. Two drug formulations were tested, Formulation A with BA preservative and Formulation B containing phenylethanol (PEA). Samples were removed at various timepoints and the level of BA or PEA measured using gas chromatography. Results obtained through three months show that the polymer coating is effective in reducing preservative loss in both types of applicators tested. The uncoated devices show a greater rate of loss in agreement with previous studies. One other potential failure mode for polymer-coated devices in this application is delamination. Visual and microscopic examination of coated devices show evidence of delamination from physical stress when parts are moved. SEM analysis of coated devices shows no evidence of significant migration of the coating into the drug product. Results collected through three months will support a business decision to proceed or not proceed further with the proposed packaging.

Funding provided by Pfizer Global Supply, SLS-Analytical Sciences Group.

Poster 90

Topological Modeling of Force Networks in Granular Material

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College of the Holy Cross

The aggregate properties of granular materials are determined by the network of forces between particles. These networks are prominent in a number of fields, including the pharmaceutical industry and agriculture. Force networks are, however, not well understood. The random organization of these networks makes it difficult to derive properties of a granular material from the local structure of its force network. Here, the method of swatch and cloth is instrumental. Swatch and sloth is a new and promising technique developed by Schweinhart et. al. It can be used to accurately describe a force network by analyzing the statistics of the local structure of the network's adjacency graph. This summer, we used swatch and cloth to analyze and compare the force networks of planar simulations of granular material. In addition, we analyzed the related community structure of these networks.

We thank an anonymous gift to the Alumni/Parent Summer Research Scholarship Fund for making this research possible.

Poster 91

Queering the Archive

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"Queering the Archive" is an ongoing research project, focused on identifying and making public transgender-related historical sources at the American Antiquarian Society (AAS), a world-renown research archive located in Worcester, Massachusetts. While the study of transgender history presents a growing and important field of scholarship within gender and sexuality studies, contemporary research largely focuses on materials from the late-twentieth and twenty-first centuries. Dated prior to 1876, the archival matter collected by the AAS has largely been overlooked as a potential resource. A central goal of "Queering the Archive" is to bridge this scholarly gap and locate, identify, and publicize queer history in early American record. We examined the AAS collection of physical holdings and digital artifacts, as well as materials accessible through AAS digital partnerships with outside peer libraries. Our search revealed over 130 transgender-related materials, from multiple repositories. Findings spanned a wide array of genres and media, including children's literature, dime novels, broadside advertisements, crime periodicals, and underground "racy" newspapers. To share our discoveries with researchers, we catalogued these materials in a "Queering the Archive" finding aid that we shared in hard copy form with the AAS and in a digital version with the Digital Transgender Archive (DTA) at Holy Cross. We also co-authored two formal posts for the AAS blog, *The Past is Present*: "the question of [her] sex" which shared the story of Esther Shaw, who was born male and lived as a woman for thirty years, and "Cross-Dress and Gender Expression: Re-Considering Amelia Bloomer" which discussed 19th-century social anxieties regarding representations of cross-dress. We are confident there remain many transgender-related historical materials left to uncover at the AAS, and look forward to the future research of "Queering the Archive."

We thank the Weiss Summer Research Program in the Social Sciences, Humanities, and Arts and the Ignite Fund for financial support.

Poster 92

On the Translation of *Pride and Prejudice* in China

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George Borrow said in *Lavengro* "...translations may be only a faint echo of the original." Translated versions of the literary work should be the same with the original in terms of meaning and artistic integrity. By comparing three different Chinese renderings of Jane Austen's *Pride and Prejudice* with the original text, this research makes judgments on their faithfulness as well as unfaithfulness, and explores the limitations and difficulties of translating Austen's ingenious and subtle language. Through the examination of specific words and several significant dialogues, we seek to discern the differences and the similarities among each of the Chinese versions and the original novel. As a result, we discover that problems arise in most of the renditions, that the coherence of certain words such as "pride" and the distinctive narrative function of free indirect discourse are often undermined in the translations and retranslations by different translators from different time periods. Therefore, we explore the translation history of *Pride and Prejudice* in mainland China in the past one hundred years. Finally , we propose several hypotheses regarding the popularity and retranslation boom in China, as well as some possible reasons why Austen is so hard to translate and how wrong renderings can ruin the readers' experience.

Many thanks to the Weiss Summer Research Program for financial support and to Professor Gettelman for her guidance and support.

Poster 93

Can a Just Society Tolerate Hate Speech?

T. Philbin and A. E. Hindman,
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Public conversation has, of late, been gripped by a debate over the legal and philosophical dimensions of the following question: can a just society tolerate hate speech? There have been two traditional answers to this question. The first is posited by liberalism, which contends that the suppression of hate speech violates Mill's harm principle, and therefore infringes on the liberty of individuals unjustly. The second is proposed by a certain brand of communitarianism, most prominently advanced by Jeremy Waldron, which claims that hate speech undermines the basic assurances of citizenship owed to members of marginalized minority groups, and therefore hate speech prohibitions are a necessary feature of a just society. In the precedent of the Supreme Court, both philosophical approaches are well represented. We contend that neither of these traditional philosophical approaches to free speech can be accepted. The liberal approach fails to appreciate sufficiently the role community membership plays in establishing selfhood with the result that it relies on an incoherent vision of the self. Waldron's communitarian approach, however, is also deeply flawed in that it protects the dignity of citizens from the harms of hate speech in an unjustly discriminatory manner. Such discrimination, we hold, is incommensurate with the very nature of citizenship. Having shown the flaws in the two traditional approaches, we offer a third. Our approach treats discourse as a social institution charged with the task of adjudicating disputed peacefully rather than treating free speech as an individual right. If discourse is to adjudicate disagreements peacefully, we contend that it must be open to all viewpoints. Otherwise, society marginalizes the holders of certain viewpoints from discourse, leaving them no alternative except violence to express their views. Discourse is in an a position to flourish only when disparate viewpoints are in constant contact with one another, preventing the formation of echo chambers. We close by proposing a new legal standard for free speech cases that is based in the view of discourse as a social institution.

We thank the Weiss Summer Research Program for financial support.

Poster 94

Parent Training Programs in the United States: Implementation Opportunity for World Health Organization's Parent Skills Training Program

L. Hildreth and A. Shih
Autism Speaks

Modern research has successfully investigated and supported the effectiveness of early intervention strategies for young children. However, there still exists a capacity gap for evidence-based intervention methods for children across racial, income and other demographic boundaries. Different cultures employ different childrearing methods and many ethnicities have not been studied. In order to reduce the high prevalence of this disparity, Autism Speaks looks to implement World Health Organization's Parent Skills Training (PST) program in existing programs within the United States. PST presents an innovative approach offering a customizable parenting program and demonstrating evidence-based effectiveness across all different cultures and backgrounds. Most importantly, PST research utilizes the proper outcome measures to demonstrate effectiveness for all children, including children with developmental disabilities. Together, we devised a research process consisting of inclusion and exclusion criteria, generating a systematic review of opportunities to deliver PST to communities in the United States. Next, I analyzed the evidence basis behind each program to assess the credibility of the outcome measures and other procedural components. Finally, I assessed the total implementation ability of each program and recommended the top three programs for Autism Speaks.

We thank the Crusader Internship Fund for the financial support.

Poster 95

Investigation of Anti-HIV-1 Domain of APOBEC3G

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APOBEC3G (A3G) is a human protein that plays a role in innate anti-viral immunity, specifically functioning in resistance to human immunodeficiency virus (HIV-1) infection. The viral infectivity factor (Vif) is a protein expressed by HIV that inhibits A3G function. The co-expression of A3G and Vif in virally-infected cells results in the loss of A3G. In the absence of Vif, A3G is incorporated into budding virus particles; this packaging results in defective particles that are unable to continue viral replication. In particular, virus particle-associated A3G inhibits the essential process of reverse transcription by hypermutating the viral genome during the genome copying process. The A3G-mediated hypermutation results in abortive infection. In addition to this well-characterized viral suppressive function, additional data have suggested that A3G also exerts a unique antiviral function. This uncharacterized antiviral function is currently being investigated using a previously-generated mutant library. Recent experiments examining the catalytic activity of A3G have preliminarily identified a few important amino acids in the middle of the protein. When several of the amino acids in this region were mutated, the catalytic activity was lost, yet A3G retained its antiviral function. This suggests that this region of A3G is critical in the uncharacterized antiviral function of A3G. An understanding of regions of A3G that are essential to its antiviral function is the first step in characterizing this unique antiviral function of A3G and can change the way the field views the antiviral response of humans to HIV-1.

We thank the generous contribution made by Ms. Mary Ellen Eagan '75 to the Alumni/Parent Summer Research Scholarship Fund.

Poster 96

Effects of Environmental Enrichment on Emotional and Stress Responses in Mice

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Previous work from our laboratory has demonstrated subtle effects of laboratory-controlled environmental enrichment on sociability and anxiety-like behavior in C57BL/6J mice (Hendershott et al, 2016). However, that study and other published literature present conflicting ideas regarding how environmental enrichment affects emotional regulation, anxiety-like behavior and social behavior. One of the challenges to interpreting these findings is the reduction of emotional and social behaviors to measures easily measurable by automated methods. To obtain a more detailed and nuanced understanding of these behaviors in the context of enrichment effects, we conducted a free-moving social interaction assay and scored the results manually in the form of a social ethogram. Thus, we measured complex social behavior of adult male and female mice reared in either enriched or standard environments from weaning age. For the assay, a sex-matched juvenile mouse was introduced into cage with the test subject for a five-minute period during which the interactions of the two mice were video recorded. The number, duration and type of social interactions between the test subject and juvenile mouse were then scored from the video by a researcher blind to experimental condition. The behaviors scored include climbing, social grooming, self-grooming, digging, exploring, rearing and sniffing. These behaviors were classified as avoidant, positive, or aggressive behaviors. These different social behaviors are modulated by interactions between the limbic system and medial prefrontal cortex which are necessary for processing social information. Subtle changes in these metrics will inform future studies of neural pathways that may mediate effects of environment on emotional and social behavior.

We thank the Alumni/Parent Summer Research Scholarship Fund for financial support.

Poster 97

Dissecting Generalized Fear in Pavlovian Conditioning

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Pavlovian (classical) conditioning is a set of procedures for experimentally controlled modification of reflexive responses, and it can be used to condition a fear response. By presenting a conditioned stimulus (auditory tone) paired with an unconditioned stimulus (mild footshock), animals can be conditioned to exhibit a fear response to the tone alone. In mice, freezing (cessation of all movement except breathing) is a sympathetic nervous system response by which fear is operationally defined. However, freezing may be related to general aspects of the context in which the conditioning protocol is administered, and not the result of specific associative learning related to the conditioned stimulus. In this study, we attempted to isolate factors that contribute to generalized, non-associative fear responses in our Pavlovian conditioning paradigm. We used mice of the inbred C57BL/6J strain to ask whether levels of freezing were affected by the olfactory or spatial cues we use to manipulate the experimental context. Our goal is to control the non-associative effects of these factors on freezing to better isolate the results of associative fear learning. This enhanced experimental control will enable us to gain a better understanding of the neurobiological mechanisms involved in emotional learning and memory.

We thank the Robert J. Stransky Foundation Summer Science Research Fellowship.

Poster 98

Effects of Age and Environment on Neuronal Morphology in Mice

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The effects of aging and environment on neuronal morphology have not been studied extensively in mice, which are an important genetic model organism in the study of behavior, cognitive function, and human neuropsychiatric disorders. Prevailing assumptions regarding age- and environment-related changes are based on data from rats and nonhuman primates. Furthermore, there is neither a standard environmental enrichment procedure nor a standard method of morphological analysis that have been employed consistently in the literature. This study analyzes neuronal morphology in the brains of C57BL/6J mice stratified by experience of environment (enriched or standard caging), age, and sex. Brain samples are processed by the Golgi method, sectioned, and stained for visualization of individual neurons with a light microscope. Individual neurons are imaged reconstructed and analyzed using Neurolucida software (MBF, Inc.). Measures of interest include dendritic length, dendritic complexity, and spine density.

We thank Dr. and Mrs. Anthony M. Marlon '63 for financial support.

Poster 99

Investigation of the Temporal Dimension of Prepulse Inhibition of the Acoustic Startle Response

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Prepulse inhibition (PPI) of the acoustic startle response is a sensorimotor gating process characterized by attenuation of the startle response when a startle stimulus is shortly preceded by a stimulus of lesser magnitude (i.e., a prepulse). PPI is compromised in various neuropsychiatric populations, notably those marked by disruptions in attentional processing such as schizophrenia. Sex differences have been observed in both PPI and the progression of neuropsychiatric disorders characterized by deficits in attentional processing, with healthy males exhibiting more PPI than healthy females but an earlier age of onset and more severe symptoms within patient populations. A deeper understanding of these sex differences may elucidate neural pathology underlying disorders characterized by attentional processing deficits, as well as more effective treatment for these conditions. Therefore, standard parameters must be established for reproducible data collection and interpretation in terms of specific neural processes. The current study investigates the temporal dimension of PPI, particularly the time interval between the prepulse and the startle stimulus, in male and female C57BL/6J mice. By observing the percent inhibition of the startle response when a standard prepulse is presented at 10, 50, 100, and 500 ms intervals preceding a startle stimulus, we hope to demonstrate the temporal dependence of the PPI phenomenon. We have included male and female mice to investigate sex differences. The dependence of any sex differences in the temporal aspects of PPI on ovarian steroids can be studied further by determining estrous stage in female test subjects. The establishment of a standard PPI protocol that takes sex of the test subject and temporal characteristics of the phenomenon into account will contribute to controlled studies of risk factors for neuropsychiatric disorders.

We thank Gary R. Gregg and Karen Connelly Gregg '79 for their generous contribution to the Alumni/Parent Summer Research Scholarship Fund.

Poster 100

Examining the Effects of Timing of Food Exposure on the Expression of Feeding Structure Plasticity

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Phenotypic plasticity occurs when an organism changes its phenotype in response to its environment with no concomitant change in genotype. A lag time between sensing the environment and phenotype production can occur when the environment is finely grained, i.e. when the environment changes faster than the organism can respond. Previous research has shown that marine invertebrate larvae can respond to changes in external food concentrations by altering the lengths of their feeding structures. Although most lab experiments of this phenomenon in echinoid larvae routinely only examine responses to absolute differences in the mean concentrations of food, previous research has demonstrated that organisms can cue on both the range (maximum and minimum) of food concentrations as well as the mean. What remains unknown, however, is how the timing of exposure to maximum or minimum food concentrations affects the expression of larval feeding structure plasticity. We reared larvae of *Lytechinus variegatus* under equal food means, but varying food maximum and minimums across a 12-day developmental period. By manipulating the point of development in which larvae receive the food maximum or minimum, we can understand how the grain of the environment correlates to feeding structure plasticity. We predict that larvae given low food levels daily will exhibit longer feeding structures than those exposed to food less frequently, but in larger quantities. Our results will provide a greater understanding of the effects of environmental grain on larval growth.

I thank the generous contribution made by Daniel J. Polacek, M.D. ’73 P14,12 to the Alumni/Parent Summer Research Scholarship Fund.

Poster 101

Voicing Volunteer Narratives: Making Meaning of Experiences in the Abby's House Thrift Store

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The implications of charitable aims often go unscrutinized, due to the moral nature of such actions. It is for exactly this reason that charity and volunteerism must be critically examined -- not necessarily criticized or denounced, but understood realistically in practice. As part of a greater investigation of the implications of doing charity, this research focuses on the ways in which volunteers understand their own experiences doing charitable work. The ethnographic study took place over the course of eight weeks, during which I spent approximately twenty hours a week volunteering in the thrift shop affiliated with Abby's House. Abby's House is a Worcester non-profit that seeks to provide safe and affordable shelter and housing to women and children experiencing homelessness. Employing the anthropological techniques of participant observation and in-depth, ethnographic interviews, I constructed three case studies of volunteers who I worked along during the summer. Each case study that illuminate three key themes in their experiences: the influence of neoliberalism; senses of self and a shared sense of humanity; and volunteer communities and social networks. These themes reveal that volunteerism must be examined closely in order to understand the real implications of doing volunteer work and to complicate a view of charitable efforts as either purely altruistic or inherently dominating.

We thank the Weiss Summer Research Program for financial support.

Poster 102

Sustainable Student Housing at College of the Holy Cross

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In an era characterized by increasing complexity of building technologies, creative solutions to both global and localized challenges arise on a near-daily basis. As a field dedicated to understanding and characterizing the human experience, architecture addresses these issues through form. In this vein, many architects and builders have been using their specialized skill set to change attitudes around climate science, doing their part to mitigate carbon usage through efficient energy and water systems, and through localizing the materials and labor used in their projects. These trends in building have led to the development of the US Green Building Council's LEED (Leadership in Energy and Environmental Design) certification, and, more recently, the Living Future Institute's Living Building Challenge. As technologies develop, more guidelines for green buildings arise—and colleges and universities are often at the cutting edge of building trends. For this reason, may colleges in the Northeast have decided to implement stringent green building regulations. My project aims to raise awareness about the prevalence of sustainable building in academia while also suggesting a possible plan of action for Holy Cross to implement net-zero water and energy modules as student housing.

I'd like to give special thanks to the Weiss Summer Research Program and Ignite Fund for finacial support.

Poster 103

Temperature and Pressure Optimization of PI-PspI enzyme

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A thermophilic enzyme, PI-PspI, is a homing endonuclease that is part of an intein, an intervening sequence in precursor proteins. It is found in the extreme thermophile, *Pyrococcus* species GB-D, present in deep-sea thermal vents where there is high pressure. The optimal condition for this enzyme is 65°C for an hour at 1 atm. To determine if PI-PspI would be as efficient in cleaving a target sequence in pressures similar to those present in its native condition, we measured enzymatic activity under different temperatures and also at relatively high pressure at varying time points. Our results showed that at 75 atm there was cleavage in time points of 90 min and 180 min. However, no cleavage was present at 150 atm. Our results suggest that not all thermophilic enzymes can be optimized or have suboptimal activity under their native condition. Although this enzyme is not active at higher pressure, other intein-derived homing endonuclease enzyme from extremophiles can cleave at high pressure.

This work was supported by the National Science Foundation (grants MCB-1244089 and MCB-1517138 to KVM) and the Dreyfus Foundation (KVM).

Poster 104

Investigation into Totalitarian Government

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This project was an investigation into totalitarian politics and ideological governance in Communist Russia as understood from the perspective of French philosopher and sociologist, Raymond Aron. The goal was three-fold: to extract from Aron's work a definition for totalitarianism and the ideological regime, determine whether or not that definition fits in a historical context, and decide whether or not Aron offers a means to ameliorate or even solve the totalitarian condition. After completing this part of the work, it was determined that Raymond Aron falls demonstrably short in offering a viable solution to the problem. To fill this void, the work turns to a Russian dissident writer whom the Frenchman admired, namely Aleksandr Solzhenitsyn. Solzhenitsyn fills in the gap left in Aron's analysis. He offers a compelling means of ameliorating the disease of ideology by placing an emphasis on traditional morality and its application to politics. Finally, utilizing Solzhenitsyn's insight, it is determined that the West may very well be heading towards a more totalitarian or at least authoritarian future due to a similar deemphasizing of traditional morality and personal responsibility and an overemphasis on legality and resolution via the legal system.

We thank the Center for Liberal Arts in the World and the Weiss Summer Research Program both for their financial support and the opportunity to engage in this intellectual endeavor.

Poster 105

The Tale of Solubilization and Splicing of *Haloferax volcanii* intein

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Protein splicing is a post-translational process facilitated by an intervening polypeptide called an internal protein, or intein. The intein is centrally located between two flanking polypeptides, called exteins. The intein catalyzes its excision from the extein concomitantly with the ligation of the exteins. The extremophile *haloferax volcanii* lives in a high salt environment. We are interested in the halophile because we want to learn how the intein splices as a function of salt concentration. After protein expression and purification the precursor was not present in the purified fraction. The precursor was instead in the insoluble fraction; using a French Press we were able to solubilize it. We tested a variety of salt concentrations over 8 hours and 16 hours at 28° C and 37° C, to see how the splicing varied.

This work was supported by the National Science Foundation (grant MCB-1517138) and by the Camille & Henry Dreyfus Foundation

Poster 106

How Does Age Affect the Reparative Capacity of Stem Cells in *Hofstenia miamia*?

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Although some animals show no apparent signs of aging, in those that do, aging is associated with higher mortality, susceptible to disease and frailty. On a more molecular level, aging can reduce the capacity of stem cells to respond to injury. The Paxson lab focuses on multiple model organisms to examine how aging affects stem cell function. We believe that *Hofstenia miamia*, a regenerative acoelmorph also known as the three-banded panther worm, may be a good candidate to examine how aging affects the regenerative capacity of stem cells in vivo. Unlike the highly regenerative flatworm Planaria, *Hofstenia miamia* regularly produces progeny through sexual reproduction, which gives us the opportunity to examine how their stem cell populations change with age. To date, there is no data on whether Hofstenia exhibit characteristics of aging as measured by lifespan and healthspan assays. Neither are there reports examining age-related changes to stem cell function in this worm as measured through declining regenerative capacity, fecundity and mobility along with changes in gene expression profiles. As a new model organism, we have begun working with Hofstenia to optimize culture techniques in our lab, along with developing a better understanding of behaviors unique to the organism. In addition, we have begun to optimize protocols that will enable us to study RNA expression in-situ by first successfully performing DAPI staining, a fluorescent nuclear stain on Hofstenia embryos. During the upcoming academic year, we plan to determine whether Hofstenia exhibit characteristics of aging by examining the lifespan as well as healthspan of our new model organism. We also plan to develop assays for RNA in-situ hybridization for stem cell and aging markers in this organism such as Piwi and P53.

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Poster 107

An Investigation of the Fundamental Immune Response of *Apis mellifera* and *Bombus impatiens*

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Bees are dying off in staggering numbers. The ecological niche that bees fill as key pollinators is essential. The loss of bees has profound effects on food availability and the global economy. While the loss of honeybees and bumblebees are occurring at the hive level, it is necessary to first understand what is happening to individual bees. It has been hypothesized that the hyperactivation of an innate immune response may lead to a dysfunctional chronic immune response. Chronic immune stimulation in other organisms can lead to a profound immunosuppression; subsequent exposure to pathogens when immunosuppressed can result in death. The stimulants leading to this proposed inadvertent dysfunction in bees are currently uncharacterized. To explore chronic immune stimulation in bees, *Apis mellifera*, the European honeybee, and *Bombus impatiens*, a native North American bumblebee species, were exposed to LPS (a component of Gram-negative bacterial cell walls) and β-1,3-Glucans (a component of fungal cell walls) in order to determine the fundamental immune response to these stimuli, both of which are expressed by pathogens in the natural environment of bees. To quantify immune response, the stimulated expression of antimicrobial peptides (AMPs) was examined. AMPs comprise the primary immune defense in bees. Bees express a panel of four AMPs: Abaecin, Defensins, Apidaecins, and Hymenoptaecin. Preliminary data suggest that honeybees exhibit a peak expression of Apidaecin 24 hours post-LPS exposure, while bumblebees experience a peak immune response in Abaecin, Apidaecin, and Hymenoptaecin at 24 hours when exposed to β-1,3-Glucans. The next step in experimentation will be to compare Honeybee and Bumblebee AMP expression while exposed to the same stimulant. Follow-up experiments will aim to construct a comprehensive characterization of the immune response of honeybees and bumblebees.

We thank Dr. and Mrs. Arnold A. Criscitiello P18,17 for financial support.

Poster 108

Investigating the Catalytic Function and HIV-1 Suppression of Mutant APOBEC3G Constructs

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The human protein APOBEC3G exhibits potent antiviral activity against HIV-1 infection. By mutating the HIV genome, during the viral process of reverse transcription, APOBEC3G renders the virus incapable of continuing infection. However, this effect is only observed in laboratory settings because HIV-1 expresses a protein, Vif (Viral infectivity factor) that can counter this innate immune defense. Although the active site for catalysis has been mapped to a C-terminal domain of A3G, we have recently characterized an independent region in the N-terminus of A3G that appears critical to its function; in particular we have delineated an essential triple arginine motif. Mutagenesis of individual amino acids within this motif results in a significant loss of viral restriction although the enzymatic activity of A3G is functional. Several APOBEC3G mutants lost catalytic activity but maintained antiviral activity, indicative of this alternative mechanism of viral inhibition. Further characterization of this mechanism will enhance our understanding of the host-defense pathogen interface with particular interest in disrupting the A3G:Vif axis of interaction.

We thank Dr. and Mrs. Anthony M. Marlon ’63 for their financial support.

Poster 109

Working Toward Racial Justice: The United Negro Protest Committee and the Movement for Jobs and Civil Rights in Pittsburgh, 1963-1973

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Using the example of the United Negro Protest Committee (UNPC), a Pittsburgh civil rights groups, this project studied the critical relationship between the civil rights movement and organized labor and economic justice. Using archival sources, mainly newspaper and organization records, this project studied the efficacy and appeal of approaching civil rights activism with a focus upon labor issues pertinent to the black community of a Northern industrial city. The UNPC was selected as the subject for our analysis because it grounded its activism in the belief that the path towards racial justice lay in strengthening the economic base of the black community and primarily engaged in demonstrations and negotiations aimed at creating job opportunities for African Americans. Additionally, the UNPC functioned as a leader among Pittsburgh's civil rights organizations, staging the city's first first mass demonstrations and setting the tone for a local civil rights movement that placed an emphasis on labor issues during the 1960s. This study concludes that the history of the UNPC encapsulates the trajectory of black activism throughout the North over the course of the 1960s. Founded in 1963 to spearhead non-violent, direct action campaigns, the UNPC exclusively conducted protests against and negotiations with discriminatory employers. In the mid-1960s, the UNPC expanded its scope to include other social justice causes in response to the needs of the local black community. Near the end of the decade, the UNPC incorporated black power ideologies, emphasizing local ownership in the black community and changing its name to the United Black Protest Committee (UBPC). Despite criticism by both white and black contemporaries, the UNPC nevertheless charted a class-conscious course for the local civil rights movement and achieved real, if limited, gains for the black community in Pittsburgh.

We thank the Weiss Summer Research Program.

Poster 110

Impulsivity and Cognitive Control: Not So Fast…Sometimes Related and Sometimes Not

A. Szkutak, L. Orozco, M. Rabinovich, and G. DiGirolamo
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This experiment aimed to assess the relationship between cognitive control (measured by the antisaccade task) and self-reported impulsivity (measured by the BIS-11). Previous research is conflicted, with some studies finding a direct association (e.g., Spinella, 2004) and others not (e.g., Taylor, 2016). We predicted that the relationship between self-reported impulsivity and performance would be more complex than a simple, direct association. 32 undergraduate students (aged 19-21) completed 4 blocks of 60 trials (240 total anti-saccade trials). In each trial, participants were instructed to look at a central fixation cross until a dot appeared either on the left or right. Prior to the dot's onset, a brief flash was used as a distractor to increase the number of errors participants made. When the dot appeared, participants looked away from the dot (an antisaccade) and towards the opposite side of the screen. Errors were initially high and then decreased over time until the 4th block where they then increased, likely due to fatigue. Cognitive control was associated with impulsivity only when participants were first learning how to apply cognitive control on the antisaccade task. Once performance had plateaued, impulsivity was no longer associated with cognitive control. Thus, the association between cognitive control and impulsivity is multifaceted. These data suggest that non-clinical and clinical inferences relying on a simple, direct association between impulsivity and cognitive control are likely misguided, as the relationship between these two factors is more complex than it may seem.

Thank you to the College of the Holy Cross' Alumni/Parent Summer Research Scholarship Fund.

Poster 111

Where the H%#k Is Waldo? You Might Not Know, But Your Brain Does!

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Finding a target in a field of distracting or irrelevant information is an important visual search task (e.g., a radiologist searching for a tumor) which is thought to rely on perception and conscious awareness. In our previous data (DiGirolamo et al., 2016), however, we have shown that when radiologists fail to detect a lesion, their eyes linger on the missed lesion, suggesting that parts of their brain register the lesion even though they do not report it. In this study, 12 undergraduates completed a difficult Where's Waldo search task. Each participant completed 60 trials and had 12 seconds per trial to find Waldo. Using high-speed video eye tracking, we measured where participants looked, how long they looked, and how often they looked. On average, participants consciously located Waldo on 16 out of the 60 trials (27%). Most importantly, even if they did not report finding Waldo, participants, on average, fixated significantly more often ($p < 0.00001$) on Waldo than any other location in the image. Therefore, participants' brains are unconsciously detecting Waldo in the absence of conscious awareness. These findings provide further evidence of unconscious detection and demonstrate that even non-experts have these unconscious processing abilities without extended visual search training (e.g., radiologists). Unconscious processing may be a basic human brain process that remains untapped as a means to measure the full spectrum of a person's cognitive and perceptual abilities.

We kindly thank William F. McCall, Jr. 55' P90,90,89 for financial contributions made to the Alumni/Parent Summer Research Scholarship Fund.

Poster S 1

Coding Against the Wall of Silence: Coding Music for Charlie Chaplin's Silent Film, "The Immigrant"

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With this project, I coded an original electronic music score for Charlie Chaplin's silent film "The Immigrant" using knowledge that I learned in Professor Arrell's "Coding Music" class, which I took this past spring, as well as advanced techniques that I studied with Prof. Arrell during the summer. While I considered a number of silent films in preparing for this project, "The Immigrant" caught my attention in particular. Its themes of immigrant hardship and the search for a better life continue to resonate one hundred years after the film's release. In constructing this project, I first coded a synthesized orchestra consisting of unique electronic sounds that I built from scratch. I then coded different generative systems that, quoting from Brian Eno, "explore the permutational power of computer programming," to create motives and soundscapes to accompany the various thematic ideas explored in the film's narrative. While my generative systems guarantee a degree of certainty, the systems also allow chance operations to control certain factors of the music. For example, in creating a motive I might limit the allowable notes to a particular scale but also use random operations to generate the order and duration of pitches drawn from that scale. As a result, the music is given constant life through continual permutation. After nine weeks of work, I managed to come up with twenty-four minutes of music to accompany the film. The project serves to both enrich my experience in computer music and give me a taste of film music as a career.

We are grateful to the Ignite Fund and to the Weiss Summer Research Program for financial support.

Poster S 2

Medical Marvel or Malpractice? Double-edged Scalpel of Sexology

M. Salmassi, G. Comerford, and K. J. Rawson
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The medical community has historically had a heavy hand in constructing the experience of trans individuals, and the implications of their work are still seen today. Those who consider themselves experts in the field of gender –from outside the trans community– often dictate how gender-variant practices and identities are viewed, approached, and treated, particularly in regards to those who seek gender realignment surgery. Our research examines the studies of these medical and psychiatric professionals– known as sexologists– who have shaped the perceptions of the trans community so deeply. Specifically, we demonstrate how the narratives they construct in their various writings and case studies affected and continue to affect the lives of trans people seeking medical care. Using materials from early psychiatrists, psychologists, and doctors who made the study of labeling and understanding gender-variant practices an academic and medical endeavor, eventually culminating in the characterization of these practices as pathology, we explore the evolution of gender realignment surgery into an accepted, yet difficult and highly regulated, series of procedures. The medicalization of the transgender community provides the framework for access to gender realignment surgery and leads to a potentially more affordable process via insurance coverage for those who sorely need care, but cannot afford it. Such medicalization, however, characterizes people as deviant and mentally ill. Ultimately, classifying the behavior and identity of transgender people as pathological, as seen in the DSM diagnosis, has done harm to the social and medical experience of transgender people, stigmatizing them and their bodies; however, the academic and medical study lends itself to a scientific credibility that proves useful when asserting the necessity of affordable, accessible healthcare.

We thank the Weiss Summer Research Foundation and the Ignite Fund for financially supporting our research and our travel, the Canadian Lesbian and Gay Archives for allowing us access and use of their materials, and Nick Matte of the Sexual Representation Collection at the University of Toronto.

Poster S 3

Women, Dancing and Social Control in the Irish Free State

J.Palmerino and M. Conley
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This project explores how Irish dance halls, public spaces where young Irish men and women met to socialize and dance in the 1920s and 1930s, became sites of moral regulation and gendered control by Church and State. The halls were initially sites not only of music, dance, and entertainment--they were sites where youth culture mingled with modernity and Irish nationalism, the consequences of which fostered fear and anxiety among political and clerical leaders. Having won its independence from Great Britain after years of violent revolution and a divisive civil war, the 1920s and 30s served as formative years for the Irish Free State which inculcated a nationalism that mixed republicanism with moralism and misogyny. On a global level, the interwar years were a time of turbulent sociopolitical change around the world, with the onset of widespread globalization and the emergence of social modernity. The convergence of domestic and international changes prompted political anxiety, which catalyzed a renewed interest in the control and containment of women and women's bodies by the State and the Catholic Church. This collaboration between the new Irish Free State and the Irish Church authorities over dance hall regulations reflected an increased willingness of the Free State to collude with Catholic authorities when it came to containing women's choices and careers, and reinforcing their roles as wives and mothers. The 1937 Constitution, which formally inscribed women's maternal roles to the nation was the culmination of a set of policies that circumscribed women's rights within the state. This summer, we explored the musical, cultural and social aspects of the Irish dance hall phenomenon, and examined the ways in which these social spaces became spaces of political regulation and gendered control. For the project, we drew largely on primary sources collected during a research trip to the National Archives in Dublin in June 2017.

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NOTES