

# COLLEGE OF THE HOLY CROSS

Nineteenth Annual Undergraduate  
Summer Research Symposium



September 7, 2012

Hogan Ballroom

*Dear Members of the Holy Cross Community,*

*Welcome to the 2012 Undergraduate Summer Research Symposium. Now in its 19<sup>th</sup> 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 2012. 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 a faculty member about conducting research during the upcoming year and summer. We hope you enjoy the impressive collection of research on display today.*

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*Pr. Daniel Bitran, Science Coordinator*

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The summer research program was organized by Pr. Daniel Bitran, the College Science Coordinator, by Pr. Daniel Klinghard, the Director of the Summer Research Program in Humanities, Social Sciences and Arts, and by Pr. Bryan Engelhardt, the Director of the Summer Research Program in Economics.

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## Poster 1

### Identifying STEM Vocabulary in ASL

*Kristina Domaney, Jenny Sipiora, and Pr. Judy Fask*  
*Deaf Studies Program, College of the Holy Cross*  
*School of Education, Boston University*

Science, Technology, Engineering, Math (STEM) are important academic fields in education from elementary to post graduate work. This is true for students who can hear and also applies to Deaf students using American Sign Language (ASL). Because of the technical nature of STEM vocabulary, the translation of English terms to ASL has not been uniform. Professionals who use ASL, particularly teachers and interpreters, often respond to the translation challenge by ‘creating/inventing’ ASL STEM signs. These signs tend to be used in specific classrooms and not shared in the educational community. The lack of shared consistency is a challenge, given the spiraling and complex nature of the STEM curriculum. Many invented vocabulary items also violate ASL language rules. This project is an attempt to survey existing technical ASL vocabulary for conceptually and linguistically appropriate terminology. Lectures by expert Deaf instructors are examined to verify terms and identify additional ASL vocabulary. The primary aim is to develop an interactive website to be a resource in the education of Deaf children.

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## Poster 2

### Digitally Editing the *Iliad*: the Escorial Y.1.1 Manuscript

*N. Curran, S. Lindeborg, M. Ebbott and N. Smith*  
*Department of Classics, College of the Holy Cross*

An 11th century Byzantine manuscript of the *Iliad* in the Escorial has never been published completely. Scholarly commentaries (“scholia”) appear alongside the main text and refer to lost works of classical Greek authors and Alexandrian scholars. We worked with high resolution photography of the manuscript to create a searchable, digital edition of everything in Book 2. Our edition captures every feature as it appears, treating the manuscript as its own historical artifact, instead of looking for the “right” text. We link our edition to visual evidence, allowing verification of our edition. We created guides for reading the handwriting of Y.1.1. Other teams completed editions of Book 2 in the 10th century Venetus A and 11th century Venetus B manuscripts. Initial comparisons with Venetus A revealed that many scholia have similar content worded more concisely in Y.1.1. Differences raise questions about the ultimate sources and transmission of the scholia. While Venetus B is often identical to Y.1.1, our comparisons revealed unrecognized differences. These tell us about the relationship between manuscripts and how they were once assembled. Comparing similar scholia allows us to better understand the ancient Homeric scholars and their otherwise lost works. In Y.1.1, we investigated features that depend on visual evidence. We reconstructed for the first time the original binding process of Y.1.1 and Venetus B. Our plan is to publish our edition within the Homer Multitext project, which will make it freely available on-line and useable in conjunction with all its resources.

We thank the generous contributions made by Timothy W. and Deborah Coleman Diggins, Paul E. and Kathleen M. Roughan, and Stephen P. and Nancy Savage Skinner to the Alumni/Parent Summer Research Scholarship; the Andrew W. Mellon Foundation, and the Center for Hellenic Studies.

### Poster 3

#### **The Most Important List in Classical Literature: *Iliad* Book 2 in the Venetus A Manuscript**

M. Angiolillo, T. Arralde, M. Whitacre, M. Ebbott, N. Smith  
*Department of Classics, College of the Holy Cross*

Venetus A, a 10th-century CE manuscript, preserves the oldest extant complete text of Homer's *Iliad* and contains "scholia," marginal notes on the content and language of the epic. Many scholia are the only witnesses to scholarship from the ancient Library of Alexandria. Using high-resolution photographs of the manuscript, we produced a complete digital edition of the text and scholia of Book 2. This complete edition is searchable and linked to visual evidence, allowing this work to be useful for Homeric scholars. Book 2 contains the Catalog of Ships, a list of combatants in the Trojan War. The Catalog gives insight into the oral tradition of the *Iliad* by displaying characteristics of poetry composed in performance over time, such as changes in language and culture throughout Bronze Age Greece. The Catalog is set apart from the rest of Book 2 and is marked with dividing lines. These features raise questions about the Catalog: Why is it differentiated from the rest of the book? Why does it begin with Boeotia? What do the divisions within the text mean? These are questions our work allows us to investigate. Other teams are producing editions of two *Iliad* manuscripts, Escorial Y.1.1 and Venetus B, so now we can compare observations about the transmission of the *Iliad* and its scholia. These comparisons have revealed variations between manuscripts, such as lines in one not found in others. For example, Y.1.1 and Venetus B contain a controversial line about Ajax that does not appear in Venetus A. All of our work is published within the Homer Multitext under a license permitting free reuse. As we continue, ease of access to the manuscripts and comparison across manuscripts will provide insight into the Homeric oral tradition, the origin of the *Iliad* we have today.

We thank the generous contributions made by Timothy W. and Deborah Coleman Diggins, Paul E. and Kathleen M. Roughan, and Stephen P. and Nancy Savage Skinner to the Alumni/Parent Summer Research Scholarship; the Andrew W. Mellon Foundation, and the Center for Hellenic Studies.

### Poster 4

#### **Recapturing a Lost Text: The Archimedes Palimpsest**

C. Roughan and N. Smith  
*Department of Classics, College of the Holy Cross*

The 10th century CE Codex C contained seven treatises by the 3rd century BC mathematician, Archimedes, which are now preserved in the Archimedes Palimpsest: a recycled text. In the 13th century Codex C was unbound and its erased parchment reused to create a prayer book. Digital imaging and manipulation, however, reveal the traces of the original text for study. Today the palimpsest offers the only Greek copy of one treatise and the only surviving copies of two. My research adds to the dataset of material in the Archimedes Palimpsest, and it draws on an unpublished 16th century CE manuscript, Codex Bodmer 8, for comparison. I created a guide to familiarize readers with the scribe's handwriting and abbreviations, and I revised digital transcriptions to present the exact reading of the palimpsest. My work focused on the relationship between the text and accompanying mathematical diagrams. Every diagram received a unique identifier, and its page and location was noted so that its image might be automatically retrieved. Since alphabetic labels link the diagrams to the text, every element of the diagrams was also identified and located. This allows us to use the identifier to explicitly link the text to the location referred to on the diagram. Several questions arise when looking at the diagrams: How were the scribes involved working? What can the diagrams tell us about how Archimedes was thinking? During my examination of the diagrams, I made numerous observations that suggest answers to these and related questions. We can see that the scribe added diagrams later in Codex C's construction. The scribe likely copied them from his source, rather than follow Archimedes' construction. These answers are now possible because of work done improving the palimpsest's accessibility. Confirming the texts, creating a paleographic guide, capturing the diagrams, and identifying links between the diagrams and text form a foundation for still further study of the material which the palimpsest preserves.

We thank the Andrew W. Mellon Foundation for financial support.

## Poster 5

### The Effect of Extracellular Matrix Age on the Proliferation and Cell Phenotype of Lung Mesenchymal Stem Cells

*Elizabeth Mazzeo and J. Paxson*  
*Department of Biology, College of the Holy Cross*

Chronic lung diseases affect millions of older people, and have no effective treatments. To develop better therapies for these diseases it is crucial to understand lung development, repair and regeneration after injury. Lung mesenchymal stem cells (LMSCs) are lung stem cells of mesodermal lineage, important in both fetal lung development and in repair/regeneration after injury. LMSC function, however, appears to decline in older animals, commensurate with declining abilities to regenerate the lung. Previous studies suggest that, *in vivo* the surrounding extracellular matrix is critical in the proper function of LMSCs, and that matrix composition changes with age. Our study investigates how the age of the extracellular matrix affects the proliferation and phenotype of old LMSCs, using extracellular matrix from decellularized young (3mo) and old (12mo) mouse lungs. Our hypothesis is that old LMSCs undergo greater proliferation and maintain a “younger” phenotype when in contact with a young extracellular matrix compared to older extracellular matrix. To test this hypothesis, lung extracellular matrices from both 3 and 12 month old mice were repopulated with 12mo LMSCs, and grown in culture for 21 days. In the preliminary analysis, LMSC proliferation and cell phenotype is being assessed using immunohistochemistry with antibodies against PCNA (a proliferation marker) and Alpha-SMA (a myofibroblast phenotype marker). Further assessment of LMSCs will be made using qPCR, GCMS, and western blot analysis. In understanding how the aging extracellular matrix affects LMSC proliferation and phenotype, we will be able to better understand how their function changes in the aging lung.

We thank the O'Brien Family Summer Research Fellowship for financial support

## Poster 6

### Development of an Efficient Method for the Synthesis of the C-terminal Fragment of Peptide Isosteres

*K. Poremba and B. Sculimbrene*  
*Department of Chemistry, College of the Holy Cross*

Our research is focused on developing an efficient way to synthesize peptide isosteres. Peptide isosteres are compounds that mimic the structure and size of peptides (or their larger counterparts, proteins), but have replaced the amide backbone with a different functional group. The amide backbone is responsible for the structure and binding of peptides and proteins and is readily hydrolyzed under physiological conditions. Peptide isosteres can thus be used to study the structure and binding of peptide or proteins or provide alternatives to peptide drugs that are not currently pharmacologically viable. The use of peptide isosteres is often limited by lengthy syntheses that are specific for a particular amino acid combination. We employ the Nobel Prize winning reaction olefin cross metathesis to synthesize peptide isosteres, combining a carboxyl (C) and amino (N) terminus. The focus of our study is to create an efficient way to cross different C and N termini to allow for the creation of a variety of peptide isosteres. Previous chemistry use in our laboratory to synthesize the C terminus was difficult to conduct and inefficient. Our new method uses pseudoephedrine as a chiral auxiliary in a diastereoselective alkylation reaction. The goal is to eventually have libraries of C and N termini that are easily combined to create a wide array of peptide isosteres that can be studied with any amino acid combination.

We thank the generous contribution of David M. and Michele Keenan Joy to the Alumni/Parent Summer Research Fellowship.

## Poster 7

### Investigation of Optimum GC Separation Conditions for Biodiesel Fuels

*Julian Goding, and Amber M. Hupp*

*Department of Chemistry, College of the Holy Cross*

Biodiesels are one of the most promising renewable fuels that could replace fossil fuels in our economy. They can be made from a variety of different sources, including soy, animal fat, waste grease, coconut oil, and others. The primary components of biodiesels are fatty acid methyl esters (FAMES) which can be profiled by gas chromatography with mass spectrometry detection (GC-MS). The chromatogram that is generated is used as a chemical fingerprint for each sample based on its FAME profile. A 100m polar bis-cyanopropyl-polysiloxane column was used to optimize the separation of FAMES in a complex FAME standard. Various temperature programs and split ratios were investigated. Peak to peak resolutions of all components in the FAME standard were calculated and compared for the three best temperature programs. These three programs were then used to analyze eleven biodiesels derived from various sources. Principal component analysis (PCA) was used to compare the peak areas of all major components identified in the three temperature programs. The analysis clustered samples together by sample type (i.e. all soybean biodiesels clustered together) regardless of the temperature program used. Thus, as long as the separation is adequate (resolution near 1.0 for all peaks in the biodiesel), most temperature programs could likely be used to fingerprint a biodiesel sample.

The authors thank the O'Brien Family Summer Research Fellowship for financial support.

## Poster 8

### Comparison of Stationary Phases for the Separation of Biodiesel Fuels using GC-MS

*Dorisanne Ragon, and Amber M. Hupp*

*Department of Chemistry, College of the Holy Cross*

As our petroleum resources diminish, an alternative source of energy is essential in order to sustain our fuel economy. Renewable resources resulting from natural waste grease, animal fats, and plant oil are now being chemically converted into biodiesel by a simple process called transesterification. Each biodiesel is composed of many fatty acid methyl esters (FAMES) that contribute to a unique fatty acid profile particular to the starting material (feedstock). The feedstock is the highest contributor to the fuel quality and efficiency of the biodiesel. By further studying the FAMES of the different feedstock, a fingerprint can be developed that will identify their chemical components. This information could provide specification for which feedstock produces the most efficient biodiesel. In this research, three gas chromatography capillary columns are compared for the separation of the FAMES in various biodiesel feedstock. Focus was placed on determining elution order and the resolution of several isomers that are known to be difficult to separate (C18:1). All three columns show similar elution order for FAMES; however the polyethylene glycol (PEG) and nitroterephthalic acid derived PEG are most similar to one another. Of the C18:1 isomers, the PEG columns can selectively separate the cis and trans C18:1, yet the cyanopropyl column is selective for all C18:1 isomers (cis-9, trans-9, cis-11, trans-11).

The authors thank the O'Brien Family Summer Research Fellowship for funding.

## Poster 9

### Disparity Tuning to Detect Moving Objects

*Laura Webber and Constance Royden  
Department of Mathematics and Computer Science  
College of the Holy Cross*

The goal of this research is to use a computational model of the human visual system to more accurately detect moving objects in a scene. When an observer moves through a scene, the velocities of the images on the retina of the objects in the scene form an optic flow field. One way a moving object can be detected from this flow field is to compare the speed of the velocity vectors of the moving object to the speed of the other velocity vectors in the optic flow field. However, additional information about the object's depth is needed to make this comparison because of the problem of motion parallax; images of objects closer to us move faster on our retinas than images of more distant objects. Therefore, depth information is necessary. We incorporated depth information using binocular stereo. We calculated the binocular disparity of each point in the scene, and modeled how MT cells respond to that disparity. I used the fact that cells in MT have preferred disparities, similar to their preferred velocities and preferred directions. I tuned each response through the following equation in order to find the maximum response:

$$\cos^2\left(\frac{\pi}{2} \frac{D_{pref} - D_{actual}}{D_{max}}\right)$$

I plotted the disparity difference responses with the velocity difference responses along the borders of stationary objects at various distances from the observer. I found that the disparity and velocity difference responses at different headings form a linear relationship. We can use this relationship to detect moving objects.

I thank Dr. Dan Kennedy for his generous contribution to the Alumni/Parent Summer Research Fellowship.

## Poster 10

### Development of Ceramic Nanophosphors

*Courtney Downes and Timothy J. Boyle  
Department of Chemistry, College of the Holy Cross  
Advanced Materials Laboratory, Sandia National Laboratories*

A phosphor is a material that will emit light upon an external stimulation that does not involve heat. Unfortunately, phosphors tend to degrade over time by inducing changes in valence, crystal structure fatigue, material corrosion, and many other routes. Therefore, we were interested in developing self-activated ceramic materials that utilize the heavier elements to circumvent a number of these issues. Two phosphor systems explored were the scheelite phase of  $\text{ZnWO}_4$  (ZWO) and the hafnium germinate phase of  $\text{HfGeO}_4$  (HGO). The isomorphous, scheelite phase metal tungstates ( $\text{WO}_4^{2-}$ ) are self-activated ceramic phosphor materials that have found widespread use as scintillator materials due to high stopping power, strong color, and short after-glow. Many metals, such as Ca, Pb, and Cd, have been studied in conjunction with the  $\text{WO}_4^{2-}$  materials; however, we focused on the Zn modified  $\text{WO}_4^{2-}$  scheelite material. Hafnium germinate demonstrates high UV fluorescence around 365 nm under X-ray excitation. Because hafnium is an excellent absorber of X-rays,  $\text{HfGeO}_4$  is of interest for X-ray screening imaging for medical applications, as well as a fluorescent lighting replacement for nationally critical materials (i.e., lanthanides). Synthesis of novel single-source precursors, specifically metal and mixed metal alkoxides, development of solution routes focusing on the solvothermal method, and characterization of the resultant nanomaterials were investigated for the ZWO and HGO systems. In particular, we explored the nanomaterial properties versus the bulk powders.

We thank Sandia National Laboratories, the National Science Foundation, and the University of New Mexico for financial support.



## Poster 11

### Interpersonal Synchrony and Cooperation

*J. Borders, M. Hallahan, and R. Schmidt*  
*Department of Psychology, College of the Holy Cross*

Past research by Wiltermuth and Heath (2009) found that interpersonal motor synchrony created cooperative behavior. Our study examined whether underlying factors such as interpersonal attention and mood contributed to Wiltermuth and Heath's results. We assigned pairs of participants to one of four conditions. In the hand clapping condition, participants did a signaling game that required motor synchrony. The three other conditions did not involve motor synchrony but did incorporate other aspects of the hand clapping game. In the time-randomized signaling condition, subjects played a signaling game prompted by beeps at random intervals, which required mutual attention. Two other conditions did not require interpersonal attention. They involved participants watching a video of either the hand clapping game, which was expected to produce a positive mood, or a video of people doing paperwork, which was not expected to affect mood. After one of these initial tasks, participants played the public goods game, which measured interpersonal cooperation. Levels of cooperation did not differ across conditions. Dyads in the hand clapping condition, however, experienced more feelings of connectedness and showed more within-dyad similarity in how they played the public goods game, which suggests more cohesion between partners compared to the other conditions. Results from a meta-analysis revealed that synchrony induces positive feelings towards an interaction partner but does not increase affect, which was consistent with our findings. Moreover, questionnaire results indicated that variables that past research had deemed distinct constructs, e.g. connectedness, entitativity, and similarity, are in fact overlapping.

We thank the Mellon Summer Research Program for their financial support.

## Poster 12

### How Does Provenance Affect the Price of Antiquities?

*Molly Muldoon, Katherine Tedesco & Professor Katherine Kiel*  
*Department of Economics, College of the Holy Cross*

In order to deter illegal excavation and the looting of artifacts, the United States passed the Cultural Property Implementation Act in 1982, which partially implemented the UNESCO Treaty. The UNESCO Treaty stated that only artifacts with legitimate historical documentation dating back prior to 1970 were legal for sale and purchase. Despite the changes in legislation, the enforcement of these laws remained lenient until December 2005 when Marion True, the curator of antiquities at the Getty Museum, was taken to trial by the Italian government on charges of conspiracy to buy and sell looted artifacts. The charges were dropped in October 2010. This study examines whether provenance dating back to at least 1970 increases the price of an antiquity. We consider whether or not the impact of a well documented provenance changed while the Marion True trial was ongoing (December 2005-October 2010). We find that items with pre 1970 provenance sell for higher prices after 2005, providing confirmation that the art market has reacted to the law suit. Further work this summer has expanded the data set to include more antiquities from more Sotheby's auctions in New York. When the data set is complete, regression analysis will allow us to estimate the same hedonic regression with a larger data set. We expect to find similar and more reliable results with a larger sample size.

We thank the May and Stanley Smith Charitable Trust for financial support.

## Poster 13

### **The Wisconsin Recall: A Case Study in Direct Democracy**

*D. Brand, C. Cummings, P. Hovey and D. O'Keefe*  
*Department of Political Science, College of the Holy Cross*

During the Progressive era, direct democracy devices such as initiative, referendum, and recall were introduced in states across America. However, these devices appear to contradict the Founding Fathers' commitment to a republican form of government. While initiative and referendum allow voters to directly influence the legislative process, recall provides voters with the ability to remove their elected officials without waiting until the next regularly scheduled election. Yet, the widespread use of recall has remained relatively rare, especially at the gubernatorial level. Although the only two attempts to recall governors before 2012 had succeeded, uses of recall for other elected representatives were often minor, fringe efforts that did not garner enough support to unseat the targeted politician. However, after many tumultuous protests over Wisconsin governor Scott Walker's proposed legislation to limit the collective bargaining rights of most public employees, the people of Wisconsin brought recall back to life. Despite labor protests that captivated national media attention and a prolonged campaign, Scott Walker retained his office, defeating his opponent Tom Barrett with a greater percentage of the vote than in the 2010 general election. While he remained in office subsequent to the recall, the process greatly polarized the state. We attempted to answer the question: Did the recall provision work as envisioned by its creators, allowing Wisconsin citizens to place a check on their elected officials? Or, did the recall serve to undermine stability, deliberative democracy, and good governance? Through detailed interviews with many key actors in Wisconsin politics involved in the recall election, we have determined that recall has unintended consequences. Namely, the institution can actually empower the incumbent should they win, even though victory may amount to little more than voter hesitancy to remove an elected official in the middle of his term, rather than an endorsement of his policy. Moreover, it has the tendency to exacerbate the "permanent campaign," a phenomenon where public officials spend most of their time in office campaigning for reelection, rather than actually governing. Thus, these two consequences can have a great effect on the ability of recall to act as an effective part of state governments.

We thank the Mellon Summer Research Program for its generous support.

## Poster 14

### **Cross-Cultural Differences in Reactions to Accounting Narratives: A Literature Review**

*Pei Yu Liao and Alex Yen*  
*Department of Economics and Accounting*  
*College of the Holy Cross*

Prior research by Riley, Semin, and Yen investigates how accounting narratives (non-quantitative narratives that accompany earnings reports and provide commentary on them) influence Western investors' decisions. They find that Western investors are least likely to invest when negative financial results are described concretely. In the current study, we draw on results from prior psychology research to see if this result holds across cultures. Prior literature is grouped into three categories: Cultural Differences, Linguistic Differences between the West and the East, and Economics and Accounting in Different Cultures. The first group of literature suggests that Westerners are dispositional, whereas Easterners are situational. The second group of literature demonstrates that Westerners tend to use more abstract language. In contrast, Easterners tend to use more concrete language. The final group of literature shows that cross-cultural differences lead to differences in the application of accounting rules. Based on these findings, we predict that Eastern investors would be least likely to invest when negative financial results are described abstractly, and they are most likely to invest when positive financial results are described concretely. In future work, we plan to conduct an experiment with Chinese graduate students who have recently moved to the U.S. for testing the hypothesis.

We thank the May and Stanley Smith Charitable Trust for their support.

## Poster 15

### Role of Structure and Conserved Sequences in Protein Splicing

*Jennifer M. Puszta, Julie N. Reitter, and Kenneth V. Mills*  
*Department of Chemistry, College of the Holy Cross*

Protein splicing is a post-translational event by which an intervening polypeptide, called an intein, facilitates its own excision from the flanking polypeptides, called the exteins, and the ligation of the exteins. The *Clostridium thermocellum* TerA protein contains an intein that lacks the N-terminal nucleophile. The TerA intein splices as a class three intein by bypassing the first step in the protein splicing mechanism and using an internal Cys to attack at the N-terminal splice junction. Inteins share blocks of conserved sequences that play important roles in their structure and mechanism of splicing. The HTH domain, which contains a beta hairpin, was proposed to be present in Archaeal thermophiles. We used the InteIn Data Base and visual molecular imaging to investigate the role and presence of the beta hairpin in inteins from various organism types. We found that the beta hairpin was present in inteins from Archaeobacteria but not from Eubacteria.

This material is based upon work supported by the National Science Foundation under grant MCB-0950245 and by the Camille and Henry Dreyfus Foundation.

## Poster 16

### Protein Splicing in *Trichodesmium erythraeum* and *Synechococcus* sp. 7002

*Nicolle M. Siegart, Julie N. Reitter, and Kenneth V. Mills*  
*Department of Chemistry, College of the Holy Cross*

Protein splicing is the process by which an intervening polypeptide, or intein, self-catalyzes its excision from two flanking polypeptides, or exteins, and the ligation of the two exteins. *Trichodesmium erythraeum* (Tery) and *Synechococcus* sp. 7002 (Ssp 7002) are two cyanobacteria that contain inteins with 62% sequence identity. Both inteins have cysteine residues in conserved blocks F and G that could contribute to disulfide bonds that may influence folding and/or prevent splicing. The Tery intein has a C-terminal glutamine, while the Ssp7002 intein has a C-terminal asparagine. We mutated these to asparagine and glutamine, respectively. While the Tery intein can promote C-terminal cleavage with Gln or Asn, the Ssp7002 intein is unable to cleave with glutamine. Both inteins contain a homing endonuclease domain, though only the Ssp7002 endonuclease appears active. We mutated the homing endonuclease domain of Ssp 7002, which greatly increased overexpression.

This material is based upon work supported by the National Science Foundation under grant MCB-0950245 and by the Camille and Henry Dreyfus Foundation.

## Poster 17

### **The Effect of the Fourmile Canyon Fire on Housing Prices: A Hedonic Regression Analysis**

*Pr. Katherine Kiel, Pr. Victor Matheson,  
and Charles Cunningham*

*Department of Economics, College of the Holy Cross*

In September 2010, the Fourmile Canyon forest fire burned 6,181 acres, destroyed 169 homes, and caused \$217 million in property damages. The question of interest in this study is whether this fire affected housing prices in vulnerable neighboring areas that were not directly impacted by the fire. This fire may have increased home owners' perceptions about the risk associated with living in forested areas and this heightened risk perception could be reflected through a change in prices of at risk housing parcels. Data were collected on housing sales that occurred seven quarters before and eight quarters following the fire. Using the Hedonic Pricing Model, we econometrically estimated housing prices based on relevant structural and neighborhood characteristics of each housing parcel. By comparing the change in prices of vulnerable houses before and after the fire to the change in prices for non-vulnerable houses, the effect of the fire on home prices in local areas at risk of future disasters can be estimated. Preliminary results suggest that the Fourmile Canyon wildfire did not affect housing prices in vulnerable areas. This is possibly due to pre-existing awareness and knowledge of the associated wildfire risk with the houses or perhaps due to the fire having a negligible effect on consumers' valuations and perceptions of risk of houses vulnerable to wildfire hazard.

We thank the May and Stanley Smith Charitable Trust for their support.

## Poster 18

### **Rationales Invoked in State Courts Regarding Income Tax Treatment in Personal Injury and Wrongful Death Litigation**

*Pr. David Schap and Lauren Guest*

*Department of Economics, College of the Holy Cross*

While federal tax law mandates that damages awarded in personal injury and wrongful death litigation are exempt from income taxation, much is left up for debate with regard to the treatment of income taxes in the calculation of such awards. Many state courts have ruled it appropriate to adjust any award to reflect its tax-free character, but courts in the majority of states make no such adjustment. Differences in judicial opinion can also be found in the propriety of instructing the jury on the tax-exempt nature of the award, with the dominant position being one of no instruction. In an effort to further understand the divide, relevant cases were examined for all 50 states, as well as District of Columbia, for the purpose of extracting the rationales invoked by the various courts in support of their positions on the matter. As the investigation progressed, it became apparent that a number of rationales held greater prominence than the rest, appearing recurrently across jurisdictions, while many others were unique to a single state. All relevant rationales have been documented in a comprehensive outline indicating the state courts in which they have been invoked and the case law from which such reasoning has been extracted.

We thank the May and Stanley Smith Charitable Trust for financial support.

## Poster 19

### Union's Role In Eliminating Monopolies

*Pr. Robert Baumann, Pr. Bryan Engelhardt, and Anthony Spagnoletti,  
Department of Economics, College of the Holy Cross*

Our research stemmed from Prof Engelhardt and Prof Baumann's model concerning reducing a Monopoly's power with a short selling constraint. In the model, a third party would attempt to coordinate unionization while simultaneously shorting the firm's profits the result of which would reduce monopoly profits and move toward the market competitive equilibrium. The next step was to analyze how much profit could be generated by short-selling a firm that is about to be unionized. To analyze this data, we collected stock prices for each firm in the periods before and after unionization as well as the market capitalization and number of employees in each firm. To control for market fluctuations we also collected the industry specific S&P 500 index for each firm. This information allowed us to better analyze unionization's effect on stock prices. Running the regression we found on average a 25% decrease in the ratio of firm's price to the industry index over the 9 month period surrounding unionization. In the future we would like to expand the data set and apply this valuable information to a real world scenario. By going back more years to collect more data we would be able to see if there are any underlying patterns in firms being unionized. Also, we have contacted the AFL-CIO to see if they are interested in using this idea in an actual unionization drive.

I thank the May and Stanley Smith charitable trust for its generous support.

## Poster 20

### From Ruhlmann to Rohde: How French Art Deco Became American

*Lily Meehan and Fr. John Reboli SJ  
Department of Visual Arts-History, College of the Holy Cross*

The American art deco designers of the 1930s were truly innovators, inventors and artists. They were not, however, the only ones creating "a modern world" during this time. America was one of the last countries to embrace the art deco style which was already thriving in Germany, Austria and France. Although every art deco book touches on the European influences of art deco, no one until now has conducted a comprehensive study focusing solely on how the 1925 Paris World's Fair sparked the American art deco movement until now. By sifting through primary and secondary sources in museums and libraries all over the country, I was able to piece together the progression of art deco in the United States beginning with French pieces by Émile-Jacques Ruhlmann imported by curators and department stores and ending with Gilbert Rohde's innovative new designs prominently featured at the Chicago World's Fair of 1933. My book follows this timeline, guiding the reader from Paris to New York to Chicago using many quotes from primary sources as well as period advertisement images.

We thank the Mellon Summer Research Program for funding of this project.

## Poster 21

### Transnational *ikat*, Fieldwork Explorations—An Overview

*Hana Carey, Tricia Giglio, Martha Walters,*  
*and Prof. Susan Rodgers*

*Department of Sociology and Anthropology, College of the Holy Cross*

Joint research entailed review of scholarship on Southeast Asian ‘traditional’ textiles and ethnographic fieldwork in Bali, Indonesia, and Kuching, Sarawak, Malaysia about the transnational, trans-societal, increasingly commercialized character of a famous type of Asian ceremonial textile, *ikat*. In *ikat*, the warps or wefts (rarely, both) are dyed into patterns, after tying off sections of the threads to form resists. Dyeing of yarns occurs before the cloth is woven in a backstrap loom. Subtle cloths result, with ritual meanings and deep connections to gender ideologies (*ikat* is often dyed and woven by women and embodies their ‘fertility forces’). We traveled together to Ubud, Sidemen, and Tenganan, Bali and Kuching in Sarawak to study the sweeping changes *ikat* is undergoing today, in terms of motifs, meaning, use, dyeing, and marketing scope—contemporary *ikat* is rapidly becoming a secularized cloth of the touristic and international fashion world marketplace. In spring 2013, Carey, Giglio, and Walters will serve as docents for Cantor Art Gallery’s exhibition, “Transnational *Ikata*,” curated by Rodgers. This poster with fieldwork photographs gives an overview of the summer 2012 field research.

For financial support we thank the Andrew W. Mellon foundation and the W. Arthur Garrity, Sr. family, which endowed the Garrity Professorship at Holy Cross.

## Poster 22

### Ideology and “Nature”: Reviving Natural Dyes in Indonesian Textiles

*Martha Walters and Prof. Susan Rodgers*

*Department of Sociology and Anthropology, College of the Holy Cross*

Natural dyes were once widespread in Indonesia to color intricately beautiful *ikat* ceremonial textiles. These natural dyes had rich semantic connections to local worldviews in many of Indonesia’s 300 societies. After the introduction of synthetic dyes to Indonesia in the early 20<sup>th</sup> century, natural dyes became less popular. Commercial dyes offered a simpler, less time-consuming process that attracted most weavers. However, today this is viewed as a loss of “tradition” by some, especially by international art collectors. A Bali-based non-governmental organization (NGO) called Threads of Life shares this view. We studied Threads of Life in ethnographic fieldwork in June 2012. This NGO tries to revive the use of natural dyes for the sake of preserving cultural integrity in places like Lembata, Eastern Indonesia. I see this NGO’s stand as ideological. Natural dyes have made such a comeback because of a wave of increasing international demand for “green” natural products. Indonesian weavers should not, however, be forced to switch completely back to natural dyes because of foreign demand and foreign-founded NGOs. Rather, weavers should be able to choose what they want to use, and further research should be done to increase efficiency of natural dyes.

For financial support we thank the Andrew W. Mellon Foundation and the W. Arthur Garrity Sr. family, which endowed the Garrity Professorship at Holy Cross.

## Poster 23

### **Healing Textiles? Loss of Spiritual Protection with the Rise of Biomedicine in Indonesia and Malaysia**

*Tricia Giglio, and Prof. Susan Rodgers*

*Department of Sociology and Anthropology, College of the Holy Cross*

Indonesian and Malaysian *ikats* are Southeast Asian cloths embedded in culture. *Ikats* are associated with spiritual beliefs and are thought by villagers and some city residents to possess supernatural powers. These cloths are often involved, specifically, in the protection and healing of individuals and communities. One such textile is the Geringsing, produced in a village in East Bali. Despite Geringsing's ceremonial and spiritual importance, the cloth is undergoing significant secularization as Bali's cloth worlds increasingly commercialize. A fieldwork-based case study of the Geringsing as a healing textile in contemporary Bali shows that the use of textiles for spiritual protection and healing appears to be declining as biomedicine in Bali increases in scope and public legitimacy. The island has many clinics, hospitals, physicians, and nurses, and the biomedicine treatments they offer are attractive to many Balinese because of demonstrated cures and associations with modernity. Geringsing's shifting relationship with globalized biomedicine provides a promising future medical anthropological study. What is happening to these historical and culturally significant cloths as traditional medical practices contend with biomedicine today in increasingly globalized Indonesia?

For financial support we thank the Andrew W. Mellon Foundation and the W. Arthur Garrity Sr. family, which endowed the Garrity Professorship at Holy Cross.

## Poster 24

### **Traditionally Modern: I Wayan Karja, a Contemporary Balinese Artist?**

*Hana Carey and Prof. Susan Rodgers*

*Department of Sociology and Anthropology, College of the Holy Cross*

The Indonesian island of Bali is engaged with Asia-wide history and with the Balinese Hindu religion, which came into the island from Java and ultimately from India starting in the 11<sup>th</sup> century. Bali is also an island where imagined, invented 'traditions' contend with Asian modernities and with national Indonesian identities. I Wayan Karja is a painter from Bali who creates works influenced by his contemporary study of art in both Bali and the United States as well as his sense of spirituality since birth. He exemplifies Bali's cultural complexity. This research is based on a lengthy fieldwork interview in June 2012 with Karja at his Santra Putra Art Studio and Guesthouse in Ubud. To a Western eye, the paintings (some based on textiles) displayed in his gallery appear to be modern art or abstract expressionism. However, to Karja they come from a deeply rooted belief in Balinese Hinduism and the cosmic symbol called the mandala. The organization and structure of many aspects of Balinese culture are based on the mandala, and Karja bases his 'contemporary' paintings on this same classic symbol. In this sense, Karja walks the line between tradition and modernity begging the question: on which side does he fall? Karja's complex work suggests that such categories as 'traditional Balinese artist' and 'contemporary Balinese artist' are artificial and misleading.

For financial support we thank the Andrew W. Mellon Foundation and the W. Arthur Garrity Sr. family.

## Poster 25

### Splicing Investigation with Zinc Inhibition

*Nicholas E. Gulbrandsen, Julie N. Reitter, and Kenneth V. Mills*  
*Department of Chemistry, College of the Holy Cross*

Protein splicing is an auto-processing event where there is an excision of an intervening polypeptide, the intein, from a precursor protein sequence. The intein interrupting the DNA Polymerase II subunit in *Pyrococcus abyssi* has a C-terminal glutamine and facilitates protein splicing in a temperature-dependent fashion. First we explored the mechanism of splicing by observing the activity of site-directed mutations. We found that an asparagine residue in the block F domain of the Pol II intein has no effect on splicing. Next we investigated the means by which zinc inhibits splicing. We found that zinc inhibits splicing through forming a precipitate and the inhibition is reversible. Third, we wish to use a splicing reaction to facilitate protein purification.

This material is based upon work supported by the National Science Foundation under grant MCB-0950245 and by the Camille and Henry Dreyfus Foundation.

## Poster 26

### The Effect of Academy Award Competition on Market Share

*M. Boyle, V. Matheson, M. Quinn, and L. Chiou<sup>1</sup>*  
*Department of Economics, College of the Holy Cross*  
<sup>1</sup>*Department of Economics, Occidental College*

This paper investigates how the value of an Oscar nomination or win varies over time with the number of award categories and number of nominees per category. Over the past decade, the Academy of Motion Picture Arts has made two noteworthy changes impacting the race for best picture. First, in 2001, the Best Animated Feature category was introduced, recognizing up to five animated films in a separate award category. More recently, in 2009, the Academy increased the number of nominees in the Best Picture category from five to ten with a goal of increasing recognition for deserving films. Several prior studies have found that Oscar nominees and winners enjoy higher box office revenues and an increased market share of theaters. This study investigates how these benefits differ as competition within and across award categories changes. Using a panel of weekly box office data for nominated and non-nominated films from 1999 to 2011, we test for changes in revenues and market share of nominees and winners as the number of nominees and categories increases over time. Results suggest that increasing the number of nominees in the best picture category negatively impacts box office revenues of nominated films in that category.

We thank the May and Stanley Smith Charitable Trust for financial support.



## Poster 27

### Computing the Trajectory of Moving Objects Using a Neural Model

*M. Pettinati and C. Royden*

*Department of Mathematics and Computer Science  
College of the Holy Cross*

How does a moving observer judge the direction of a moving object? As an observer moves through a surrounding scene, the points projected onto his/her retina shift. The displacement of the points that compose the images on the retina creates a flow pattern, which varies in complexity depending on the observer's movement. An observer moving in a straight line, through a static scene, will generate a radial pattern with a center corresponding to the observer's direction of motion ("heading"). This center point is lost with observer rotation and motion subtraction must be used to recover the heading. This motion subtraction is done by neurons in the medial temporal (MT) area of the brain. MT projects to the medial superior temporal (MST) area of the brain. Cells in MST respond to radial patterns of motion and are believed to be responsible for processing information about observer heading. A computer model based on the cells of MT and MST has been developed to compute heading (Royden, 1997). A moving object causes a break in the radial pattern that is projected from MT to MST in the case of a static scene. Difference vectors at the object's borders depend on object and observer motion, so a moving object can be identified by the distinctiveness of these difference vectors (Royden, *Vision Research*, 2002). Difference vectors at the object borders contain information about both observer and object motion. Therefore, information regarding object motion can be computed from this field. We created a mathematical model to substantiate this claim. We found that with information taken from the flow field alone one can predict the trajectory of the object relative to the observer. We have added the computation to the aforementioned model. The model predicts the object trajectory accurately under certain conditions; a bias appears when the observer heading is varied.

Supported by NSF grant IOS-0818286 to Professor Royden

## Poster 28

### Mood Profiles of U.S. Army Ranger Students Associated with a Qualification Road March

*Callia Cummings<sup>1,2</sup>, Victoria Goetz, Anthony J. Karis,  
and William J. Tharion<sup>1</sup>*

*<sup>1</sup>USARIEM, Natick, MA, <sup>2</sup>College of Holy Cross*

Mood state has been associated with performance in athletes; U.S. Army Rangers are the military's equivalent to the elite athlete. This study served to examine the relationship between mood and time on a qualification road march during Ranger School. Thirty-nine male Ranger students from two training classes participated. Road march distances were 8 and 12 miles (summer and winter classes respectively). To achieve a passing grade, students needed to complete the march under a 16:25 min/mile pace; while carrying ~31 kg of equipment. The Profile of Mood States (POMS) was administered to assess mood responses during the road march. Road march time averaged a 15 min/mile for the 8 mile course and 15:15 min/mile for the 12 mile course. A significant correlation between two mile run time and road march time existed. Correlations between mood and road march time were not significant for the winter class. Significant correlations for tension, depression, fatigue, and confusion, were seen during the summer class. Those passing the road march qualification time exhibited significantly less vigor than those failing. No other mood difference between those passing and those failing were evident. Higher levels of tension, depression, fatigue and confusion were associated with slower road march times. Negative moods did not influence performance during the winter march. Those passing the road march test exhibited less vigor, perhaps from expending more effort during the run. During the more environmentally stressful summer march, mood was related to performance. These results are similar to those observed regarding mood states and athletic performance.

Supported by: U.S. Army's Medical Research and Materiel Command

## Poster 29

### Exploring the Mechanism of Human Fibroblast Adhesion to Rough PDMS Surfaces

*Allegra Parrillo<sup>1</sup>, Garrett Peck<sup>1</sup>, Morgan Stanton<sup>2</sup>, Christopher Lambert<sup>3</sup>, and Robert Bellin<sup>1</sup>*

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*<sup>2</sup>Department of Chemistry and Biochemistry, Worcester Polytechnic Institute*

*<sup>3</sup>Department of Bioengineering, Worcester Polytechnic Institute*

Traditionally, cells have been cultured and studied on flat surfaces. These surfaces do not replicate *in vivo* conditions; rather, they only allow cells to grow in two dimensions. Members of our team at WPI have created a rough surface with 2-5  $\mu\text{m}$  features, which allows cultured cells to proliferate in a three dimensional-like fashion. This surface was created by casting PDMS onto silicon carbide paper and was characterized by atomic force microscopy. The surface was then treated with 1% amine terminated silane and human fibroblast cells were seeded on surfaces for two days before analysis. Cells were fixed with paraformaldehyde and anti-body tagged for vinculin or fibronectin. Fibronectin staining was performed post cell extraction with 2% Triton X-100 to observe fibronectin deposition on the PDMS surfaces. Vinculin staining is indicative of focal adhesions and helps to characterize the nature of the interactions between the cells and PDMS. We observed differences in cellular morphology between the rough and flat PDMS surfaces. Fibronectin deposition was observed around the wells of the rough surfaces, suggesting that fibroblasts are secreting an extra cellular matrix (ECM) on the PDMS surface and then are adhering to that matrix. Vinculin tagged points reinforced this conclusion and were observed only at contact spots with the PDMS.

We thank BD Corp for financial support.

## Poster 30

### The Chemistry of Carbon Plasmas

*S. Craig and J. Kelley*

*Department of Chemistry, College of the Holy Cross*

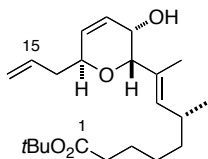
Laser induced breakdown spectroscopy (LIBS) forms a superheated plasma when a highly focused laser beam interacts with a sample. As the plasma cools, it emits light characteristic to the elements in the sample. These plasmas also contain ions, and molecular fragments. When the intended target is a carbon sample, the plasma contains  $\text{C}_2$ .  $\text{C}_2$  is highly unstable and reacts almost immediately after its formation. However, using LIBS, we are able to study this short-lived species. The spectroscopic lines corresponding to  $\text{C}_2$  are known as the Swan Bands. Although visible at atmospheric pressure, these lines were found to be poorly resolved. One of the causes for this peak broadening is due to the interactions between the air and the plasma. The air collides with the plasma causing it to cool faster, decreasing the lifetime of the plasma. This increases the lifetime broadening and pressure broadening of the peaks. Thus, a vacuum chamber was built and used to take the LIBS of carbon samples in the absence of air. Currently, the vacuum chamber needed to evacuate the air for these experiments has been assembled and can reach pressures of  $10^{-6}$  torr. Adjustment of the optics needs to be done in order to ensure well-defined and repeatable results. Future work will be done to limit further broadening of the spectroscopic lines. An investigation of other factors affecting the formation of  $\text{C}_2$  such as pressure, laser power, and gaseous environment will be undertaken.

We thank Diane D. Brink for her generous contribution to the Alumni/Parent Summer Research Fellowship and the Clare Boothe Luce Scholarship for financial support.

## Poster 31

### Efforts Toward the Synthesis of the C1-15 Segment of (+)-Sorangicin A

Randolph A. Escobar, Jeffrey E. Thode and Kevin J. Quinn  
*Department of Chemistry, College of the Holy Cross*



Sorangicin A is a highly oxygenated macrolide isolated from the myxobacterium *Sorangium cellulosum* with high activity against both Gram-positive and Gram-negative bacteria. The structural complexity of sorangicin A necessitates the use of a convergent strategy in which subunits are synthesized individually and coupled to one another in order to complete an efficient total synthesis. In this poster, we will present our progress on the synthesis of the C1-C15 portion of sorangicin A. This fragment is comprised of a core dihydropyran ring with three substituents, including an alkenyl C1-C8 chain with a stereogenic center at C6. Our approach involves independent synthesis of the dihydropyran core and subsequent coupling with the C1-C8 side chain. We will present the optimization of our routes these subtargets and our proposed strategy for completion of the C1-C15 segment.

We gratefully acknowledge the National Science Foundation and the generous donation of the O'Brien family to the Summer Research Program for financial support of this research.

## Poster 32

### Synthesizing the N-Termini of *trans*-Alkene Peptide Isoesters

K. Connolly and B. Sculimbrene  
*Department of Chemistry, College of the Holy Cross*

Peptide isosteres are analogs of a particular peptide that replace the backbone amide with a different functional group. These biomimics are popular components of pharmaceuticals because they contain many of the benefits of proteins as drugs without the side effect of rapid decomposition via hydrolysis of the amide bond. Our research focuses on *trans*-alkene peptide isosteres since they are geometrically similar to the amide bond but remove the peptide's ability to be hydrolyzed and / or form H-Bonds via the backbone amide. Thus, *trans*-alkene peptide isosteres could make effective pharmaceuticals and they can be used to study binding interactions with biological targets that rely on H-bonding. Our key step in synthesizing *trans*-alkenes is to couple an N and C termini via Olefin Cross Metathesis. The cross metathesis step is sensitive to the sterics or electronics of the N and C termini. As a result, Olefin Cross Metathesis often produces varying amounts of the desired peptide isostere and undesired homodimers. The goals of my research are to build a library of N-termini with different molecular properties to give our lab insight when studying the conditions that affect the key Olefin Cross Metathesis step.

We thank the Richard B. Fisher Summer Research Fellowship for funding.

### Poster 33

#### Study of $\text{Re}(\text{CO})_3^+$ with Phenyl Derivatives

*Jacob M Bass, Richard S Herrick, <sup>1</sup>Christopher J Ziegler*  
*Department of Chemistry, College of the Holy Cross*  
*<sup>1</sup>Department of Chemistry, University of Akron*

Rhenium is a promising element in Bioorganometallic chemistry, as  $^{186}\text{Re}$  and  $^{188}\text{Re}$  are both  $\beta$  emitters and can be prepared in a nuclear reactor. In the future, this research may help find ways to both detect and treat cancer, making bioorganometallic chemistry an exciting field. The Herrick Lab, in conjunction with Dr. Ziegler of the University of Akron, has been looking at the reactions of phenylenediamines, hydrazines, and aminophenols with pyridine-2-carboxaldehyde and the appropriate rhenium (I) carbonyl compound to form new diimine compounds. This summer, several new compounds were confirmed by a single crystal X-ray analysis or NMR analysis. Many of the reactions use  $\text{Re}(\text{CO})_5\text{Br}$  or  $[\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3]\text{Br}$ . In addition to expected compounds, the reaction of o-phenylenediamine gave unexpected results: three separate novel compounds were isolated and characterized by X-ray diffraction. Future work will include variations of various experiments performed and testing the properties of compounds prepared.

This work was supported by a grant from the Petroleum Research Fund, administered by the American Chemical Society. The authors thank Professor Chris Ziegler at the University of Akron and his students for performing the crystallography.

### Poster 34

#### Protein splicing of a temperature-dependent intein from an extreme thermophile

*Kathryn M. Colelli, Julie N. Reitter, and Kenneth V. Mills*  
*Department of Chemistry, College of the Holy Cross*

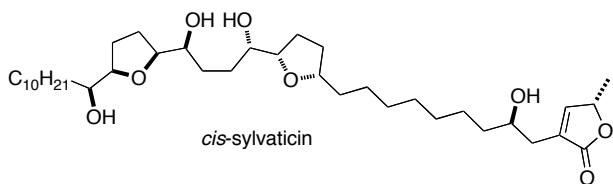
Inteins are intervening polypeptides that are excised by the process of protein splicing. Protein splicing is a self-catalyzed process in which the intein directs its own removal and the ligation of the flanking polypeptides (N- and C- exteins). The *Pyrococcus abyssi* (*Pab*) PolIII intein is unusual in that it only reacts at elevated temperatures. This allows for purification of unspliced precursor protein on over-expression from *E. coli* and *in vitro* analysis of the rate of splicing and the influence of mutations on the steps of splicing. We recently collaborated on a biochemical and structural analysis of the *Pab* PolIII intein (Du, Z., Colelli, K.M., *et al.*, *J. Biol. Chem.* 286(44) 38638-38648). Many important observations emerged from the NMR data including conserved residues in intein blocks B and F that are well positioned in the active site to catalyze the reaction. We found that mutations to these sites slow cleavage. Relaxation data show that the intein is particularly rigid, and the intein has a  $\beta$ -hairpin found only in the structures of thermophilic inteins, which may contribute to the thermal stability of the intein. We have found that mutations to this hairpin have an effect on the rates of cleavage and splicing as well as on the structural stability of the intein.

This material is based upon work supported by the National Science Foundation under grant MCB-0950245 (KVM), the Camille and Henry Dreyfus Foundation (KVM), and the Arnold and Mae Beckman Foundation (KMC).

## Poster 35

### Synthetic Studies on (+)-*cis*-Sylvaticin

*Kaylie E. Gage, Caroline M. Stanners and Kevin J. Quinn*  
*Department of Chemistry, College of the Holy Cross*



*cis*-Sylvaticin is a cytotoxic natural product isolated from the leaves of the *Rollinia mucosa* plant belonging to the Annonaceous acetogenin family. We have developed a synthesis of the bis(tetrahydrofuran) core of *cis*-sylvaticin using a two-directional strategy that takes advantage of its local  $C_2$  symmetry. Key steps in our approach include a silicon-tethered ring-closing metathesis reaction for construction of the central C-C bond and a double  $S_N2$  cyclization for formation of the two tetrahydrofuran rings. Our route makes use of Sharpless asymmetric epoxidation and dihydroxylation reactions to control the absolute configurations of the six stereocenters present in the symmetric core. Our current efforts are aimed at optimization of our route and desymmetrization of our advanced intermediate for completion of the total synthesis.

We gratefully acknowledge the National Science Foundation and the generous donation of the O'Brien family to the Summer Research Program for financial support of this research.

## Poster 36

### Improved Frequency Locking of an Extended Cavity Diode Laser for Laser Cooling of Rubidium

*C. Richardson, K. Moran, K. Candee, and T. Roach*  
*Department of Physics, College of the Holy Cross*

Laser cooling a gas of rubidium (Rb) atoms requires very specific frequencies of light. Using a negative feedback control loop, we lock the frequency of an extended-cavity diode laser to a Rb reference absorption peak. We send some of the light through a cell of Rb vapor and monitor the absorption with a photodiode. The absorption signal is demodulated to produce an error signal, which is fed back to the laser tuning control. The tightness of the lock depends on the open loop gain, so we have carefully measured and optimized the gain characteristics of each component of the system. We also added an amplifier to increase the gain. The improved control loop can keep the laser locked for more than an hour. It is resistant to mechanical vibrations, as we see the frequency remain locked while we work on the apparatus. Further, using an acousto-optic modulator, we can detune the primary laser cooling light up to 20 MHz, while keeping the light going to the Rb cell locked on the reference peak. Detuning the cooling light further from resonance can produce a colder gas of atoms.

We are grateful for financial support from the Massachusetts Space Grant Consortium (CR and KC) and to the Richard B. Fisher Summer Research Fellowship (KM).

## Poster 37

### **Evidence for Relative Roles of the 5-HT<sub>2A</sub> Receptor on Mesolimbic and Mesocortical Dopamine and Prepulse Inhibition in Mice**

*Tara Raj, Samantha Nardi, Gregory Peters, and Pr. Daniel Bitran  
Department of Psychology, College of the Holy Cross*

Though amphetamine, a dopamine-releasing agent, and TCB-2, a 5HT<sub>2A</sub> receptor agonist, are known to disrupt prepulse inhibition (PPI) in a mouse model of schizophrenia, their effects have not yet been mapped onto dopaminergic circuitry. To discern the mechanisms by which these drugs disrupt PPI, reboxetine, a drug that selectively increases dopamine activity in the mesocortical pathway, was used to characterize the action of amphetamine and TCB-2 on the mesolimbic-cortical circuit. First, each drug alone was administered to mice and their PPI was measured against vehicle controls. Next, the effects of amphetamine and TCB-2 were tested in the presence of reboxetine, which significantly increases PPI. Compared to controls, reboxetine (5 mg/kg) still increased PPI in the presence of a low dose of amphetamine (0.5 mg/kg), which alone had no significant effect. When combined with a highly disruptive dose of amphetamine (2 mg/kg), reboxetine normalized PPI, demonstrating that elevated dopaminergic activity in the mesocortical system by both drugs was enough to negate amphetamine's putative increase of dopamine in the mesolimbic system. Finally, a dose of TCB-2 that alone had no effect on PPI (1 mg/kg), nevertheless prevented the increase of PPI by reboxetine, suggesting that TCB-2 acted on 5HT<sub>2A</sub> receptors to block reboxetine-induced increases in dopamine specifically in the mesocortical system. Comparison of alone versus combined effects of these three drugs yielded evidence for pathway-specific mechanisms that align with the current dopamine hypothesis of schizophrenia which posits the presence of a hyperdopaminergia in the mesolimbic system and a hypodopaminergia in the mesocortical system.

This research was made possible by the generous contributions of Marion and Samuel E. Krug, Ph.D.; and Sean J. and Jennifer O'Scanllain to the Alumni/Parents Summer Research Fellowship Fund.

## Poster 38

### **Gel Microparticles for Lung Cancer Drug Deliver**

*R. Guerra, B. Benson, and R. K. Prud'homme  
Department of Chemical Engineering, Princeton University*

Non-small cell lung cancer (NSCLC) is currently the leading cause of cancer related deaths in the United States. As surgical removal of lung tumors often results in a loss of critical lung function, chemotherapy offers the best means of treating NSCLC. Camptothecin (CPT), a hydrophobic anti-tumor agent, is an ideal candidate for treating NSCLC, however due to its high toxicity, delivering an appropriate dosage would result in deadly side effects. We have focused on developing a two-stage targeted delivery method for transporting CPT to tumor sites in the lungs, thereby avoiding its harmful attack in other areas of the body. First, using flash nanoprecipitation, we have developed CPT nanoparticles that increase the drug's bioavailability. Those nanoparticles are then encapsulated in gel microparticles (GMPs) of approximately 10-20  $\mu\text{m}$  in size. When injected into the pulmonary artery, GMPs of this size will passively lodge into the lung capillaries, allowing for their degradation and release of the nanoparticle CPT to the cancerous tissue via leaky tumor vasculature. We have successfully produced nanoparticles of the desired size and are able to encapsulate them into GMPs. We have developed a method that produces relatively monodisperse GMPs in the size range of 10-20  $\mu\text{m}$ , but needs a little more fine-tuning. Generating emulsions allows us to produce large quantities of GMPs relatively quickly, however the GMPs are fairly polydisperse and are not entirely in the desired size range. Future optimization of the parameters of the emulsification process will be the next steps in the development of an adequate drug delivery system.

We thank NSF for funding through their summer REU program.

## Poster 39

### Imaging Cone Photoreceptors Using Spatially Non-Coherent Light

*Allison Hartman<sup>1</sup>, Changgeng Liu<sup>2</sup>, and Dr. Myung Kim<sup>2</sup>*  
*<sup>1</sup>College of the Holy Cross, and <sup>2</sup>University of South Florida*

In order to get clear images of the photoreceptors in a living human eye, we constructed collimated beam of light with non-coherent spatial phase information. In the past, imaging techniques using coherent light have shown interference speckles that are the same size and shape as photoreceptors; these experiments have been unable to differentiate the speckles and the photoreceptors that are in the retina of the eye. In our experiment we used MatLab to create a simulation of the optical system using spatially non-coherent and verified is using an experimental setup. We found that by giving the incident beam random phase information the speckles cancel each other out the through the propagation yielding images without interference speckles. We were able to get clear images of resolution targets and our future work will be to image retina samples using spatially non-coherent light.

We thank the National Science foundation for funding this project and University of South Florida and the Digital Holography and Microscopy Lab for hosting A. Hartman.

## Poster 40

### New Organometallic Rhenium Compounds as Potential Radiopharmaceuticals

*Catherine A. Bogdanowicz and Richard S. Herrick*  
*Department of Chemistry, College of the Holy Cross*

Rhenium compounds have attracted much interest from researchers in recent years. It acts as a cold analog of technetium-99m, a gamma emitter, which has no stable isotopes. With the recent advance where rhenium-188, a  $\beta^-$ -emitter can be created carrier free, there is even more interest in this research, as it may now be possible to create analogous compounds for diagnosis and therapy. This summer's research focused on attaching tripodal ligands, or new ligands prepared from the Schiff base reaction of a phenylenediamine, and pyridine-2-carboxaldehyde to the  $\text{Re}(\text{CO})_3^+$  center. Several new compounds were created and their identity was confirmed by single crystal X-ray analysis or NMR analysis. The reaction of the o-phenylenediamine gave three different compounds. Each was analyzed by X-ray crystallography. Future work in these areas will include variations of reactions and testing properties of compounds.

This research was funded by a grant from the ACS-PRF foundation.

## Poster 41

### Screening of Urine Bioassay Samples using a Standard Nuclear Medicine Gamma Camera

*Angela Vu, Christopher Martel CHP, and Rakesh Kannan RT (N)*  
*Department of Health Physics and Department of Nuclear Medicine,*  
*Brigham and Women's Hospital*

In a situation where a radiological dispersion or nuclear disaster occurs, a method which permits screening a large amount of people for internal contamination within a short period of time would be extremely valuable. In this experiment, a standard Nuclear Medicine Gamma Camera was tested to determine whether it is sufficiently sensitive to screen urine bioassay samples for radioactive contamination. A series of three tests were developed in order to calculate minimum detectable concentrations (MDCs) of the Gamma Camera for comparison to the EPA's Protective Action Guideline Values. The tests determined: contribution from background radiation, efficiency of the Gamma Camera detector to detect photons of different energies, and the effect of sample volume on detector efficiency. After MDCs were calculated, estimated doses (mSv) were calculated for Days 1-7 post radiological incident. Plain tap water was used to simulate human urine because of their approximately identical physical densities, and Tc-99m ( $\gamma = 0.140$  MeV) and F-18 ( $\gamma = 0.511$  MeV) were the radioactive isotopes tested. The samples were imaged and counted with a Symbia Dual Head SPECT/CT (Siemens) with E.SOFTVA25A; version 6.5.9.19 program. Results concluded that the method allows for the rapid screening of multiple samples with MDCs far below Radiation Protection Action Guideline values for some isotopes of concern. Urine samples identified as "radioactive" i.e., above the screening threshold, can then be sent off to a laboratory for further testing and analysis.

We thank Brigham and Women's Hospital for financial support.

## Poster 42

### Laser Cooling of Rb with Improved Laser Tuning and Optical Microwave Sideband Power

*Kevin Moran, C. Richardson, K. Candee, and Timothy Roach*  
*Department of Physics, College of the Holy Cross*

A Magneto-Optical Trap (MOT) can trap atoms and cool them to near absolute zero. The primary force used is the recoil momentum from scattering a photon of light. Cooling is achieved by making this force velocity dependent using the Doppler effect and magnetic sub-level shifts. Laser light incident from several directions creates an "optical molasses" that slows the atoms, lowering the temperature of the gas. The end goal of this experiment will be to observe what occurs when a cloud of laser-cooled rubidium atoms scatters off a magnetic surface. We have made significant improvements to two key parts of the MOT apparatus. First, the mode-hop-free tuning range of our extended cavity diode laser (ECDL) was improved by simultaneously adjusting the cavity length and the electric current through the diode. This increased the tuning range from less than 1 GHz to about 9 GHz, making the MOT both easier to get running and much more stable long-term. The second major improvement was in the production of sideband laser light used to keep the Rb atoms in the correct state for cooling. Modifications to the electronics for microwave injection increased the sideband light from less than 1% to about 6% of total optical laser power, with a consequently large increase in the number of atoms trapped.

KM is grateful for support from a Richard B. Fisher Summer Research Fellowship.



## Poster 43

### **Entosis, A Nonapoptotic Cell Death Program, may be Involved in the Linker Cell Death of *Caenorhabditis elegans***

*M. Fitzgerald, O. Florey, and M. Overholtzer*

*Department of Cell Biology, Memorial Sloan-Kettering Cancer Research Center*

Entosis is an unusual process first discovered by Dr. Michael Overholtzer involving the invasion of one cell into another, leading to a transient state in which a live cell is contained within a neighboring host cell. This mechanism can lead to nonapoptotic cell death such as in epithelial cells when they are detached from the extra-cellular matrix and may represent an intrinsic tumor suppression mechanism for cells that are detached from the ECM. In order to further comprehend how entosis works the linker cell in *Caenorhabditis elegans* which leads gonadal elongation was studied, as it proceeds independently of caspases and apoptotic effectors suggesting a nonapoptotic cell death program. In addition, the engulfment of the linker cell proceeds by an engulfment mechanism unlike any other such as apoptosis or phagocytosis. However, imaging this linker cell is a difficult process as the *C. elegans* needs to be fully alive yet immobile. Both paralysis and gluing of the *C. elegans* were attempted followed by imaging for visual evidence that this linker cell death proceeds by an entosis mechanism. Paralysis resulted in a slow poisoning of the worm distorting imaging results and while gluing was more successful in providing better images of the linker cell, great precision is required and if not done exactly right the worm will be poisoned. Gluing is currently the best method for imaging the linker cell death but seeing as visual evidence for entosis in this process still has not been directly found a better protocol could be created.

## Poster 44

### **Rhenium Diimine Compounds**

*Calvin Luu and Richard S. Herrick*

*Department of Chemistry, College of the Holy Cross*

Recent experiments on rhenium tricarbonyl compounds suggest that  $\text{Re}(\text{CO})_3\text{L}$  compounds have noteworthy and useful applications in bioorganometallic chemistry. Diimines have shown to be good ligands for  $\text{Re d}^6$  compounds. Some of the most common examples of diimines serving as strong ligands are: 2,2'-bipyridine, pyridine-2-carbaldehyde imine, and diazabutadiene. Recently, we have made less commonly used diimines, such as, 2,2'-biimidazole, and have found them to be excellent ligands. New synthetic paths were employed to create a unique set of  $\text{Re}(\text{CO})_3(\text{diimine})\text{X}$  compounds. The focal point of these new paths was to bind different ligands to the  $\text{Re}(\text{CO})_3^+$  center. While working with various compounds containing rhenium and diimine ligands such as the biimidazole, pyridinyl imidazole, and benzimidazole ligands, new crystal structures of  $\text{Re}(\text{CO})_3(\text{diimine})\text{X}$  were resolved from products of these reactions ( $\text{X} = \text{Cl}, \text{Br}, \text{I}$ ). Throughout this process different experimental procedures were used to improve yields. Future work in this area will comprise of improving experimental methods and solving crystal structures of  $\text{Re}(\text{CO})_3\text{L}^+$  compounds. Attaching different side chains, such as amino acids, to the ligand will be another future goal. This research will help provide further understanding of rhenium and organometallic chemistry.

We thank the O'Brien Family Summer Research Scholarship for their financial support.

## Poster 45

### Phosphorylation of Functionalized Alcohols Using a Lewis Acid Catalyst

*Kyle P. Pedretty and Bianca R. Sculimbrene*

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Phosphate is an important functional group present in many organic molecules. This functional group is found in DNA, RNA, small molecule messengers and pharmaceuticals. Phosphate groups are responsible for a wide variety of functionality in living systems. Specifically, phosphates are used to drive metabolic pathways and to signal a cellular change based on a stimulus. Within pharmaceuticals, replacing an alcohol with a phosphate group can increase the solubility of a drug, making it more available to interact with its target. Our goal is to develop an effective method to integrate phosphates into organic molecules. This process is known as phosphorylation. Prior phosphorylating techniques used harsh conditions which limited the types of molecules that could be phosphorylated. We have developed a Lewis acid catalyst that enables the phosphorylation of diverse compounds, without sacrificing the functionality of these molecules. This has included the successful phosphorylation of the amino acids, serine and tyrosine; the terpenoid, geraniol; and an analog of the immunosuppressant drug, FYT720. All of these phosphorylated organic compounds had not previously been synthesized and thus were completely characterized.

We thank Linda K. and Christopher P Cheney, MD for their generous contribution to the Alumni/Parent Summer Research Fellowship fund.

## Poster 46

### Effect of *Neisseria meningitidis* PorB Variation on Outer Membrane Protein Expression: A Laboratory Investigation of the Natural History of Antigenic Diversity

*Jacob A. Miller<sup>1,2</sup>, Lilian Amer<sup>3</sup>, and Margaret Bash<sup>3</sup>*

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The remarkable amount of antigenic diversity within the outer membrane proteins of the bacterial pathogen *Neisseria meningitidis* has complicated the development of protein-based vaccine candidates. Variability of PorB, a major outer membrane porin protein, occurs primarily in surface exposed loops. The structural, functional and fitness effects of genetic diversity in PorB are under study using a panel of transformant strains expressing PorB with defined differences in surface exposed loops. Using RT-PCR, we examined *porB* and *rmp* gene expression in the isogenic *porB* transformants, the parent MC58ΔporA and wild type (WT) strains. Results showed a trend towards decreased expression of *porB* especially in the transformants with *porB* from a laboratory strain Cu385 and a laboratory-constructed hybrid PorB::OCH. This suggests that some combinations of naturally occurring loop sequences may have a fitness disadvantage. In parallel, we examined the natural history of PorB diversity by sequence analysis of *porB* genes from a large collection of Brazilian serogroup B *N. meningitidis* strains. Variations in *porB* from Brazilian epidemic strains were compared with non-epidemic strains of other genetic lineages. *porB* variation was present among epidemic strains collected over a twenty year time period, even among strains with identical Multi Locus Sequence Type (MLST). As expected, variation was greater among strains belonging to non-epidemic clonal complexes (CC), but unexpectedly, the pattern of *porB* sequence diversity among strains belonging to the epidemic type ST33 differed from that observed among non-epidemic CCs strains.

We thank ORISE for funding this project.

## Poster 47

### **‘The only time we talk about it is to make sure the drugs are taken appropriately’ - Subjective Experiences of Children with HIV/AIDS and their Guardians in Tanzania**

*Kathryn A. Chobanian<sup>1</sup>, Renee L. Beard<sup>1</sup>, and Paul E. Palumbo<sup>2</sup>  
College of the Holy Cross<sup>1</sup> and Dartmouth Medical School<sup>2</sup>.*

Research of first-hand experiences of families with HIV/AIDS in any part of the world is limited. Given the widespread incidence of HIV in Africa, it is important to understand the experiences, basic needs and desires of affected families. This study involved 2 months of observing infected children and their guardians, (N=75) while collecting subjective, open-ended data and objective survey-based needs assessment at a pediatric HIV/AIDS clinic in Tanzania. The findings reported are qualitative data from both children (n=36) and guardians (n=39). All interviews were conducted in Kiswahili, the native language, by a nurse, translated and transcribed verbatim and analyzed using grounded theory methodology. Overarching themes generated from both groups included: *disclosing the disease* and *unmet needs*. Infected children and guardians reported a lack of discussion of HIV/AIDS among themselves. Primary needs identified by children were school supplies and books, whereas for guardians, food, bus fare and medical insurance and additional educational needs were deemed essential. Themes from the children involved *future occupational aspirations* and *daring to wish*; guardians felt *supportive service needs* were important. While the dataset is small and cannot be generalized to the larger population from which it was drawn, the significance of these preliminary findings for education, prevention, treatment and supportive services is vital. Since the decision *not* to disclose the diagnosis was based on fears of being misunderstood or the risk of social pariah, better education must be provided. Likewise, many of the unmet needs reported could be addressed by improving the current system of care – a primary objective of this survey.

We thank the Greisch Family Summer Research Fellowship for financial support.

## Poster 48

### **Bactericidal Antibiotics Lead to Cellular Death Through Lipid Peroxidation**

*Jonathan Ye, Peter Belenky, and James Collins  
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Bactericidal antibiotics induce cellular death through a common oxidative damage mechanism. This mechanism acts via the elevation of the tricarboxylic acid cycle, depletion of NADH, destabilization of iron-sulfur clusters, and culminate in the production of hydroxide radicals through the Fenton reaction. Hydroxide radicals can lead to cellular death by damaging three major cellular components: DNA, proteins, and lipids. Here we conduct a metabolomic profile of antibiotic treated bacteria and find that antibiotics dramatically change the matabolome of *E. coli*. Interestingly the precursors of inner membrane lipids showed dramatic changes indicating possible damage through peroxidation. Consistent with this we find that malondialdehyde (MDA), a by-product of lipid peroxidation was dramatically upregulated following treatment with H<sub>2</sub>O<sub>2</sub> ampicillin, kanamycin or norfloxacin. A *fabR* deletion strain with elevated levels of unsaturated fatty acids, proved to be more susceptible to ampicillin, kanamycin or H<sub>2</sub>O<sub>2</sub>. This suggests that cellular susceptibility to these toxins is related to the saturation state of the membrane phospholipids. Finally, we find that a *yqhD* mutant, which has decreased ability to detoxify MDA, is also more susceptible to antibiotic treatment confirming the role of peroxidation and MDA production in antibiotic toxicity. This information underscores the importance of oxidative damage in antibiotic mediated cell death and may be applied to enhance the effectiveness of current antibiotics and develop novel anti microbial therapy.

We thank the Howard Hughes Medical Institute for financial support.

## Poster 49

### The Discovery and Application of Mathematical Concepts in Musical Compositions

*S. Crifo and S. Korde*

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Mathematics has been an essential component of Western Classical music throughout history. We studied analyses of musical pieces that are believed to be particularly mathematical and verified their validity according to definitions of mathematical concepts that we compiled. We began, appropriately, with some of the earliest surviving western music by looking in depth at Robert Cogan's analysis of an antiphon by Hildegard von Bingen that reflects fractal symmetry. Ms. Crifo also worked to perform this piece and others under the influence of her voice teacher, Marsha Vleck. We also analyzed the "Crab Canon" in Johann Sebastian Bach's *Musical Offering* and created graphs to visually portray the symmetry present in the piece. We also studied group theory in twelve-tone compositions, the presence of Fibonacci numbers and the Golden Section in works by both Béla Bartók and Claude Debussy. Our work will continue during the 2012-2013 school year as the bulk of Ms. Crifo's senior thesis for the College Honors Program. In addition to analyzing those pieces we have identified as being possibly mathematical, we will also begin looking at chaos and fractals in György Ligeti's music and the highly mathematical compositions of Iannis Xenakis, namely *Nomos Alpha*.

We thank the Andrew W. Mellon Foundation for financial support.

## Poster 50

### The Impact of Nutrient Addition on the Enzymatic Activity in the Waters of the Kolyma River Watershed

*M. LaRue<sup>1</sup>, W. Sobczak<sup>1</sup>, P. Mann<sup>2</sup>, R. Holmes<sup>2</sup>, and E. Bulygina<sup>2</sup>*

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In order to fully understand the implications associated with climate change, it is important to consider all aspects of biogeochemical cycling in the Arctic. The enzymatic breakdown of organic material in Arctic aquatic ecosystems is a major means of CO<sub>2</sub> release into the atmosphere. Enzymatic activities are thought to be dependent on nutrient availability, the key regulator of oxidase and hydrolase activity rates. Inorganic nitrogen and phosphorus were added to samples representing a gradient of Arctic aquatic systems ranging from first order streams to ocean, and the activity of four enzymes (phenol oxidase, phosphatase, beta-glucosidase, and leucine aminopeptidase) were monitored for eight hours. Polyvinylpyrrolidone (PVP), a chemical that lowers phenolic content, was added to certain samples in addition to inorganic nutrients to assess the impact of carbon composition on enzyme activity rate. No clear patterns were seen in response to nutrient addition, indicating that nutrient availability may not be the key regulator of microbial metabolism. In the Kolyma River, enzyme activity rates were unaffected by nutrient addition only, but changed in response to PVP and nutrient addition. The removal of phenolics by PVP allowed for an overall increase in hydrolase activity rates, and allowed these hydrolase enzymes to respond to nutrient addition. This suggests that the carbon composition of organic material is important as well as nutrient availability in microbial metabolism. If the organic carbon composition and/or nutrient availability were to change in aquatic ecosystems due to Arctic warming, our results suggest that this will change the microbial respiration rates and associated CO<sub>2</sub> release into the atmosphere.

Thank you to the National Science Foundation and the Polaris Project for financial support.

## Poster 51

### Asymmetric Iodolactonizations Using a BINOL Derived Catalyst

*Christopher Shugrue, Chao Fang, and Stephen Martin\**

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Previous work in the Martin group has shown that a bifunctional (*R*)-BINOL derivative, containing both a phenol group (Brønsted acid) and an amidine group (Lewis base), gives excellent enantioselectivity with certain halolactonization reactions. This involves the cyclization of various olefinic acids in the presence of electrophilic halogens. Stereoselectivity is believed to result from the formation of a hydrogen-bond between the BINOL's phenol and the substrate's carboxylic acid, with the molecule orienting in such a way as to avoid steric repulsion between the catalyst and any bulky groups on the substrate's olefin. The amidine group can then deliver the halonium ion selectively to one face of the olefin, resulting in stereochemical control during cyclization. Extensive work has been done in using this catalyst in the iodolactonization reactions of various 5-aryl-4(*Z*)-pentenoic and 6-aryl-5(*Z*)-hexenoic acids. These substrates favor 5-exo and 6-exo cyclization respectively, resulting in carbon-iodine and carbon-oxygen bonds being formed on two new stereogenic centers with high enantioselectivity (7 substrates  $\geq$  98:2 er). This catalytic method could potentially be applied in the future to create valuable enantiomerically pure intermediates in the syntheses of biologically active natural products.

We thank the NSF, the NIH (GM31077), and the Robert A. Welch Foundation (F-0652) for financial support.

## Poster 52

### A Deeper Look into the Spectral Lines of the Near UV Range

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In LIBS, laser light is focused on a sample, turning a small amount of the sample into a superheated plasma. The wavelengths of light given off by excited atoms in the plasma are characteristic of the atoms themselves, resulting in elemental identification. We are developing a means of quantifying heavy metal contamination in sediment from the nearby Blackstone River. Unfortunately, our instrument has exhibited decreased sensitivity in the near UV range between 200 and 400 nm. This is a major issue because heavy metal contaminants such as lead and chromium have extremely useful spectral lines in this region. In order to troubleshoot the missing near UV range, four brass alloys were used as a reference due to their multiple spectral lines in this region. An analysis of the UV-Vis spectra of our focusing lenses demonstrated that borosilicate glass does not transmit much light with a wavelength shorter than 400 nm. Therefore, both lenses were replaced with fused silica; a glass that does not absorb in this region. This change resulted in the new detection of multiple lines in the 300 to 400 nm range. In light of the improvement in spectra, the beam splitter composed of soda lime glass will also be replaced with fused silica glass. Additionally, the ability of argon and helium gases to enhance LIBS spectra was tested yielding encouraging results at atmospheric pressure. Future studies will examine LIBS spectra in these gaseous environments at lower pressures.

We thank the generous contribution made by Domenic J. and Catherine Eagen Dinardo to the Alumni/Parent Summer Research Fellowship.

## Poster 53

### Elucidation of Metabolite Response to Dole Polyphenol Juice and Exercise Supplementation

*Rachelle Zribi and Dr. Kevin Knagge  
David H. Murdock Research Institute*

Prior to this summer, the Human Metabolite Library at the DHMRI consisted of 104 compounds. Currently, the library consists of 167 compounds, including sixteen plant metabolite compounds. The development of the library was an integral step in referencing compounds in the Dole Polyphenol Juice Study. This study consisted of thirty-two human subjects and tested how a Dole Juice mixture impacted human recovery from exercise monitored through examination of metabolites. Through the use of NMR and multivariate statistical tests, it was possible to identify differences between the metabolite profiles of the supplement and control groups. For each of the thirty-two participants, a 1D Proton NMR experiment was performed on blood samples taken at four time points during the study. These spectra were integrated and analyzed through Principal Component Analysis and Partial Least Square Discriminant Analysis. After comparing metabolite standard spectra to the blood serum spectra, a total of thirty-three metabolites were identified as well as another possible fourteen. After studying the normalized data from the 0.01 ppm bucket, we identified significant changes in nineteen metabolites throughout the study.

We thank the Buchta Family for financial support.

## Poster 54

### Survey of Continuous Infusion Protocols Used in Hemophilia Treatment Centers in Canada in 2012.

*Andrew Sullivan and Dr. Mary Frances Scully  
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Hemophilia A is a deficiency of factor VIII (FVIII), which is an essential blood-clotting protein. This deficiency prevents the coagulation system from functioning properly leading to an increased risk of bleeding. The current treatment of major bleeding episodes, perioperative and periprocedural, in hemophilia A is through the administering of either recombinant FVIII or plasma-derived FVIII to the patient, via bolus injection (BI) or continuous infusion (CI). This study focuses on the clinical advantages and disadvantages of using CI to treat hemophilia A. We plan to conduct a retrospective audit of the hemophilia clinic at the Health Sciences Centre in St. John's, Canada. As a first step, we have surveyed hemophilia clinic directors and nurse coordinators across Canada to gain knowledge of how CI is currently used in Canada. According to the literature, the advantages of CI are that it is a safer and more cost-efficient method of treatment, and also avoids the need for pharmacokinetic studies. By keeping levels steady with CI through an I/V, factor is kept at safe levels for coagulation. Intermittent BIs result in high peaks that waste expensive factor and can cause clotting, followed by troughs that put the patient at risk of hemorrhage. Studies show average FVIII savings of approximately 36% with CI over BI, which translates into savings of thousands of dollars per patient. In Canada, most Hematologists use BI, describing perceived disadvantages such as risk of inhibitor formation, local thrombophlebitis, decreased product stability after reconstitution, bacterial contamination and risk of overgrowth, and inconvenience/increased need for monitoring of patients. Our survey found that there was much disagreement amongst hematologists in many of these areas.

We thank Bayer HealthCare for the research grant given to Dr. Scully in 2002 by the Bayer Hemophilia Awards Program.

## Poster 55

### **Whispers of the Holy: The Disclosure of Truth and the Work of Art in *To the Lighthouse* and Heidegger's Later Philosophy**

*Benjamin Oxford, Professor Lawrence, and Professor Kee*  
*Departments of Philosophy and English, College of the Holy Cross*

My research deals with a hermeneutical reading of Virginia Woolf's masterpiece *To the Lighthouse* in relation to the phenomenological understanding of truth as articulated by Martin Heidegger. Both profound thinkers had reservations about the conception of truth which emerged out of the history of western philosophy and modern science which sought to impose a mastery over reality. Throughout his philosophical career, Heidegger developed a new approach to truth that emphasized it not as something achieved through abstract reasoning or empirical science, but rather as the constitutive phenomenon of Being disclosing itself. Heidegger's later essays, such as "On the Origin of the Work of Art," claim if one is to approach Being in hope of having it reveal its truth, one must approach Being poetically. Although Woolf does not explicitly argue the primacy of a phenomenological understanding of Being in *To the Lighthouse*, the novel enacts in its structure and style what Heidegger articulates in thought. Called to uncover the truth in Being, artists and poets are then engaged in creative acts of "preservation" which do not fix the truth for all time but can themselves be remade or reinterpreted in an ongoing hermeneutical process of discovery. The character of Mrs. Ramsay embodies a truth that Lily preserves in her painting, and that Woolf preserves in her novel, and that readers [re]interpret from the text. Heidegger and Woolf's shared philosophy of Being does not seek absolute knowledge along a linear pathway of reason but rather celebrates dwelling in and preserving moments of revelation when truth shines from Being despite the darkness of death.

We thank the Mellon Foundation for financial support.

## Poster 56

### **Faith and Reason in the Secular Age: Understanding and Addressing New Conditions for Belief**

*Michael J. Lodato and W. Reiser, S.J.*  
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In *A Secular Age*, the Catholic philosopher Charles Taylor traces how it became possible for a vast number of people to describe themselves as having no religious beliefs, when in a previous era God's nonexistence was, for most people in the West, unimaginable. New philosophical approaches to the world emerged in the modern era. These also furnished new ways of critiquing faith, as Avery Dulles, S.J. explains in *Models of Revelation*, where he synthesizes various understandings of revealed truth in the modern context. These new conditions for the possibility of belief affect the modern person's ability to recognize and accept mystery. In his encyclical *Fides et Ratio*, Pope John Paul II argued that, when considering the divine, the extremes of fideism and rationalism are to be avoided. Fideism ignores the mind's desire to understand religious belief, while rationalism leads to philosophical hubris and the eclipse of mystery. Perhaps the solution is to view atheism and theism as two ways of reading human experience. Human beings today may be encountering the divine mystery in a unique way. Yet as always, genuine faith is possible only when reason approaches reality with humility.

We thank the Mellon Summer Research Program for financial support.

## Poster 57

### The Digitally Remastered Dodo

*Andrew Biedlingmaier, Gregory Monfette, Jaclyn Vignati,  
and Pr. Leon Claessens*  
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The dodo (*Raphus cucullatus*) was a large, flightless pigeon endemic to the island of Mauritius. With the arrival of Dutch settlers to the island in the early 17<sup>th</sup> Century came a host of selective pressures that led to the bird's disappearance. Dodo remains collected prior to its extinction in the late 17<sup>th</sup> Century consist solely of two craniums and one foot, leaving many aspects of the bird's morphology shrouded in mystery. Much of our understanding of dodo anatomy is derived from bones extracted from the Mare aux Songes, a marshland in southern Mauritius containing an abundance of fossilized remains. But a limitation to the study of dodo anatomy is that no articulated bones or skeletons have been extracted from the marsh. Our investigations show that only two complete dodo skeletons are in existence. These skeletons are housed at the Natural History Museums of Port Louis, Mauritius and Durban, South Africa, respectively. On separate trips to Mauritius in August 2011 and Durban in January 2012, we 3D scanned these skeletons. Our current models show the skeletons as they were mounted at the museums almost one hundred years ago. These mounted specimens, however, do not necessarily indicate the actual standing posture of a living dodo. This summer, we digitally-dismantled the virtual skeletons by separating all bone elements from one another, so that they can be reassembled in an anatomically correct manner. We plan to analyze the models using SIMM software to determine the dodo's center of gravity, reconstruct its muscles, and animate its locomotion.

This work was funded by a grant from the National Science Foundation, and by the generous contribution of Herman R. and Mary R. Charbonneau to the Alumni/Parent Summer Research Scholarship fund.

## Poster 58

### Gender Discrepancies in Mortality to Incidence Ratios of Various Cancers

*Sean Coyle, Edward Messing, and Emelian Scosyrev*  
*Department of Urology, University of Rochester Medical Center*

There is a substantial amount of empirical evidence portraying a tendency for female patients with bladder cancer to have a worse prognosis than male patients. Several explanations have been proposed, including the more frequent diagnosis of higher stages at first presentation among women. Although our study did not hope to propose new or support preexisting explanations of this difference, we hoped to reinforce the current evidence of this difference using the GLOBCAN 2008 database. This database provides contemporary estimates of the incidence of, mortality, and prevalence from major types of cancer for 184 countries of the world. In our analyses, we calculated the ratio of mortality to incidence in males and females, and then calculated the difference between the two ratios. In addition to applying this analysis to bladder cancer, we conducted the same gender discrepancy MIR analyses on 8 other cancers using data available in 49 different countries. The additional cancer types were lung, colorectum, stomach, esophagus, kidney, liver, melanoma and pancreatic cancer. Also, countries ranged from Asia, the Pacific Region, Middle East, Europe, and the entire American Continent. This worldly perspective has not been used extensively in the past and our results were sufficiently interesting. Although the overwhelming majority of the world conformed to the general trend of increased bladder cancer mortality rates in females, almost every country localized to Eastern Europe (Hungary, Romania, Slovakia, Belarus, Poland, Serbia, Croatia, Russia and Ukraine) not only neutralized the discrepancy, but recorded significantly higher mortality rates in diagnosed males. In addition, male mortality rates were substantially higher than women for lung and melanoma cancer to an internationally consistent extent. The opposite held true for stomach and liver cancer.



## Poster 59

### Cytotoxicity and Transfection Efficiency using Branched and Linear Polyethylenimine

*G. Peck, A. Parrillo, A. Srungavarapu\*, S. Granados-Focil\* and R. Bellin*

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Polyethylenimine (PEI) is a common non-viral transfection reagent used to deliver DNA into various cell lines due to its high DNA complexation and transfection efficiency, its low cost and also its relative ease of use. Despite these advantages, PEI suffers from its high cytotoxicity. Although optimal concentrations of PEI yield high transfection rates, a decrease in cell viability is generally observed. However, through the grafting of Polyethylene glycol (PEG) groups onto linear PEI (L-PEI) and branched PEI (B-PEI), members of our research team at Clark University have sought to lower PEI cytotoxicity while maintaining its high transfection efficiency. In order to assess the cytotoxicity of both commercial PEI and PEG-PEI conjugates, we have been working on a series of both transfection and toxicity assays. Through testing cell viability via 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide Colorimetric Assays (MTT), we were able to determine the cytotoxicity of L-PEI and B-PEI. Additionally, through confocal analysis, transfection could be qualitatively analyzed through using a red fluorescent protein coupled with nuclei staining. Through developing these assays we were able to better understand toxicity and the transfection efficiency of commercial PEI. Future research will involve testing newly developed PEG-PEI reagents in order to assess both cytotoxicity and transfection efficiency.

A special thanks to the Center For AIDS Research – UMass Medical School for providing financial support.

## Poster 60

### Regioselective Ring Openings of Cyclic Esters using Hydrogen-bonding Catalysts

*Daniel J. Arnold and Professor Brian R. Linton  
Department of Chemistry, College of the Holy Cross*

In recent years, the field of organocatalysis has become an important and useful mean to controlling the stereoselectivity, regioselectivity and rate of many organic reactions. Thiourea derivatives, a class of organocatalysts, have been shown to catalyze many different types of reactions such as Diels-Alder and asymmetric Michael additions through unique dual-hydrogen bonding functionality. Uncatalyzed, cyclic esters react with amines to form mixtures of hydroxyl amides and amino acids. This research sought to employ various thioureas as a means to controlling the regioselectivity of cyclic ester ring openings through transition state stabilization, leading to the promotion of the amino acid products over the hydroxyl amides. Various thiourea derivatives were synthesized and used to catalyze the reactions of cyclic esters with a variety of amines. We have found that a number of thiourea derivatives are effective at catalyzing cyclic ester ring openings, affecting both product ratio and rate of the reaction. This approach may also offer a viable method to synthesize a wide variety of amino acids without much difficulty.

This research was funded by the generous contribution of Robert A. Harrington, M.D., and Rhonda L. Larsen to the Alumni/Parent Summer Research Scholarship, and by the National Science Foundation.

## Poster 61

### Glucose Stress Reduces Male Fertilization Success but Improves Lifespan and “Healthspan” in *Caenorhabditis elegans*

*Marjorie R. Liggett and Dr. Michelle A. Mondoux*  
*Department of Biology, College of the Holy Cross*

Diabetes currently affects 25.8 million people in the United States. This disease, along with obesity and many cardiovascular diseases, has been linked to the consumption of high sugar diets. The nematode worm *Caenorhabditis elegans* has a conserved insulin-signaling pathway, making it an ideal model organism for studying the effects of excess glucose. Previous studies show that exposing hermaphrodite *C. elegans* to high glucose conditions decreases fertility and lifespan. To test whether this response to glucose stress was sex-specific, I performed mating assays on high glucose and found a decrease in the number of progeny as well as a decrease in the percentage of males from 40% to 25%, suggesting a decrease in male fertilization success. Interestingly, males on high glucose had no loss of courtship ability: they contacted hermaphrodites just as often as males on normal glucose. Furthermore, these results showed a uniquely male sensitivity to glucose since the concentrations used had no effect on hermaphrodite fertility. Lifespan assays with males on high glucose also showed that unlike hermaphrodites, male lifespan was either unaffected or improved by glucose and that male “healthspan” was greatly improved. Future studies will continue to explore causes of this decrease in male fertilization success, such as the possibility of decreased sperm transfer or competitiveness when exposed to high glucose, as well as continue to characterize the “healthspan” phenotype.

This project was generously funded by the BD Corporation Summer Research Fellowship.

## Poster 62

### Newly Irreducible Iterates of Some Families of Quadratic Polynomials

*Emma Colbert, Patrick Hefferman, Sarah Orchard, Katharine Chamberlin, Pr. Rafe Jones, and Pr. Sharon Frechette*  
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*College of the Holy Cross*

For most rational numbers,  $m$ , all iterates of the polynomial  $g_{\gamma,m}(x) = (x-\gamma)^2 + \gamma + m$  are irreducible where  $\gamma$  is a fixed rational number. Yet, there is an infinite set of  $m$  such that  $g_{\gamma,m}(x)$  is reducible. On the other hand, there is an infinite set of  $m$  such that the second iterate,  $g_{\gamma,m}^2(x)$ , is reducible when  $g_{\gamma,m}(x)$  is irreducible. We have identified the conditions that define these sets of rational numbers. Our main result is that for  $n \geq 2$  there are only finitely many  $m$  such that  $g_{\gamma,m}^n(x)$  is irreducible and  $g_{\gamma,m}^{n+1}(x)$  is reducible. However, when  $n \geq 3$ , our proof is only valid for  $\gamma = r/s$  where  $r$  and  $s$  are relatively prime with  $s$  not divisible by 4. We use results from Katharine Chamberlin’s senior thesis as well as Linda Danielson and Burton Fein’s paper from *Proceedings of the American Mathematical Society* for the  $\gamma = 0$  case when  $n \geq 3$  and  $n = 1$ , respectively. We used similar techniques to make conclusions about the  $n \geq 3$  and  $n = 1$  cases for a general  $\gamma = r/s$  where  $r$  and  $s$  are relatively prime with  $s$  not divisible by 2. To prove the  $n \geq 3$  case for  $s$  not divisible by 4, we use the field of 2-adic numbers and Newton polygons. The  $n = 2$  case required the use of a system of equations created by a reducible third iterate and this system’s Groebner basis. Faltings’ Theorem plays a crucial role in the proof of our main result.

Our research was generously supported by the National Science Foundation, grant DMS-0852826, to Pr. Jones.

## Poster 63

### Characterizing the Antiviral Function of APOBEC3G as a Potential Target for HIV-1 Therapeutics

*M. May and A. Sheehy*

*Department of Biology, College of the Holy Cross*

The retrovirus, Human Immunodeficiency Virus type 1 (HIV-1) is the cause of Acquired Immunodeficiency Syndrome (AIDS). Essentially, HIV-1 destroys the human immune system leaving infected people particularly susceptible to devastating opportunistic infections. Within the immune system, human T lymphocytes do naturally express a protein called APOBEC3G (A3G) which exerts potent antiviral activity against HIV-1. However, HIV-1 endogenously expresses a protein called Virion Infectivity Factor (Vif) which specifically targets A3G for degradation via the 26S proteasome. Characterizing the interaction between the A3G and Vif proteins may elucidate molecular details allowing the liberation of A3G from Vif-mediated regulation. This project seeks to delineate such a domain or sequence of A3G that mediates a Vif-independent A3G restriction of HIV-1. Using a previously-created library of mutant A3G constructs, we will screen for a gain of function, the ability to A3G to retain its antiviral function regardless of Vif expression. Identified mutants of interest will be further characterized by co-immunoprecipitation experiments to observe the A3G:Vif interaction. Characterization of such unique domains of A3G may have significant implications in the rational design of novel therapeutics.

This research was funded by a BD Corporation Summer Research Fellowship.

## Poster 64

### Structures of Pitch, Time and Form in Rāg Bhairavi by the Dagar Brothers

*Matthew Szwyd and Prof. Shirish Korde*

*Department of Music, College of the Holy Cross*

My research focuses on North Indian (Hindustani) Rāgas (melodic structures) and Tālas (cyclic rhythmic structures.) Many examinations of Hindustani Rāgas focus primarily on particular melodic rules: ascending and descending structure, characteristic phrases and important notes. Often overlooked are the large scale gestures and melodic contours that slowly develop and evolve over the course of a performance. Part of my research focused on the writings of Indian theorists, particularly Nazir Jhairazbhoy's writings on Rāga Theory. I also studied compositional methods under Prof. Shirish Korde, which gives me unique perspective on the analysis of Rāga performance. My study of Tāla included nine weeks of study on the Tabla (drums) under Amit Kavthekar, a renowned Tabla maestro of the Punjabi gharana. Specifically, my project examines in detail a performance of the Alāp section of Rāg Bhairavi as performed by Ustad Nasir Moinuddin Dagar and Ustad Nasir Aminuddin Dagar recorded on UNESCO records. I have transcribed, in western notation, the entire 12 minute performance of the Alāp. My analysis is based on this transcription. My analysis will demonstrate several significant symmetrical melodic gestures, which expand, contract and evolve over the course of the performance. Large scale phrase structure and melodic emphasis reveals a stepwise unfolding up the Rāga. Completion of melodic goals, along with the closing phrase of the mōhra, determines sectional articulations. Focusing on these qualities of this performance, I will demonstrate an overall sense of continuity and complex development of the melodic gestures, phrases and sections of this performance. Graphs, charts, diagrams and my annotated transcription will present the structure of this historic performance of Rāg Bhairavi by the Dagar brothers.

We thank the Andrew W. Mellon Foundation for financial support.

## Poster 65

### Provider Survey of 2012 Cervical Cancer Screening Guidelines

*Brooke Cunningham, Amy Johnson MD, John Greene MD, and  
Kathleen Dean MD*

*Department of Women's Health, Hartford Hospital*

Over the past five years the American Cancer Society (ACS) and the American Society for Cervical and Colposcopic Pathology (ASCCP) have changed the recommendations for cervical cancer screening multiple times<sup>1,2</sup>. Since the guidelines have changed frequently<sup>1-7</sup>, our goal was to determine if a practice and knowledge gap exists among OB-GYN providers concerning the latest cervical cancer screening guidelines released in 2012. An anonymous survey was distributed to OB-GYN providers in Connecticut. A total of 50 surveys were collected during a three month time period. The minority of physicians surveyed (36%) was knowledgeable of the new screening intervals and only 16% reporting incorporating the recommendations into their practice. In conclusion, the surveys showed that not only were the majority of providers surveyed not knowledgeable of the new guidelines, they also do not agree with the new ACS guidelines.

We thank the Hartford Hospital Summer Student Research Fellowship Program for financial support.

## Poster 66

### Barriers to Health Care for Racial/Ethnic Minority Children: A Review of the Literature

*E. McManus  
Etiology Team, Autism Speaks*

Significant racial/ethnic disparities exist in access to health care for children. These disparities apply to children with autism. Reviewing past research strategies represents an integral part in creating effective methods for investigations and action plans to improve access to health care services for minority children, both on the autism spectrum and in general. This project involved a literature review of the methods used to evaluate barriers to accessing health care for racial/ethnic minority children. Based on the reviewed methods, recommendations are made for effective research strategies that the field of autism research can adapt and Autism Speaks can use for future projects. A systematic literature review of all peer-reviewed articles related to access to health care for minority children was performed. A total of 54 studies, using 9 different research methods, were reviewed. The findings of these studies indicate lack of insurance, cultural values, and language barriers as contributors to health care disparities. Research gaps include investigations into the impact of a parent's language on child health care access, studies on provider expectations when caring for minorities, and exploration of what constitutes positive health care for minorities. Autism Speaks and autism researchers should use qualitative focus groups and in-depth interviews, case study analyses, researcher-designed or adapted questionnaires, and the analysis of administrative data for future research projects. Studies incorporating these strategies should focus on underrepresented racial/ethnic minorities, such as Asian subgroups.

## Poster 67

### **Aves 3D: A Digital Archive of Bird Skeletal Anatomy**

*Gregory Monfette, Jaclyn Vignati, Andrew Biedlingmaier,  
and Pr. Leon Claessens*  
*Department of Biology, College of the Holy Cross*

Aves 3D is a National Science Foundation funded online database of skeletal elements from extant and extinct birds. Three-dimensional digital models of elements are produced using a Roland LPX 1200 spot-beam triangulation scanner and a Konica Minolta Range 7 light sectioning triangulation scanner. Raw scans are edited using the software package, Rapidform. Skeletal elements are obtained from the Harvard Museum of Comparative Zoology, the Yale Peabody Museum of Natural History, and other institutions. Database growth is driven by undergraduate student research projects. This summer we focused on adding limb elements of pigeons for a study of locomotion in flightless Columbiformes, including the extinct dodo. The Aves 3D database allows three-dimensional data, of both common and potentially rare species, to be accessed digitally worldwide. The database has been accessible online since July 2009, and the amount of users steadily increased over the past year, with a total 8068 viewers. Aves 3D currently hosts more than 1000 digital skeletal elements. Future efforts will focus on using the Konica scans with Rapidform software to segment two Dodo skeletons. Once segmented, the skeletons will be reassembled in an anatomically correct manner. We will then use biomechanical analysis software to reconstruct muscles, calculate center of gravity, and animate Dodo locomotion. Our hope is that this will begin to provide a greater understanding for the relationship between Dodo form and function.

We thank the National Science foundation (NSF Aves 3D, L. Claessens) and Herman R. and Mary R. Charbonneau for their generous contribution to the Alumni/Parent Summer Research Fellowship.

## Poster 68

### **Developing a MARCM Protocol for Targeting and Testing Mechanosensation in *Drosophila melanogaster***

*J. A. DeSimone, D. D. Luu, and S. M. Webster*  
*Department of Biology, College of the Holy Cross*

The physiological processes of hearing and balance can be studied using the bristle mechanoreceptors of the fruit fly as a model system. We developed a simple behavioral touch assay in *Drosophila* that can be used as a screening tool to detect defects in mechanosensation and created a heat shock protocol to create mosaic flies that are marked at specific regions. Flies naturally respond to the touch of a bristle by initiating a grooming reflex. By screening flies from various genetic backgrounds, we were able to establish a baseline for future testing of mechanosensory mutants. If tested every 2 minutes, we found that flies respond on average 5 out of 6 times. We found flies that shared the MARCM background were not significantly different from each other. To study the effects of genetic mutations on grooming behavior, we can test new mutations and circumvent any potential lethality by using mosaic flies created with MARCM (Mosaic Analysis with a Repressible Cell Marker). We heat shocked flies during development at different time points to get flies with patches of GFP-marked clones on their body. We found that the ideal time to heat shock the flies was 90-120 hrs after egg-laying for 1 hr. in a 37°C heat bath. Our long-term plan is to test the grooming reflex in mosaic flies to study whether mutations affect the mechanosensory pathway.

We thank BD Corp Summer Research Fellowship, SOMAS-URM from the Howard Hughes Medical Institute, and the National Science Foundation for financial support.

## Poster 69

### A Critical Evaluation of Alasdair MacIntyre's writings on Morality and Modernity

*A. Sarni and L. Cahoon*  
*Department of Philosophy, College of the Holy Cross*

In Alasdair MacIntyre's philosophical writings, he argues that our ability to be rational about morality is eroded in modern society. MacIntyre attributes the modern inability to engage in moral reasoning to the 18<sup>th</sup> century Enlightenment Project. The basis for MacIntyre's criticism is the notion that each of the early Enlightenment philosophers excluded the ideal of a tradition, and in doing so rejected critical parts of Aristotle's Virtue Ethics. MacIntyre argues that moral reasoning can only occur in a cultural tradition. My research consisted of critically examining MacIntyre's writings, which include the philosophical works: *After Virtue: A Study in Moral Theory* (1981), *Whose Justice? Which Rationality?* (1988), *Three Rival Versions of Moral Enquiry: Encyclopaedia, Genealogy and Tradition* (1991) and the essay "Relativism, Power and Philosophy" (1989). My paper presents and examines MacIntyre's criticism of the modern liberal tradition, his argument for tradition-dependent moral reasoning and his response to the charge of relativism. I then proceeded critically to question MacIntyre's claim that members of contemporary society ought to leave the modern liberal tradition that they are a part of. For MacIntyre's claim, in conjunction with his central thesis, raises the question: if there is no moral rationality internal to the modern liberal tradition how can people rationally respond to MacIntyre's claim? Would leaving the modern liberal tradition require an irrational leap? My critique of MacIntyre's work discusses the rational recourse we ought to take while we live in the tradition of modern liberalism.

I thank the Mellon Summer Research Program for their financial support.

## Poster 70

### Expression and Auto-Processing of Hedgehog Proteins from *Brugia malayi*

*Sarah A. Cahn, Julie N. Reitter, and Kenneth V. Mills*  
*Department of Chemistry, College of the Holy Cross*

Hedgehog proteins are signaling molecules that are essential for embryonic growth and patterning. These proteins are synthesized as a precursor composed of two domains, an N-terminal signaling domain and a C-terminal auto-processing domain (HINT). The HINT domain includes a sterol recognition region (SRR). The first residue of HINT domains is a cysteine, which facilitates an amide to thioester rearrangement of the peptide bond linking the signaling and HINT domains. We attempted to find conditions to detect this rearrangement in a *Brugia malayi* hedgehog protein by cleavage of the thioester with dithiothreitol (DTT) or hydroxylamine. Hydroxylamine, but not DTT, induced cleavage. However, hydroxylamine induced cleavage in the absence of the cysteine, suggesting an alternative pathway for cleavage. We will attempt to find different expression contexts for the *Brugia* HINT domain to facilitate cleavage, and we also will attempt to study cleavage of two hedgehog-like proteins from *Cryptosporidium*.

This material is based upon work supported by the National Science Foundation under grant MCB-0950245, the Camille and Henry Dreyfus Foundation, and the BD Corporation Summer Research Fellowship.

## Poster 71

### **Effect of Exogenous DNase-I Treatment on Acute Murine Hindlimb Ischemia Reperfusion Injury**

*R. Malley, H. Albadawi, J. Yoo, and M. T. Watkins*

*Vascular and Endovascular Surgery, Massachusetts General Hospital*

Ischemia-reperfusion injury (IR) is a potential medical complication in patients with peripheral arterial disease who have undergone surgical interventions. This is due to several complications including edema, tissue necrosis and inflammation. Extracellular nucleosomes that are released from dying tissue or infiltrating inflammatory cells have been implicated in exacerbating tissue injury following kidney and brain IR. Studies have shown that degrading these complexes with exogenous DNase-I has proven to be beneficiary. The purpose of this study is to determine whether administration of exogenous DNase-I will ameliorate skeletal muscle injury by reducing circulating nucleosomes fragments following acute hind limb IR. Two groups of C57BL6 male mice were subjected to 1.5hrs hindlimb ischemia followed by 24hrs reperfusion. Mice were treated with either DNase-I intraperitoneally or buffer alone starting 3hrs before ischemia then every 6hrs. Plasma and hindlimb muscles were harvested to assess muscle fiber injury and the localization and levels of DNase-I protein. Plasma was analyzed for nucleosome levels. Exogenous DNase-I treatment did not alter the level of nucleosomes in the plasma. In contrast, DNase-I treatment significantly increased the percentage of injured fibers in the tibialis anterior muscle compared to the untreated mice. The levels of skeletal muscle DNase-I protein were significantly elevated following IR. Finally, DNase-I expression was localized to the extracellular domain and was associated with severely injured muscle fibers. This protocol of exogenous DNase-I treatment proves to exacerbate skeletal fiber injury following IR. Increased local DNase-I protein suggests that DNase-I expression is activated in response to injury. Further studies to assess DNase-I activity during IR are needed.

We thank the National Institutes of Health and Massachusetts Division of Vascular and Endovascular Surgery for their financial support.

## Poster 72

### **The Role of Spatial Uncertainty in the Redundant Signal Effect**

*Nathan Guevremont, Christina Carlone, and Pr. Gregory DiGirolamo*  
*Department of Psychology, College of the Holy Cross*

Subjects are faster at responding to two of the same stimuli than one: the redundant signal effect (RSE). Theories of the RSE have suggested benefits of two targets (parallel processing enhancing perceptual mechanisms, or, alternatively, mutually co-activating response processing) or costs of the single target because of spatial uncertainty in localizing the single target. The present studies demonstrate that spatial uncertainty can play a critical role in the RSE. When spatial uncertainty was equated between one target and two targets (Exp. 1), the RSE effect was negated; and when spatial uncertainty was higher for one target than two targets (Exp. 2), the RSE returned. Varying the spatial uncertainty could eliminate or reinstate the RSE within the same subjects (Exp. 3). These results suggest that the RSE is highly labile and spatial uncertainty is one factor that can give rise to the RSE.

We thank John F. and Mary Figge Power; and Paul S. and Katherine L. Stuka for their generous contributions to the Alumni/Parent Summer Research Fellowship.

## Poster 73

### Identification of Genes that Respond to Glucose Stress in *Caenorhabditis elegans*

*Brian Ganley, Michael Hoy and M. A. Mondoux*  
*Department of Biology, College of the Holy Cross*

Diabetes affects 25.8 million Americans and is caused by poor insulin signaling and/or secretion. The insulin signaling pathway reduces high blood sugar levels, characteristic of diabetes, by causing the cell to uptake glucose from the blood. The nematode worm and model organism, *Caenorhabditis elegans*, has been used to explore insulin signaling due to the homology of the worm (DAF-2) and human insulin receptor. *daf-2* mutant worms have reduced insulin signaling and enter into the alternate stage of their life cycle, dauer. Dauers are long-lived, smaller worms and can be identified visually. By counting the number of dauers relative to adults in a population, we can indirectly measure the level of insulin signaling. Although insulin signaling in normal glucose conditions has been thoroughly studied in these worms, glucose stress (high glucose conditions) is relatively unstudied. We want to identify genes that regulate insulin signaling in high glucose. Past work shows that high glucose lowers dauer formation. Here we use RNA interference (RNAi) to knockdown expression of genes that potentially regulate the insulin signaling pathway under glucose stress. We tested various temperatures, plate media, and *daf-2* mutants and showed that using the *daf-2(e1370)* mutant at 22.5°C on M9 lactose plates provides a good baseline for this experiment. Of the four genes tested, *his-65*, which encodes an H2A histone, suppressed the effects of high glucose when knocked down, suggesting a connection to the glucose stress response pathway. Identifying additional genes connected to high glucose response could uncover a separate pathway specific for high glucose response that would help us to better understand diabetes.

We thank the Biology Department for funding this research.

## Poster 74

### Affective Stimuli Modulate Different Stages of the Inhibitory Control Circuit in Schizophrenia Patients with and without a History of Violence

*Gregory Peters<sup>2</sup>, Pierfilippo De Sanctis<sup>1,2</sup>, John J. Foxe<sup>1,2</sup>, Pal Czobor<sup>1,3</sup>, Glenn R. Wyllie<sup>4</sup>, and Menahem I. Krakowski<sup>1</sup>*

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Violent behavior is commonly thought to involve an interaction of faulty affect regulation and poor impulse control. Hallmark symptoms of schizophrenia include abnormal affect (e.g. flat, blunted, or labile) and deficits of cognitive control. If such an interaction is in fact essential for violent behavior, then emotional provocation may modulate disruptions of inhibitory control in patients, depending on their history of violence. The clarification of emotional provocation effects and the investigation of their neural correlates based on an individual's predisposition may be an important first step for an efficient control of violent behavior. In the present study, undiagnosed people (HC), patients with schizophrenia with and without a history of violence (VS and NVS, respectively), were asked to perform a go/nogo task that challenges participants to exercise inhibitory control. Emotionally charged images were presented in the task alongside neutral ones to test whether emotional stimuli would modulate inhibitory control in participants. Behavioral, clinical, and event-related potential (ERP) data were examined in an effort to determine whether affective valenced stimuli can modulate disease-related deficits of inhibitory control, and if so, to characterize the neural correlates of such a relationship as a function of study group. Behavioral and electro-cortical evidence confirming a response inhibition deficit for neutrally valenced stimuli in both VS and NVS compared to HC was replicated. For affective valenced stimuli, VS showed an enhancement of the N2 component relative to NVS. In contrast, NVS showed an enhancement of the P3 component relative to VS. The ERP results suggest that patients' N2/P3 reduction seen for neutrally valenced stimuli is modulated by affective valenced stimuli. Specifically, VS and NVS show partial reinstatement at different processing stages of the inhibitory control network. Similarly, clinical data showed that impulsivity was correlated with opposite effects on electro-cortical activity between groups. These results suggest that emotional stimulation interacts differently with inhibitory control deficits in patients with and without violent tendencies.



## Poster 75

### Building and Conserving Medieval English Fortification

*Matthew Bailey and Pr. Lorraine Attreed*  
*Department of History, College of the Holy Cross*

The Welsh castles of Edward I and the coastal fortresses of Henry VIII represent two of Western history's most rigorous defensive building efforts. Edward's late thirteenth century castles served as administrative footholds, at times directly subjugating enclaves of persistent Welsh resistance to English rule. Henry's forts, which dot the southern shores of England, demonstrate the actual and perceived threats of continental aggression surrounding the 1534 break with the Roman Church. Edward's and Henry's building programs pushed the bounds of not only territorial expanse, but also technological, political, and financial innovation. The physical remains of the fortifications testify to evolutions in construction styles, while documentary evidence provides nuanced glimpses at the planning, provisioning, and execution of fortification projects. Royal accounts, for example, highlight anyone who received payment for certain building tasks, forming a more detailed awareness on a certain individual's influence or lack thereof. Henry VIII constructed Forts Deal and Walmer to defend a trading center on the English Channel, but by the eighteenth century, the former was in disrepair, while the latter had become a stately home. Today, England's conservation administration, English Heritage, maintains and exhibits both forts. Deal is presented as a fort, and Walmer as an elegant home and gardens. Using a variety of methods, conservation groups overcome their major challenge, to present the essential history of each monument in a captivating manner. Some instances, such as Edward's castles in Wales, evoke divergent national passions, further complicating the task of conservation.

I thank the Mellon Summer Research Program for financial support.

## Poster 76

### Cerebral Aneurysm Neck Reoccurrence after Endovascular Coiling Following Subarachnoid Hemorrhages

*Bailey Profit and Inam Kureshi, MD*  
*Department of Neurosurgery, Hartford Hospital*

Neurosurgical management of residual aneurysms following endovascular coil embolization remains a challenging issue. This study aimed to examine different indicators, initial aneurysm size, location and type of aneurysm, and initial remnant neck size, and determine whether any played a role in predicting the likability for recanalization. Retrospective study examined all endovascularly coiled aneurysms following subarachnoid hemorrhage from March 2003 to May 2012. Medical records, angiograms, and a database from the Hartford Hospital Stroke Center were used. Analyses were performed to ascertain the correlation between durability of the coil embolization and size, location, and remnant neck of the aneurysm. 166 patients met the inclusion of the criteria. Aneurysms that displayed little to no contrast filling in neck post-operatively were significantly more likely to remain occluded ( $p < 0.001$ ). Aneurysms arising from the posterior cerebral artery, posterior communicating artery, and basilar tip artery were more likely to recanalize and require retreatment ( $p < 0.01$ ). Size of original aneurysm did not indicate a trend for recanalization ( $p = .830$ ). This study reveals that initial size of the aneurysm is not an indication of recanalization, but rather, remnant neck size, post-operatively, and location of the aneurysms are. Those that display the least amount of remnant neck are substantially more likely to stay occluded. Finally, those aneurysms arising from the posterior aspect of the Circle of Willis should be especially monitored due to their higher rate of recanalization and necessity for retreatment.

I thank the Department of Neurosurgery at the Hartford Hospital for sponsoring this research.

## Poster 77

### **Sudden Death: Survivability of Players in the National Football League**

*Pr. Anil Nathan, Pr. Victor Matheson, and James Pantano  
Department of Economics, College of the Holy Cross*

The National Football League has received a variety of negative media attention surrounding the safety of its players, revolving largely around the long term health risks of playing the sport. Recent deaths of players have brought the game under further scrutiny with respect to premature deaths and instances of suicide associated with concussions and other football related injuries. By comparing mortality rates of the general population to mortality rates of players from the 1970-1971 season, we test whether or not participation in football is significantly harmful to the longevity of its players. We also compare survival probabilities across age and race. It is possible that NFL players survive longer, but that high profile deaths make it appear as though NFL players live shorter lives than the general population. It is also possible that NFL players survive longer than the general population for reasons outside of their participation in the league.

We thank the May and Stanley Smith Charitable Trust for their support.

## Poster 78

### **A Model of Tradable Capital Tax Permits**

*Pr. Justin Svec and James Pantano  
Department of Economics, College of the Holy Cross*

When states choose their capital tax policies in order to maximize the welfare of their resident populations, capital tax rates are inefficient due to the externalities that each state fails to internalize. In this paper we consider the externalities associated with both horizontal and vertical tax competition. In horizontal tax competition, tax rates are inefficiently low, as states with lower tax rates attract capital from states with higher taxes, causing an outflow of capital from the state with the higher tax rate to the state with the lower tax rate. The state with the lower tax rate does not take into account that it has hurt the other state due to its policy and only recognizes that it has increased the welfare of its own residents. In vertical tax competition, the capital tax rate is inefficiently high due to the overlap of tax base between state and federal governments. States have an incentive to increase their capital tax rates and thus tax revenues, but do not take into account that their increased tax rates shrink the overall level of capital and consequently the tax base of the federal government, resulting in lower federal tax revenues and government spending. To correct for these inefficiencies, we propose a system of tradable capital tax permits, where the federal government requires a state to hold a permit if it wanted to reduce its capital income tax rate from some pre-defined benchmark value. These permits would be tradable across states. We attempt to show that if the federal government sets the correct number of total permits, both vertical and horizontal externalities can be eliminated and social efficiency can be achieved.

We thank the May and Stanley Smith Charitable Trust for their support

## Poster 79

### **Tunisian Music: A Soundtrack of the Revolution, a Voice of the People**

*Lucia Westin and Alan Karass*

*Department of Music, College of the Holy Cross*

This research considers the influence of the Tunisian revolution of 2011 on the musical scene in Tunisia, and the effect of that musical scene on the revolution. The results of this research suggest that the musical scene acted as a type of soundtrack of the revolution, voicing the emotions of the Tunisian masses as it went through, and emerged from, what has been dubbed *the Jasmine Revolution*. This conclusion was reached after five weeks of interviews with professional and amateur musicians as well as non-musical civilians in Tunisia. Upon examination of the information gathered in the interviews and a variety of literary sources it becomes clear that the popular lyrical music of Tunisia did not cause the revolution, but certainly encouraged large numbers of Tunisian youth in their fight for dignity against dictatorial powers. The influence of the revolution on the musical scene is noted with the prominence of Rap and *chanson engagée* in popular Tunisian music. By examining the effects of the revolution on Tunisian musical works and studying the inspiration effected by Tunisian popular music, this research highlights elements of the present, past and those possible for the future which are a direct result of the unique relationship between Tunisian music and the Tunisian revolution.

I thank the Mellon Summer Research Program for sponsoring this research.

## Poster 80

### **Spatial Distribution and Population of a Cold Atom Cloud Measured by Fluorescence Detection**

*K. Candee, K. Moran, C. Richardson, and T. Roach*

*Department of Physics, College of the Holy Cross*

We developed a system to measure both the intensity and spatial distribution of laser-stimulated fluorescence light from a cloud of cold rubidium (Rb) atoms. The atoms are cooled and collected inside a vacuum space by a magneto-optic trap (MOT). A known fraction of the atomic fluorescence light is captured by a lens and focused onto an amplified photodetector. We use the photodetector signal to determine the number of atoms present by taking into account the detection efficiency and the atomic photon scattering rate. Concurrently, we acquire images of the atomic cloud with a new high sensitivity digital camera and customized lens system. The 2D distribution of pixel intensity in the image is reduced to a 1D distribution, which has approximately a Gaussian shape (for atoms in a well-aligned MOT). We determine the size of a Rb atom cloud by fitting the data to a Gaussian and extracting the width parameter. We also measured the quantum efficiency of the camera, so we can independently ascertain the total number of atoms, using the integrated pixel intensity.

We thank the Massachusetts Space Grant Consortium and the Richard B. Fisher Summer Research Fellowship program for financial support.

## Poster 81

### Cognitive Outcomes After Lung Transplantation (The COLT Study)

*Ryan P. Judy<sup>1</sup>, Jason D. Christie<sup>2</sup>, M.D., M.S.C.E., and Mark E. Mikkelsen<sup>2</sup>, M.D., M.S.C.E.*

*<sup>1</sup>Thoracic Oncology Research Laboratory; <sup>2</sup>Pulmonary, Allergy and Critical Care Division, University of Pennsylvania School of Medicine*

Cognitive impairment is a feared complication of aging and a major threat to functional independence, general health and quality of life. Cognitive impairment is increasingly recognized as an important and long-lasting consequence of critical illness that may be preventable. Lung transplantation is an effective option for patients with advanced lung disease to extend life expectancy and increase quality of life. Critical illness is common at the time of the transplant and afterwards, due in part to the medications required to prevent rejection. Furthermore, prior studies suggest that many patients awaiting lung transplantation exhibit neuropsychological (cognitive and psychiatric) impairment. It is critical to understand the trajectory of neuropsychological function after lung transplantation and to identify modifiable risk factors associated with the development of cognitive impairment. In this pilot study, we examined the frequency of neuropsychological impairment in patients being considered and patients who had received lung transplantation

Thank you to Dr. Anil Vachani, of the Thoracic Oncology Research Laboratory, for funding.

## Poster 82

### Short Term Outcomes of Stress Urinary Incontinence Surgery

*Paulina Lange, Hema D. Brazell, MD, David M. O'Sullivan, PhD, and Paul Tulikangas, MD*

*Department of Urogynecology, Hartford Hospital*

Stress urinary incontinence (SUI) is the involuntary loss of urine, usually in small amounts, with increases in intra-abdominal pressure. Recent literature suggests an increasing trend in surgical management of SUI, specifically with midurethral slings. Through a retrospective chart analysis of patients receiving surgery in 2007, our aim was to determine the rate of reoperation of transvaginal tape (TVT) retropubic midurethral sling when compared to transobturator tape (TOT) midurethral sling. Our secondary outcomes looked at rate of de novo detrusor overactivity and risk of urinary retention. A total of 511 patients were operated on in 2007 and 132 were eligible for inclusion criteria. There were 105 patients in the TVT cohort and 27 in the TOT cohort. No significant difference was found when comparing the rates of reoperation for TVT and TOT patients in the short term (7.6% vs 0%,  $p=0.139$ , respectively). TVT patients were more likely to start anticholinergic medication postoperatively when compared to individuals who had TOT procedures ( $p=0.023$ ). There was no difference between the two groups for patients sent home with a foley catheter ( $p=0.087$ ).

We thank the Urogynecology Department at Hartford Hospital for financial support.

## Poster 83

### Expertise and Sketching in Science

*J. Butler and B. Jee*

*Department of Psychology, College of the Holy Cross*

Capturing the nature of peoples' mental representations and how they change with increasing expertise is a primary goal in cognitive science and education. This can be challenging when these representations contain complex spatial and causal relationships because such relationships are difficult to convey verbally. In this research we tested whether sketching can be used to gauge students' understanding of biology diagrams, using new technology designed to facilitate this process. Participants were college students majoring in science or the humanities. We presented all participants with a series of biology-related and -unrelated diagrams and later asked them to draw them from memory. To facilitate analysis of the drawings, participants sketched on a tablet PC running CogSketch software (Forbus et al., 2008, 2011). The participants also completed two spatial ability tests so that we could assess the contribution of general spatial skill. Preliminary analyses revealed that participants with more biology experience were more likely to recall spatial and causal symbols for all diagrams, not just the biology-related ones. Participants with higher spatial skill also tended to recall more of these symbols. These findings suggest that people's ability to reproduce spatially complex diagrams may depend on both domain-specific knowledge and domain-general spatial skill. We discuss the implications of this research for science education.

We thank Lisa R. and James F. Mooney III for their generous contribution to the Alumni/Parent Summer Research Fellowship fund.

## Poster 84

### A Survey of Spider and Ant Diversity in Rutland State Park, Massachusetts

*Kimberly Morsch and Brian Moskalik*

*Department of Biology, College of the Holy Cross*

In order to understand how different organisms interact within a community, we must first establish the type of biodiversity that exists in a given area. Although relatively simple when considering larger mammals, most diversity is found among arthropods that inhabit the leaf litter. Throughout our study, we focused on identifying differences in spider and ant diversity across a variety of different habitats, including one with carnivorous plants. We found that there was greater spider and ant diversity in coniferous sites while the total biota of the sundew sites rapidly changed. We also found that spider and ant diversity are dependent upon each other. When one family of arthropod increases in diversity, the other decreases. Since both ants and spiders compete for the same resources within the same trophic levels, this observation is not surprising. Yet it is unclear which family (ants or spiders) drives the exclusion of the other. Our research provides a fundamental view of diversity in these different environments as a way to better understand the trophic relationships that exist. Additionally, this survey can be used to measure changes in arthropod diversity, which can ultimately act as an indicator of relative environmental health and stability.

We thank Linda B. and Richard K. Watson, Jr. for their generous contribution to the Alumni/Parent Summer Research Scholarship program. We also acknowledge Jennifer Bosco '12, Ben Oxford '14, and Chelsea Hogan '14 for their assistance.

## Poster 85

### Multiple Types of Sugar Stress Decrease Fertility in *C. elegans*

Uyen Ho and Michelle A. Mondoux  
Department of Biology, College of the Holy Cross

Galactosemia, a condition where the body cannot metabolize the sugar galactose, causes 2.5 million deaths annually, and is especially dangerous for infants. High consumption of galactose or reduced galactose metabolism can lead to liver failure, neurotoxicity, or ovarian cancer. Here, we tested how a high galactose diet affects fertility using the nematode worm *Caenorhabditis elegans* as a model system. Previous data showed that high glucose decreases fertility of *C. elegans* and mutants that lack the O-GlcNAc transferase *ogt-1*, have decreased fertility even at low glucose concentrations. O-GlcNAc is a post-translational protein modification derived from glucose. Glucose and galactose have the same molecular formula, and only differ in their spatial orientation, leading us to hypothesize that fertility levels would be similar for both sugars at the same concentration. However, we found that wild type *C. elegans* had no fertility defect at 333mM galactose, even though they have 30% decreased fertility at that concentration of glucose. *ogt-1* mutant worms, on the other hand, had extremely low fertility on 333mM galactose, less than 10% fertility compared to wild type worms; even lower than the published fertility levels on 333mM glucose. Although animals had no fertility defect on 333 mM galactose, 500 mM galactose reduced fertility by 50% and caused a delay in reproductive timing. Our data suggest that *C. elegans* is sensitive to sugar stress but that different genetic backgrounds have different sensitivities to different sugars. Wild type worms are more sensitive to glucose, but *ogt-1* mutants are more sensitive to galactose. Future experiments will test if apoptosis (programmed cell death) in the germ line is the cause of decrease in fertility on high galactose diet, and what role O-GlcNAc might play in this process.

We thank Edward A. Meyers, M.D. for his generous contribution to the Alumni/Parent Summer Research Fellowship fund.

## Poster 86

### Stambeli Pedagogy, Hisham, and Social Capital in Tunisia

Matthew Burke and Alan Karass  
Department of Music, College of the Holy Cross

Tunisian *stambeli* music involves the invocation of Sub-Saharan spirits and Muslim saints into performance spaces in order to relieve those who have requested a performance of a variety of mental and emotional maladies. The supernatural beliefs and ideas surrounding *stambeli* practices are rarely discussed honestly with outsiders due to the cultural notion of *hisham* (honor and shame). *Stambeli* musicians circumvent *hisham* by keeping their belief in the supernatural and the secret abilities of *stambeli* practitioners private and out of the view of curious outsiders. Two *stambeli* musicians in Tunis agreed to teach me *gumbri*, the primary instrument of *stambeli*, over six weeks during the summer of 2012. During the course of my lessons, I noted a marked absence of information, leaving gaps of knowledge between the music I was learning and its socio-cultural context and importance. Through a critical analysis of my lessons, I have reasoned that my teachers presented to me a carefully determined version of the *stambeli* repertoire and *gumbri* technique in an effort to avoid *hisham*. My teachers were deeply invested in my musical development, as my playing skills directly reflected their teaching skills. Consequently, the content of my lessons was determined by cultural values seemingly unrelated to the music I sought to learn.

We thank the Mellon Summer Research Program for financial support.

## Poster 87

### Interstate: Poems

*Egan Millard and Prof. Susan E. Sweeney  
Department of English, College of the Holy Cross*

Although we like to think of ourselves as fixed and stable beings, we tend to wander physically, mentally, and spiritually. Advances in technology have enabled and encouraged this subconscious wandering. With the Internet, we can instantly interact with billions of people around the globe and learn about virtually any topic known to mankind. One can fall asleep on an airplane in New York and wake up a few short hours later in California, having traveled over three thousand miles without even thinking. However, we have been vagabonds since long before the airplane or the computer came around. After all, one needs no technology to get lost in a memory or dream and completely forget where and when she is. Humans are constantly caught in between experiences, inhabiting a sort of emotional no-man's-land. My project, a collection of original poems and photographs called "Interstate," explores and documents this theme of transience. I composed most of the collection this past summer, while participating in the Mellon Summer Research Program for the Humanities. My research for the project included studies of various liminal spaces, such as train stations, airports, motels, waiting rooms, highways, elevators, etc. My advisor, Prof. Sweeney, helped me edit each poem and provided direction for the project as a whole.

Prof. Sweeney and I extend deep thanks to the Mellon Foundation and the College for funding and supporting this project.

## Poster 88

### The Spin-Decay of a Baseball

*Daniel Barrett, Katherine-Anne Rosenthal, Robert Eslinger,  
and Pr. Matthew Koss  
Department of Physics, College of the Holy Cross*

The spin-decay time constant describes the rate at which a spinning object slows down. We set out to determine how a raised lace pattern of a baseball affects a sphere's time constant. We measured the decay rate using electromagnetically suspended spheres and a Casio Exilim camera shooting at 420 frames per second. After spinning the spheres we measured the spin decay over the course of approximately eight minutes. By calculating the period of sample rotations during the spin-down, we were able to calculate the decay rate. The experiment was first performed on a clean sphere, then raised seam patterns were added-simulating a two-seam fastball and then a four-seam fastball. The data was compiled and analyzed using Microsoft Excel. We found that the four-seam sphere averaged the highest spin decay tau, followed by the two-seam, and the seamless sphere had the lowest.

We thank James and Jeanne Moye for providing the funds to sponsor Daniel Barrett, and Anne E. and John Kirby Bray for providing the funds to sponsor Robert Eslinger in this research. The Massachusetts Space Grants provided funding to sponsor Katherine-Anne Rosenthal.

## Poster 89

### Physics of Baseball: On Measuring Arbitrary Rotation

*R. Eslinger, K. Rosenthal, D. Barrett, and Pr. Matthew Koss*

*Department of Physics, College of the Holy Cross.*

The spin decay rate of a baseball is particularly interesting in the study of the physics of baseball. In order to measure this rate, an accurate system to detect the rotation of the ball must be put in place. Any sophisticated tracking system would require the ball to be altered in a physically meaningful way. Thus, a prudent system should not interfere with the physics of spin, i.e. light detection in the form of 1000 fps high-speed cameras. The ball must be marked, however, with 3 small dots spaced 120 degrees apart to ensure that at least one is in the camera's view at all times. After a video is captured, the time interval of interest is rendered and dissected, such that a "frame spread" of 30 frames is extracted. X and y Cartesian position dot datum is recorded, encompassing the inputs of the system. The dots' locations are then projected into three dimensions, using the known radius of the ball, in order to solve for an unknown axis of rotation. The dots are treated as discrete points in space, tracing a plane of rotation as they move in time. Our system approximates this plane using three methods (3 point-to-plane cross product and regression techniques are used). The normal vector of this plane represents the axis of rotation and the rotation rate follows from a dot product calculation. These two outputs are critical in any experiment involving the physics of spin.

We sincerely thank the Alumni/Parent Summer Research Fellowship, especially James and Jeanne Moye for providing the funds to sponsor Daniel Barrett, and Anne E. and John Kirby Bray for providing the funds to sponsor Robert Eslinger. The Massachusetts Space Grants provided funding to sponsor Katherine-Anne Rosenthal.

## Poster 90

### Synthesis of Diaminotetraphenol Ligands

*Sarah DiNapoli and Joshua Farrell*

*Department of Chemistry, College of the Holy Cross*

Multidentate aminophenol compounds have applications as ligands for biologically relevant metals, for bioinorganic modeling chemistry and in catalysis of reactions similar to those in the human body. We are developing a strategy for preparing a library of diaminotetraphenol ligands containing one, two, three or four different phenols in one compound. The synthesis of the ligands is based on a series of reductive amination reactions beginning with a substituted salicylaldehyde and 1,3-diaminopropane followed by the sequential addition of three salicylaldehydes in the same manner. We have prepared a diaminotriphenol compound with planned future work to add the fourth phenol. We also plan to study the ability of these ligands to bind to metals and the reactivity of the resulting metal complexes.

We thank the O'Brien Family Summer Research Fellowship for financial support.



## Poster 91

### Field and Laboratory Investigations on the Effects of Salinity on Decomposition Dynamics among the Hudson River's Freshwater Tidal Wetlands

*Craig Connolly<sup>1,2</sup>, William Sobczak<sup>1</sup>, and Stuart Findlay<sup>2</sup>*

<sup>1</sup>*Department of Biology, College of the Holy Cross*

<sup>2</sup>*Cary Institute for Ecosystem Studies*

Sea level rise due to climate change will expose Hudson River tidal marshes to chronic changes in salt content, thereby altering the range of habitat conditions and biogeochemical processes. Macroinvertebrates and microbes are important players in plant decomposition of the invasive plant species *Phragmites australis*. We hypothesized that litter breakdown will vary along a salinity gradient, and salinity entering the Hudson River tidal wetlands will negatively impact macroinvertebrate and microorganisms ability to decompose *P. australis*. Our research approach included deploying leaf packets at sites along the salinity gradient for measurements of microbe respiration, fungal biomass, and litter decomposition. We examined the tolerance of a common isopod and microbes found in near freshwater conditions to salt treatments. Salinity has shown to negatively impact isopods and microbes from lab treatments, but at present, the impact of a varying salinity regime is unclear. This suggests a decline in decomposition to follow increasing salinity intrusion in decades to come. We can expect a shift in the biodiversity of macroinvertebrates and microbes, and further adaption by tidal marsh species.

I thank the Hudson River Foundation for awarding me a Polgar Fellowship for financial support.

## Poster 92

### Economic Impact of Primary and Caucus Elections

*Pr. Joshua Congdon-Hohman and Jeffrey Paadre*  
*Department of Economics, College of the Holy Cross*

In our research, we analyze whether or not primary and caucus elections have a significant effect on a state's unemployment rate and personal income level using data from the BLS and BEA. In recent election cycles, states have exhibited a "race to get ahead" as we've seen primary elections moving further forward in election years. While this is typically thought to be a race for political influence, in 2008 Michigan and Florida both were penalized in the form of lost delegates for moving up too early in the cycle, indicating that states may be motivated by factors other than influence. With the amount of spending in election periods, perhaps there is an economic advantage to moving earlier in the cycle. To study the economic impact of primary and caucus elections, we examine the months or quarters around the event in each state and use fixed effects for individual states, years, and months to control for other economic trends and conditions. We find that a primary election has a significant effect on reducing a state's unemployment rate, but does not translate to a significant increase in a state's income. This could be that the jobs created are not high-earning jobs or that the labor force shrinks due to people opting to volunteer during campaign season. Additionally, we find that holding one of the first ten elections in the primary cycle has little additional effect on a state's unemployment rate, but it can lead to a 1.3% increase in personal income in the following quarter. In future work, we hope to include variables for how hotly contested a primary election cycle is as well as a further analysis into swing states and whether or not the economic effects are different in these states.

We thank the May and Stanley Smith Charitable Trust for their support.

## Poster 93

### Variability in the Iron Line Emission Spectrum from Accretion Disks Surrounding Black Holes

*K. Blanchette and T. Narita*

*Department of Physics, College of the Holy Cross*

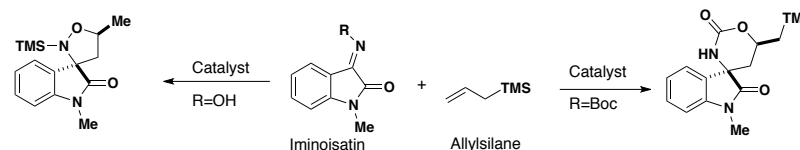
Similar to our sun, surrounding some black holes is a corona of ionized particles. Photons emitted from this layer are typically launched into space, which we observe in the form of a power law spectrum. A fraction of these emitted photons collide with the accretion disk and create an iron emission line. In the standard accretion disk model, the energy flux from the power law photons is linearly proportional to the energy flux from the iron emission line. In recent studies of the “hard” state of a black hole, however, these two parameters are observed to be nonlinearly dependant, as predicted by a novel relativistic model. Using data collected from the Rossi X-ray Timing Explorer on black hole binary systems 4U1543 and J1550, we have examined this correlation. We observe a strict linear correlation in 4U1543 and a plateau in the data of J1550, suggesting our data did not reach the critical luminosity to cause the eventual, anticipated anti-correlation. Areas for further inquiry could include proper distributions of energy across the given model components and the interrelation of this trend with the observance of quasi-periodic oscillations and accretion jets as suggested by S. Rossi et al, 2004.

We thank the Richard B. Fisher Summer Research Fellowship for funding this research.

## Poster 94

### Lewis Acid Catalyzed Allylsilane Annulations of Iminoindoles

*Emily Allen, Ben Shupe and Dr. Annaliese Franz*  
*Department of Chemistry, University of California Davis*



Located directly below carbon on the periodic table, silicon and carbon share many similar properties; however, the unique properties of silicon reagents also provide opportunities to develop for new synthetic methods. Due to the numerous examples of biologically-active spirooxindoles containing a nitrogen heterocycle, we sought to investigate allylsilane annulations of iminoindoles to create novel spirocycles. Previously our group has published the 1<sup>st</sup> enantioselective [3+2] allylsilane annulations of isatins, but reactions with iminoisatins represent a more challenging substrate. Iminoindoles will allow for direct access to substituted 3-amino spirooxindoles. While investigating various Lewis acid catalysts to develop annulations of allylsilanes with iminoisatins, we discovered the stereo- and chemoselective synthesis of a new spirocyclic carbamate (spirooxazinones) as the major annulation product. Using <sup>1</sup>H NMR spectroscopy, optimal catalysts were selected based on conversion of the N-methyl protons and the TMS. CuCl<sub>2</sub> has shown to be the most efficient Lewis Acid catalyst for the iminoisatin substrate due to its diastereoselectivity, 68:32, and in the presence of the counter ion NaBARF the product could be isolated in >99% yield. Several oxime-oxindoles were also synthesized and tested in order to access and alternate spirocycle product and extend the scope of the annulation methodology. In addition various additives and counter ions were evaluated and shown to see if enhance reactivity and selectivity of the Lewis acid catalyst.

We thank the National Science Foundation and the Department of Chemistry at UC Davis for financial support.

## Poster 95

### Fluorescence Detection System for In-Vacuum Ion-Atom Collision Experiments

*R. Kennedy and P. Oxley*

*Department of Physics, College of the Holy Cross*

Experimental studies of collisions between atoms and ions are important for understanding the behavior of plasmas. One possible outcome in such a collision is the excitation of an atomic electron, followed by photon emission from the atom. Analyzing these emitted photons is one way in which we can gain information about the collision process. The work presented here details the design and testing of an experimental apparatus which can collect and analyze photon emission from ion-atom collisions taking place inside a vacuum chamber. In order to capture the emitted light, we designed a two lens system that would be placed inside the vacuum. The lens system consists of a two achromatic, aspheric lens; one with a 40 mm focal length and the other with a 35 mm focal length. After the light is captured by the lens system, it will be focused down into a multimode optical fiber that will transport the light out of the vacuum. To maximize the light captured by the fiber, we paid careful attention to design a lens system that would minimize optical aberrations. Such aberrations limit the focusing ability of the lens system and prevent an efficient coupling of light into the fiber. The fiber will exit the vacuum through a custom vacuum feedthrough and connect to a spectrometer which will analyze the wavelengths of light present. Two different spectrometers were tested for accuracy and resolution using several different discharge lamps and a 780 nm calibrated laser.

We thank the Massachusetts Space Grant and the Richard B. Fisher Summer Research Fellowship for financial support, and Richard Miller for machining assistance.

## Poster 96

### The Effects of Vitamin D on Fatty Acid Induced Inflammation: Implications for X-linked Adrenoleukodystrophy

*Gabriel Miranda and Keith Van Haren,*

*Department of Neurology, Stanford University*

X-linked adrenoleukodystrophy (X-ALD) is an inherited disease involving a defective peroxisomal protein that affects about 1 in 20,000 people. This disease is associated with an accumulation of saturated very long-chain fatty-acids (VLCFA) in the myelin of the brain. Most of these patients develop severe, inflammatory brain demyelination. Recent evidence suggests that low vitamin D levels may predispose to this brain inflammation. We propose that vitamin D reduces production of inflammatory mediators generated by human macrophages exposed to endogenous fatty acids (e.g. C16:0 and C24:0). In several cellular assays, we stimulated immortalized human monocyte cell lines (THP-1 cells) with fatty acids of two different lengths (C16:0 and C24:0) and measured the production of the inflammatory mediator interleukin-8 (IL-8) over time using enzyme linked immunosorbent assay (ELISA) kit (Peprotech, Inc.). We found that IL-8 production was significantly lower in cells treated with Vit D than in cells without Vit D exposure. There are no therapeutic options for the prevention of inflammatory brain demyelination in X-ALD. Future studies will be aimed at demonstrating the effectiveness of Vit D in decreasing inflammatory mediators in immune cells from patients with X-ALD. The end goal of this research is to deliver the first treatment option to prevent cerebral inflammation in patients with X-ALD.

We thank the Child Neurology Foundation, The Lucile Packard Foundation, and the NIH Loan Repayment Program for financial support.

## Poster 97

### Comparison of Cotton-top Tamarins and Pigeons on an Artificial Grammar Task

*Dr. C. Locurto, M. Fox, A. Mazzella, and J. Dykes*  
*Department of Psychology, College of the Holy Cross*

Implicit learning is the process in which humans learn without awareness. This type of learning has been proposed to occur in infants as they learn language without explicit instruction (Reber, 1967). Previous studies, such as those conducted by Nissen and Bullemer (1987) set the stage for current research in this field. In their study, a serial reaction time task was administered in which subjects were asked to press a designated computer key that corresponded to spatial locations on a computer screen as indicated by an asterick. It was found that subjects tended to have faster reaction times in response to patterned information compared to random information. Research on implicit learning has been conducted on a variety of species, but rarely is work done comparing two distinct species while using identical procedures. Our study sought to determine whether the ability to learn implicitly is present in non-human primates, specifically cotton top tamarins, and in pigeons, and to see how the two species results compared with one another. Three tamarins and three pigeons were used as subjects. Our procedure used an artificial grammar to generate the position of the elements that were presented on the six-quadrant touch screen to the subjects. Subjects were required to touch the image in order to advance in the sequence, and were reinforced randomly. Results indicated that the pigeons acquired the touch screen response as quickly as did tamarins. Pigeons also completed more trials per session with fewer errors than did the tamarins. We will continue to test the pigeons this fall to determine whether their learning of the artificial grammar matches that of the tamarins.

This research was supported by a generous contribution by Jaqueline H. and George A. Paletta, Jr., M.D. to the Parent/Alumni Summer Research Fellowship, by the Richard B. Fisher Summer Research Fellowship, and by the National Institutes of Health.

## Poster 98

### Design and Analysis of a Chopped Lithium Atomic Beam

*B. Ptucha and P. Oxley*  
*Department of Physics, College of the Holy Cross*

In preparation for collision experiments between lithium atoms and protons a chopper system that will rapidly turn on and off a lithium atomic beam was designed. This chopper system, along with a series of collimating apertures, will allow the determination of the lithium beam density. The knowledge of the beam density is essential for interpreting the results of future collision experiments. The chopper system consists of a rotating slotted barrel that will chop an incoming lithium beam. The dimensions of this barrel are carefully calculated to ensure that essentially every lithium atom, regardless of its velocity, is correctly chopped by the barrel. A calculation of the chopped lithium beam density emerging from the barrel is made and is used to further refine the barrel dimensions. In addition, a motor system used to rotate the barrel was constructed and tested experimentally. A system of three apertures placed at specific locations between the source of lithium atoms and the collision region was also designed in order to define the lithium beam size at the collision site. These apertures, together with the chopper barrel, fully define the spatial and temporal distribution of the lithium beam. In the future the lithium beam density will be determined by shining a laser beam through the lithium and analyzing the change in the power of the laser when the lithium beam is on and when it is off. This change is proportional to the line integrated density of the lithium beam, and we outline the calculation which will be required to infer this density from laser absorption data.

We thank the Richard B. Fisher Summer Research Fellowship for funding and Dick Miller for machining assistance.

## Poster 99

### Studying Supersymmetry Breaking at Finite Temperature Using the Effective Kahler Potential

*Collin Manning and Pr. Ben Kain*

*Department of Physics, College of the Holy Cross*

Models of broken supersymmetry have been leading candidates for new physics as they provide insights and possible answers to questions that have arisen in the study of particle physics, such as solutions of the Hierarchy problem (where the theoretical masses don't match up with the experimental masses), and helps bridge the gap between particle physics and dark matter. David Shih proposed a model of that breaks supersymmetry in a favorable way and provides useful insights to these questions. Prof Kain and I studied this model at finite temperature using both numerical and analytical techniques. We then applied temperature corrections to this model, in order to interpret the model as applying to the early Universe, with a very high temperature, and the Universe at a much lower temperature, as it is today. This was done using both numerical and analytical techniques. The analytical approach made use of the "effective Kahler potential" and this is the first time an analytical approach has been used.

This research was funded by the Dr. Anthony and Mrs. Renee Marlon Summer Research Scholarship.

## Poster 100

### Genetic Analysis of Electronically Conductive *Geobacter* Pili

*Samantha Ziegler and Madeline Vargas*

*Department of Biology, College of the Holy Cross*

*Geobacter* species are a group of anaerobic organisms that live in subsurface environments and breathe with iron instead of oxygen. *Geobacter* is the most commonly enriched microbe on anode surfaces of microbial fuel cells that yield energy from a variety of wastes. Pure cultures of *Geobacter sulfurreducens* produce the highest current densities of any known organism in a microbial fuel cell. This is attributed to the formation of electronically conductive, thick biofilm that can reach up to 50-100 times the length of a cell. Long-range electron transfer between the surface of the biofilm and the electrode is mediated by hair-like protein projections known as pili that are electrically conductive via a metallic-like mechanism, a previously unseen phenomenon in nature. Our laboratory is examining whether delocalized electrons of aromatic amino acids within the *Geobacter* pilin are involved in conductivity. To test this hypothesis, mutants were constructed in which alanine was substituted for aromatic amino acids located at the carboxyl terminus of PilA, the structural pilin protein. However, a mutant strain containing the wild type gene was needed to assess the effect of the aromatic substitutions. In this study, we constructed an isogenic *Geobacter* strain containing a gentamycin cassette upstream of the *pilA* gene to serve as the positive control. We examined the expression of *pilA* and the outer surface cytochrome OmcS in the control and the aromatic mutant as well as current production in microbial fuel cells. The aromatic mutant was capable of expressing *pilA* and OmcS, but unlike the positive control, was unable to make current. These results are consistent with our hypothesis in which the aromatic residues within the C terminus of the pili are involved in long range electron transfer and are required for current production.

We thank the O'Brien Family Summer Research Fellowship for financial support and the Lovely lab at the University of Massachusetts Amherst for hosting us this summer.

## Poster 101

### Isolation and Characterization of Autolysis and Wall Teichoic Acid Defective Mutants of *Staphylococcus aureus*

*Patrick Tavares, Linhui Wang, and Jean C. Lee*

*Channing Laboratory, Department of Infectious Disease,  
Brigham and Women's Hospital and Harvard Medical School*

Wall teichoic acids (WTAs) are major polyanionic cell wall glycopolymers produced by most Gram-positive bacteria. WTA has been implicated in various cellular functions, such as assimilation of cations at the cell surface; however, the main function of WTA has yet to be delineated. WTAs are known to regulate the activity of peptidoglycan hydrolases such as autolysins, but the molecular interactions between these molecules are not well understood. *Staphylococcus aureus* strains deficient in WTA are more susceptible *in vitro* to autolysis induced by bile salts, cationic peptides and proteases. Furthermore, WTA-defective mutants are killed *in vivo* 1 hour after mouse inoculation. We propose that the unregulated autolysin activity may be responsible for the killing of WTA mutants *in vivo*. Here, we isolated and characterized a WTA and autolysin defective strain of *S. aureus* and investigated the behavior of the mutants *in vitro*.

## Poster 102

### Numerical Approximation of Central Configurations in The N-body Problem

*John O'Connor and Professor Gareth Roberts*

*Department of Mathematics and Computer Science  
The College of the Holy Cross*

This summer we conducted research in celestial mechanics, specifically the n-body problem. The n-body problem questions how n celestial bodies interact gravitationally. When n is greater than two, all solutions cannot be determined. Therefore, specific forms of solutions are studied. We specifically studied central configurations. Central configurations of n masses have two properties: the acceleration vector of each body produced by the gravitational pull of the other bodies points toward the center of mass and the vector is proportional to the body's position with respect to the center of mass. These central configurations are specific solutions to the n-body problem and do exist in our galaxy. These central configurations are roots to a multivariate potential function. Using MATLAB, we wrote computer programs that applied multivariate Newton's Method to find these roots. We then wrote programs to scan an area of a fixed potential to find multiple roots. In the end, we were able to find some roots but still had errors and not all the central configurations could be found.

We thank Dr. Dan Kennedy, Ph.D. for his generous contribution to the Alumni / Parents Summer Research Scholarship fund, and the National Science Foundation for funding our research.

## Poster 103

### **Raising the Curtain: The Opening Moments of a Theatrical Performance**

*Christine Freije and Barbara Craig  
Department of Theatre, College of the Holy Cross*

The curtain stands as a primary, recognizable symbol of the theatre in general. Even when a curtain is not actually used to indicate the beginning of a performance, the opening of the show is still known as “curtain-time.” The curtain, whether it is a piece of cloth draped over the front of the stage, an opening speech, a change in the lights, or a segue from the real world of the theatre space into the illusion of the theatrical event, is a key element of the event itself. Our research this summer focused on the study of the curtain’s use throughout theatre history, an analysis of the theatrical effects that the curtain can be used to achieve, and, finally, how twentieth century directors have made use of the curtain. For modern directors, such as Bertolt Brecht and Robert LePage, the curtain is used to comment on the theatricality of a production. The curtain is emphasized, rather than allowed to hang inconspicuous, or painted to be a beautiful visual for the audience as they wait for the show to begin. Other directors, like Peter Brook, have conscientiously emphasized the ritual of beginning a show--from the entrance of the audience to the beginning of the action on stage. Finally, some directors have de-emphasized the “curtain moments” of their works to such an extent that the audience must take almost full responsibility to orient themselves to the theatrical event. Focus on these pre-performance moments gives a director the opportunity to define the audience’s relation to the performers before the action of the play begins.

We thank the Mellon Summer Research Program for financial support.

## Poster 104

### **Intein Mediated Assembly and Single Molecule FRET of Chemotaxis Y**

*Michael Nicastrì, Sagar Kathuria, and C. Robert Matthews  
Department of Biochemistry and Molecular Pharmacology,  
University of Massachusetts Medical School*

The folding of Chemotaxis Y, a protein native to *E. coli*, is studied for reversible folding mechanism. Structurally the protein follows a beta, alpha, beta repeat motif. Previous work on elucidating a folding mechanism has suggested the presence of an off-pathway intermediate. The proposed unfolded to intermediate transition is hypothesized to be fast and not visible by ensemble observation methods, thus the use of single molecule FRET is our proposed observation method. To achieve intraprotein FRET, specific residues must be selectively labeled with multiple colored molecular probes. Traditional methods use peptide synthesis or amber codon introduction of unnatural amino acids. Both methods are costly and inefficient for large production and multiplicity of measurements. Our experiments seek to propose a selective attachment method using intein mediated protein ligation. Inteins perform a protein splicing reaction that results in the ligation of two exterior peptide sequences. Our experiment seeks to use the Npu split DnaE intein to facilitate a trans-splicing reaction. This strategy allows for the separate expression of two halves of the protein. Where upon mixing the trans-splicing reaction will ligate a fully functional CheY protein. Our method will allow for selective addition of maleimide fluorophores to specific residues on CheY. This method will allow for high throughput preparation of large combinations mutations for our study, and be applicable to other proteins of interest.

Research funded by the National Science Foundation, and the University of Massachusetts Medical School.

## Poster 105

### **Enhancing Low-Income Preschoolers' Numerical Abilities: Does the Game Matter and Is There an iPad Effect?**

*Simon Toledano and Pr. Danuta Bukatko*

*Department of Psychology, College of the Holy Cross*

Research done by Siegler and Ramani (2009) showed that playing linear board games improves preschool children's numerical skills, presumably because they solidify children's representations of the number line. The present study assessed whether alternative interventions could have an enhancing effect on preschoolers' numerical abilities. We compared the effect of a patterns game to a linear board game on children's counting, number identification, numerical magnitude comparison, number-quantity matching, addition, patterns, and number line performance. Because the patterns game was available as an iPad application, we also had the opportunity to assess whether this method of delivery had any advantages over a traditional board game format. Twenty-one children from a local early education center participated in the present study. Data analysis will focus on uncovering the key cognitive skills that support numerical competency.

We thank Mr. Gerard P. and Clare S. Richer for their generous contribution to the Alumni/Parent Summer Research Fellowship fund.

## Poster 106

### **Delineating Domains of the Antiretroviral Protein APOBEC3G**

*Alex Marino and Ann Sheehy*

*Department of Biology, College of the Holy Cross*

According to recent estimates, 33.3 million people worldwide are living with the Human Immunodeficiency Virus (HIV-1) and nearly 5000 people die every day of AIDS. Globally, the number of people living with HIV-1 continues to rise with ~55,000 documented new infections in the United States every year. The virus depletes cells of the immune system, rendering infected individuals vulnerable to opportunistic infections. However, host countermeasures to viral invasion do exist. A natural defense against HIV-1 infection is the cellular restriction factor, APOBEC3G (A3G). Initially, it was thought that A3G exerted its antiviral function via its cytidine deaminase activity. This activity allows A3G to introduce deleterious mutations into the HIV-1 genome, which can ultimately prove lethal to virus replication. Additional reports have demonstrated an unexpected dissociation between the antiviral properties and the delineated enzymatic function of A3G. A molecular explanation for the exertion of additional antiviral functions of A3G remains unelucidated. Previously, a library of 135 mutants of A3G was generated. These mutants were then assessed for their antiviral activity and mutagenic activity. My project focuses on specifically identifying A3G mutants that retain antiviral properties yet do not exhibit detectable mutagenic activity. The results will provide a better understanding of the domain organization of A3G and may delineate the relationship between catalysis and novel domains involved in antiviral function. Defining the full scope of the A3G-mediate antiviral effect could present novel directions for the development of chemotherapeutic targets.

We thank Edward E. Meyers, M.D. for his generous contribution to the Alumni/Parent Summer Research Fellowship fund.



## Poster 107

### Surface Modification of Upconverting Nanoparticles for Cell Targeting

*Sarah Neville<sup>1</sup>, Jennifer Ayres<sup>2</sup>, and Michael Therien<sup>2</sup>*

<sup>1</sup>*Department of Chemistry, College of the Holy Cross*

<sup>2</sup>*Department of Chemistry, Duke University*

There has been much recent work in the synthesis and surface modification of lanthanide-based upconverting nanoparticles for biomedical applications, particularly the targeting and imaging of cancer cells. The upconverting particles, NaYF<sub>4</sub> doped with ytterbium (Yb<sup>3+</sup>) and erbium (Er<sup>3+</sup>) absorb multiple photons in the NIR, in order to emit one high-energy photon that can be detected in the green, red, and purple. We have been working on altering surface chemistry to make particles water-soluble. These particles lose emission intensity when submerged in water, so we have also explored means of providing a protective coating on the surface of these particles, particularly SiO<sub>2</sub> and phospholipids. All added ligands and shells are amine functionalized for further conjugation for cell targeting. We are looking into producing particles with maximum emission intensity as well as maximizing amine conjugation. We have had some success performing surface modification reactions that address these problems.

We gratefully acknowledge the National Science Foundation, as well as the Duke University Chemistry and Applications of Smart Molecules and Materials Research Experience for Undergraduates Program for financially supporting this research.

## Poster 108

### Selective Spin Labeling of GMP Reductase for Field-Cycling NMR

*J. Williams, M. Rosenberg, and L. Hedstrom*

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Guanosine monophosphate reductase (GMPR) plays an important role in the conversion of nucleoside and nucleotide derivatives of guanine to adenine nucleotides. Inosine monophosphate dehydrogenase (IMPDH) performs a similar reaction to convert IMP to XMP utilizing analogous residues and an identical covalent intermediate, E-XMP\*. Both reactions involve a conformation change: a protein flap is mobile in the IMPDH reaction and the cofactor, NADPH, moves in the GMPR reaction. Our goal is to study the dynamics of the NADPH molecule in each of the steps of the GMPR reaction. High resolution field-cycling <sup>31</sup>P NMR will be used in conjunction with spin labeling to learn more about the role of NADPH. However, *E. coli* GMPR contains seven cysteine residues, and so isolating a single cysteine residue for spin labeling while protecting the active site cysteine proves difficult. Here, we use cysteine modification methods to discover which cysteine residues are exposed and buried the *E. coli* GMPR in order to selectively spin label one cysteine residue. By reacting GMPR with Ellman's reagent to modify the reduced cysteine residues and monitoring its subsequent activity, it was shown that two cysteine residues are exposed in the protein's natural fold. It proved to be difficult to determine which cysteine residues were labeled through modification by this method. For more precise determination of which residues were exposed, modification with *N*-ethylmaleimide followed by iodoacetamide was used. The samples were analyzed using mass spectroscopy and results are forthcoming.

Many thanks to the Hedstrom Laboratory for financial support.

## Poster 109

### Development of an HPLC Method to Determine Impurities and Degradants in an Oral Suspension Product

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Analytical test methods are necessary to quantify the active pharmaceutical ingredient (API) and its potential degradants in a drug product. A high performance liquid chromatography (HPLC) method was developed for use within Pfizer Quality Operations' laboratories for a deworming agent. In the initial development stages, numerous columns were screened for the optimal normal phase separation of the drug product. Long, silica based columns proved to be the most effective at separations. Organic and aqueous solvent compositions of the mobile phase were also varied to achieve baseline resolution and optimal peak shape. The selected silica column and mobile phase composition allowed for the separation and identification of the acid component, the API and its two related impurities. Unknown peaks with areas less than 0.1% of the API peak area were below the threshold value and not identified. Identification of the remaining unknown peaks was achieved by spiking the drug product with each excipient and analyzing by HPLC. Unknown peaks were determined to arise from caramel cream and sorbitol solution. With all peaks accounted for and baseline resolution achieved, forced degradation of the drug product under light, heat, acid, base, and oxidative conditions was initiated and considered as a final step in the method development.

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## Poster 110

### Hierarchical Self-Assembly of Perylene Monoimide (PMI) Thin Films

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Perylene-3, 4-dicarboximide (PMI) derivatives have been reported as highly absorbent and very conductive molecules. More recent studies have led to knowledge of self-assembly of PMI in solution, although the specific parameters that determine the self-assembled states in aqueous solution have not been reported. This study addresses the effects of concentration and temperature on the self-assembly of PMI in aqueous solution. To characterize the self-assembly of PMI, Ultraviolet-Visible spectroscopy, Atomic Force Microscopy (AFM) and X-Ray Diffraction (XRD) were used. We have discovered that when PMI is annealed, it can assemble into nanowires at low concentrations and larger nanosheet suprastructures at high concentrations. Based on processing conditions, we have found that these morphologies can be selectively prepared.

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## Poster 111

### The Influence of Dietary D-Serine on Brain Levels

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D-serine is a co-agonist of the NMDA subtype of glutamate receptors. It has been implicated in the pathophysiology of schizophrenia based on its interaction with NMDA receptors, and genes that regulate D-serine levels have been linked to the etiology of schizophrenia. D-serine is produced endogenously in the brain by the racemization of L-serine to D-serine by the enzyme serine racemase, and is present at approximately 4 mg/g protein in forebrain tissue of wild type mice. It has been reported that mice with a constitutive genetic deletion of the gene that encodes the enzyme serine racemase (SR<sup>-/-</sup> mice) have roughly 10% the normal amount of forebrain D-serine. This study examined diet as a potential exogenous source of D-serine by maintaining SR<sup>-/-</sup> mice on either a custom-formulated serine deficient diet or a control diet for seven days. The mice were sacrificed on the seventh day and brain samples were collected. Forebrain samples were then analyzed by High Performance Liquid Chromatography (HPLC). Forebrain D-serine levels were below the quantitation limits of the HPLC separation method in both the SR<sup>-/-</sup> mice fed the serine deficient diet and SR<sup>-/-</sup> mice fed the control diet. This finding suggests that diet is likely a contributing source of D-serine in the mammalian brain, but interpretation requires further analysis of D-serine levels in regular lab chow, the serine-deficient diet, and the control diet, as well as re-analysis levels of D-serine in the forebrains of SR<sup>-/-</sup> fed regular lab chow.

We thank the Dr. Anthony and Mrs. Renee Marlon Summer Research Scholarship for financial support.

## Poster 112

### Reversibility of Cognitive Dysfunctions Caused by Genetic D-Serine Deficiency

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The NMDA (N-methyl-D-aspartate) receptor is a voltage- and ligand-gated neurotransmitter receptor. While glutamate is the primary agonist of the NMDA receptor, glycine and D-serine act as co-agonists. D-serine is present throughout the mammalian forebrain, including the hippocampus, a part of the brain that plays a major role in spatial, contextual, and sequence memory as well as memory consolidation. Previous unpublished research using a Pavlovian fear-conditioning paradigm found a contextual memory deficit in genetically engineered mice unable to express serine racemase, the enzyme that produces endogenous D-serine. These findings raised the question of whether this cognitive deficit is reversible by acute pharmacological administration of D-serine. To test this hypothesis, serine racemase knockout (KO) mice received either a saline or D-serine injection on the day of fear conditioning. Forty-eight hours after conditioning, all experimental groups underwent a context test in which freezing behavior was recorded. Preliminary analysis indicates that the serine racemase KO mice that received the saline injection had low levels of freezing in the conditioning context, similar to the results from previous research. However, the freezing levels in serine racemase KO mice that received D-serine injections were similar to those of the wild type control mice. These results suggest that it is possible to pharmacologically rescue the contextual learning effects caused by a constitutive D-serine deficiency. Further testing is required to confirm this finding.

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## Poster 113

### The Morning Within The Dark: The Study of Suffering and Loss Poetry

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Suffering is a universal human experience. And anyone who suffers knows that there is no concrete answer as to why his or her suffering occurs. Suffering is one of life's greatest mysteries and forces one to ask: Why do bad things happen to good people? What should one do with one's suffering? Where might one find relief? It's often said that suffering make someone wise, but that is simply not the truth. Suffering brings empathy and a connection to others and the losses others have felt. It is one's empathy that offers the opportunity for one to be wise. I wrote poetry to better understand my own suffering (over my own cancer and subsequent loss of my leg and my brother's suffering and death at nineteen) and the suffering of others. I worked to create a book of poems that deal with suffering and loss, and the kind of grief and denial that accompany such loss. In addition to writing my own poetry, I read traditional and contemporary elegies such as Ben Johnson's poem "On My First Son," Milton's Lycidas, and Rosanna Warren's elegy for her father Robert Penn Warren. I worked with Job and also books on grief and grieving by C.S. Lewis, Elizabeth Kubler-Ross and the Holocaust survivor, Viktor Frankl's Man's Searching For Meaning, and a number of others. I found myself asking the larger philosophical question, Why is there anything at all? and discovered that the relief of suffering lies, ironically, in facing what the poet John Keats called, the "wakeful anguish of the soul." In short, the only way out of suffering is right through suffering, not around it. This living with and through suffering is both what I learned and wrote about.

I extend my heart-felt gratitude to the Andrew Mellon Foundation and the Holy Cross Andrew Mellon Foundation Committee for financial support.

## Poster 114

### Regioselective Ring Openings of Cyclic Esters using Hydrogen-bonding Catalysts

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In recent years, the field of organocatalysis has grown to become an important and useful approach for controlling the stereoselectivity, regioselectivity and rate of many organic reactions. Thiourea derivatives, a class of organocatalysts, have been shown to catalyze many different types of reactions such as Diels-Alder and asymmetric Michael additions through unique dual-hydrogen bonding functionality. We have applied these catalysts to the reactions of cyclic esters. Uncatalyzed, cyclic esters react with amines to form mixtures of hydroxyl amides and amino acids. This research sought to employ various thioureas as a means to controlling the regioselectivity of cyclic ester ring openings through transition state stabilization, leading to the promotion of the amino acid products over the hydroxyl amides. Various thiourea derivatives were synthesized and used to catalyze the reactions of cyclic esters with a variety of amines. We have found that a number of thiourea derivatives are effective at catalyzing cyclic ester ring openings, affecting both product ratio and rate of the reaction. This approach may also offer a viable method to synthesize a wide variety of amino acids with increased selectivity.

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## Poster 115

### Synthesis of Protected Amides and Beta Sheet Peptidomimetics

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Many neurodegenerative diseases are associated with the aggregation of misfolded proteins. Understanding the mechanisms of peptide aggregation is a critical component to developing strategies to combating these diseases such as Parkinson's, Alzheimer's, and Huntington's among others. Towards this goal, small peptides have been designed to study the causes of aggregation. These include beta-sheet peptidomimetics and sequences rich in primary amides. A new synthesis of protected primary amides was successfully developed through the reaction of a variety of acyl isocyanates with an alcohol. Separately, through the coupling of protected amino acids with one another, a small peptide has been produced with the ability to create a disulfide bridge tethering the two strands into a beta sheet.

We thank the National Science Foundation for financial support.

## Poster 116

### Synthesis of Multidentate Thiophene Based Diamine Ligands

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A library of thiophene based diamine ligands was prepared through reductive aminations with various salicylaldehydes. The diamines showed high reactivity with the salicylaldehydes, closing up to form hexahydropyrimidines. High temperatures were required for the reduction of these rings, but we successfully isolated and purified a series of tridentate ligands. Further reactivity to produce tetradentate ligands was observed with salicylaldehyde. These ligands will be used to investigate coordination chemistry with air stable metals such as rhenium, gadolinium and europium. Future work will focus on synthesizing more of the bithiophene based tridentate and tetradentate ligands and characterize all of these compounds as they have never been reported in literature.

This research was funded by the O'Brien Family Summer Research Fellowship.

## Poster 117

### **An Investigation on the Effects of Asymmetric *Versus* Symmetric Cell Division on the Ability of Murine Fibroblasts to Metabolize the Herbicide Metribuzin**

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Metribuzin is a widely used herbicide. Our laboratory recently found that murine fibroblasts dividing asymmetrically are more resistant to the cytotoxic effects of metribuzin than are those dividing symmetrically. This summer, we worked to answer the question: Are asymmetrically dividing cells more resistant to metribuzin due to a greater ability to metabolize metribuzin than symmetrically dividing cells? Two murine fibroblast cell lines, growing asymmetrically or symmetrically, were cultured in the presence of metribuzin for 3 and 72 hours. Cell cultures were analyzed using High Pressure Liquid Chromatography to detect metribuzin and its predicted metabolites. Metribuzin's predicted metabolites were never detected. On average,  $66 \pm 23\%$  of the starting metribuzin was recovered in cell culture systems, compared to a  $110 \pm 4\%$  metribuzin recovery rate in medium free of cells ( $p = 0.0046$ ). This finding suggests that the cells were able to reduce metribuzin, presumably by a metabolic pathway that did not produce the predicted metabolites. The observed degrees of reduction did not support the hypothesis of differential catabolism of metribuzin on the basis of asymmetric *versus* symmetric cell division.

We thank the Boston Biomedical Research Institute for financial support.

## Poster 118

### **Effects of Time Interval of Donation after Circulatory Arrest (DCD) and Graft and Patient Outcomes**

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Previous research has shown discrepancies with regards to desirable donor warm ischemic times (DWIT) in terms of positive DCD transplant outcomes. Also, there is conflicting data concerning graft and patient survival between standard criterion donors (SCD) and DCD donors. The current study aimed to determine how far to push the limit of DCD donors in terms of DWIT with acceptable outcomes, as well as compare the quality of DCD and SCD organs by means of graft/patient survival, indications of injury, and rejection. Using national kidney and liver transplant data provided by the United Network for Organ Sharing (UNOS), we examined all transplants between March 2008 and December 2011. Guided by the Deceased Donor Registration (DDR) form, donors were categorized as either SCD, ECD, DCD, or combined ECD/DCD. Specifically, DCD donors were divided based on their DWIT in order to examine differences as these times increased. Contrary to our hypotheses, we discovered that graft and patient survival did not differ as DWIT increased for DCD kidneys and livers. Additionally, survival rates were higher for SCD than DCD kidneys, while rates did not differ amongst liver transplants. Remarkably, indications of injury and rejection rates were similar between SCD and DCD kidneys and livers. These findings indicate a recent increase in DCD organ selectivity, which may be resulting in a DCD organ supply that is comparable in terms of quality with SCD organs. This provides valuable insight into the current national organ supply.