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# Program

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## COLLEGE OF THE HOLY CROSS

### Fifteenth Annual Undergraduate Summer Research Symposium



September 5, 2008

Hogan Ballroom

*Dear Members of the Holy Cross Community,*

*Welcome to the 2008 Undergraduate Summer Research Symposium. Now in its fifteenth 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 2008. 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.*

*Professor Jumi Hayaki, Department of Psychology  
Professor Jude Kelley, Department of Chemistry  
2008 USRS Organizing Committee*

*In recognition of those whose financial contributions have made this research possible:*

The Richard B. Fisher Summer Research Grant  
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Office of the Science Coordinator  
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Departments of Mathematics and Computer Science, Physics, Chemistry, Biology, Psychology, Sociology, and Economics.

## Posters

(Note: Presenter names are underlined below.)

1. **The Art of iRobot Programming and Guidance**, C. D'Ambrogio, L. King, and V. Kumar, Department of Mathematics and Computer Science, College of the Holy Cross.
2. **Development and Optimization of a Continuous Point-to-Grid Corona Discharge Ionization Source for Ion Mobility Spectrometry**, Anthony J. Metrano and Jude Kelley, Department of Chemistry, College of the Holy Cross.
3. **Catalytic Phosphorylation of Trivalent Phosphorous Compounds**, Elizabeth M. Morris, Owen S. Fenton, and Bianca R. Sculimbrene, Department of Chemistry, College of the Holy Cross.
4. **Psychophysics of Moving Object Detection by a Moving Observer: The Effect of Speed**, K. Moore and C. Royden, Department of Mathematics and Computer Science, College of the Holy Cross.
5. **Detecting Moving Objects: A Computational Model**, M. Holloway and C. Royden, Department of Mathematics and Computer Science, College of the Holy Cross.
6. **Laser Induced Breakdown Spectroscopy**, B. O'Leary and J. Kelley, Department of Chemistry, College of the Holy Cross.
7. **Quantitative Analysis of Illicit Drugs**, L. Tonge, O. Fenton, and K. Frederick, Department of Physics, College of the Holy Cross.

8. **Impulsivity, Mindfulness, Eating Expectancies, and Bulimic Symptoms: A Pilot Study**, A. Sica, E. Panza, and J. Hayaki, *Department of Psychology, College of the Holy Cross.*
9. **Using Three Dimensional Laser Imaging to Quantify Keel Shape of the Bird Breastbone**, M. Krzyzak and R. Marínez, *Department of Biology, College of the Holy Cross. Faculty Advisor: Leon Claessens.*
10. **Development of a Catalytic Reaction for the Phosphorylation of Alcohols**, Owen S. Fenton, Elizabeth M. Morris, and Dr. Bianca R. Sculimbrene, *Department of Chemistry, College of the Holy Cross.*
11. **A Universal Coating for the Modification of Microfluidics**, A. Buga, S. Crowley, and K. Frederick, *Department of Chemistry, College of the Holy Cross.*
12. **X-Ray Bursts of Neutron Star 4U 1728-34**, Michael Fask, Joe Palmieri, and Tom Narita, *Department of Physics, College of the Holy Cross.*
13. **Sex and Genetic Effects on Social Interaction in Mice**, Alex Newbury, *College of the Holy Cross*, Jun Xu, *Tufts University Cummings School of Veterinary Medicine, North Grafton, MA.*
14. **Aldosterone and amiloride reduce the rise of intracellular sodium concentration in ouabain-treated MDCK cells**, M. Sallah and M. L. S. Ledbetter, *Department of Biology, College of the Holy Cross.*
15. **The Effect of Buffer on the Aggregation of Human- $\gamma$ -C Crystallin**, Amy Trojanowski and Sarah Petty, *Department of Chemistry, College of the Holy Cross.*
16. **Acute Blockade of the Serotonin Transporter Increased Acoustic Startle Response and Prepulse inhibition in the Female Mouse**, Maryann Manatt, Michael J. Dean, Emily Cupelo, and Daniel Bitran, *Department of Psychology, College of the Holy Cross.*
17. **Sleep Environment, Regular bedtimes, and Young adolescents' Sleep Patterns**, Kledia Spiro, Mary Getz, and Julia Amrhein, *Department of Psychology, College of the Holy Cross. Faculty Sponsor: Amy R. Wolfson.*
18. **Implicit Learning in Cotton-top Tamarins**, L. Radville and T. Cormack, *Department of Psychology, College of the Holy Cross. Faculty Advisor: Charles Locurto.*
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20. **An Infrared Study of Structure in Polyglutamine Aggregates**, Kelly Lyons and Dr. Sarah Petty, *Department of Chemistry, College of the Holy Cross.*
21. **Rhenium Chemistry: Bidentate Complexes to Rhenium Centers**, Americo Gambella and Richard S. Herrick, *Department of Chemistry, College of the Holy Cross.*
22. **Geometry of Clairaut Metrics**, James M. Antonio and Prof. Andrew D. Hwang, *Department of Mathematics and Computer Science, College of the Holy Cross.*
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24. **Building and Testing a Lock-In Amplifier**, Miguel Juarez '09 and Professor Paul Oxley, Department of Physics, College of the Holy Cross.
25. **Elliptic Curves: Groups, Fields, and Cryptography**, S. Frechette and J. Madore, Department of Mathematics and Computer Science, College of the Holy Cross.
26. **An Examination of Excess Endowments at Private Liberal Arts Institutions**, K. Sweet, K. Teitel, and R. Baumann, Department of Economics, College of the Holy Cross.
27. **How Do Professional Sports Franchises Affect Housing Values?** Katherine Kiel, Associate Professor, Victor Matheson, Associate Professor, and Christopher Sullivan, Class of 2009, Department of Economics, College of the Holy Cross.
28. **The Present State of China's Banking Sector**, Professor Thomas Gottschang and Eric Wester, Class of 2009, Department of Economics, College of the Holy Cross.
29. **Copyright Protection for the Visual Arts**, Melissa Boyle, Assistant Professor, Debra O'Connor, Assistant Professor, and Stacy Nazzaro, Class of 2010, Department of Economics, College of the Holy Cross.
30. **Forensic Economics and Assessing Personal Injury and Wrongful Death Damages in New Hampshire**, David Schap, Professor, and Kevin Meives, Class of 2009, Department of Economics, College of the Holy Cross.
31. **The Structure of Acquisition in Aged Mice**, Taylor Cormack and Laura Radville, Department of Psychology, College of the Holy Cross. Faculty Sponsor: Dr. Charles Locurto.
32. **Murine model antibody response during intranasal colonization by *Streptococcus pneumoniae***, Aaron Goodwin, College of the Holy Cross, Nang Maung, and John Leong, University of Massachusetts Graduate School of Biomedical Sciences.
33. **The Impact of Unemployment, Income and Poverty on Crime**, Robert Baumann, Assistant Professor, and Chihiro Muroi, Class of 2009, Department of Economics, College of the Holy Cross.
34. **Formation of Peptide Isosteres Via Olefin Cross Metathesis**, Jennifer Beaudoin and Bianca Sculimbrene, Department of Chemistry, College of the Holy Cross.
35. **Efforts Towards a Convergent Synthesis of Murisolin A**, Brendan L. Mackinson, Stacy A. Powell, and Kevin J. Quinn, Department of Chemistry, College of the Holy Cross.
36. **Small molecule modeling of protocatechuate 3,4-dioxygenase**, J. Niconchuk, T. Fussell, E. Yoon and J. Farrell, Department of Chemistry, College of the Holy Cross.
37. **Regional examination of cirque patterns and distributions, Glacier National Park, Montana, USA**, N. Shea and S. G. Mitchell, Department of Biology, College of the Holy Cross.
38. **The Role of Gesture in Lexical Retrieval: Does Gesturing Make a Difference?** Pamela Doig '09, College of the Holy Cross, and Samantha Grossmith '11, Wellesley College. Faculty Advisor: Professor Jennie E. Pyers, Department of Psychology, Wellesley College, Wellesley, MA.

39. **Standardized Method for the Screening of Packaging Materials for Extractables Using Thermal Desorption GC/MS**, Patricia Gumbley, *College of the Holy Cross*, and Everett Wilhelm, *Pfizer, Inc., Groton, CT*.
40. **The Development of a Portal Preconcentrator and a Quartz Ion Mobility Spectrometer**, L. Kopsick and J. Kelley, *Department of Chemistry, College of the Holy Cross*.
41. **mor 2.0 - Automation of Phylogenetic Analyses**, T. Heider, *Department of Biology, College of the Holy Cross*, C. Ha, *Department of Computer Science, Clark University*, and D. Hibbett, *Department of Biology, Clark University*.
42. **Correlation Studies in PGS/IPFL Counterfeit Viagra Internet Investigations**, Emily Samartino, *College of the Holy Cross*, and Amy Callanan, *AS&T/IPFL, Pfizer Global Manufacturing*.
43. **Rhenium Chemistry: The Use of Dioxime Compounds as Bidentate Ligands**, Harun Rafi and Richard S. Herrick, *Department of Chemistry, College of the Holy Cross*.
44. **Older Men and Heart Health**, Stefanie Tedesco and Katie Guardino, *Department of Sociology, College of the Holy Cross*. *Faculty Advisor: Ed Thompson*.
45. **Synthesis of Amino-Phenol/Thiophenol Ligands**, T. Fussell and J. Farrell, *Department of Chemistry, College of the Holy Cross*.
46. **Evaluation of Coating Performance in Capillary Electrophoretic Separations by Monitoring Electroosmotic Flow**, S. Crowley and Professor K. Frederick, *Department of Chemistry, College of the Holy Cross*.
47. **The Physics of Baseball: Building the Drag Coefficient vs. Reynolds Number Curve**, J. Singleton, Z. Donahue, K. Sullo, T. Morell, and M. Koss, *Department of Physics, College of the Holy Cross*.
48. **Hiatal Hernia Repair at the Initial Laparoscopic Adjustable Gastric Band Operation and its Effect on Gastroesophageal Reflux Disease Symptoms**, Ela Banerjee, *College of the Holy Cross*, and Dr. Papasavas, *Hartford Hospital, CT*.
49. **Investigations of Collinear Central Configurations**, Shea Sennett and Professor Gareth Roberts, *Department of Mathematics, College of the Holy Cross*.
50. **Timing and Spectral Analysis of the Neutron Star X0921-630**, Joseph Palmieri, Michael Fask, and Tom Narita, *Department of Physics, College of the Holy Cross*.
51. **Drosophila melanogaster as a Model Organism for X-Linked Spinal Muscular Atrophy and Other Neurodegenerative Diseases**, J. Ghobrial, *College of the Holy Cross*, H. Liu, and C. Pflieger, *Department of Oncological Sciences, Mount Sinai School of Medicine*.
52. **Neurogenesis in Adult Mice in the Neocortex**, M. Hausse, M. Rizzi, *Wolfson Institute and UCL*, M. Vornle von Haagenfels, *College of the Holy Cross*, and S. Moncada, *Wolfson Institute and UCL*.

53. **The Mutagenic Capacity of the Anti-HIV Protein APOBEC3G**, *Michelle Arata, Natasha Tobarran, Melissa Farrow, and Ann Sheehy, Department of Biology, College of the Holy Cross.*
54. **The Importance of Viral Packaging of the anti-HIV protein APOBEC3G**, *Michelle Arata, Justin Rucci, Melissa Farrow, and Ann Sheehy, Department of Biology, College of the Holy Cross.*
55. **The Search for the Holy Grail: Assay for a dominant-negative APOBEC3G mutant that is active against wild-type HIV**, *Justin Rucci, Melissa Farrow, and Ann Sheehy, Department of Biology, College of the Holy Cross.*
56. **Interacting with Others: A Comparison of Face-to-Face and Electronic-Mediated Communication**, *C. Spilka and P. Kramer, Department of Psychology, College of the Holy Cross.*
57. **Access to care for rheumatic diseases: a private / public discrepancy**, *Lesley Bautista, College of the Holy Cross, Yatesh Setty, Rose Ardern, and Proton Rahman, Memorial University of Newfoundland, Canada.*
58. **Cytokine Expression of Seeded Tissue Engineered Vascular Grafts**, *Ani Nalbandian, College of the Holy Cross, Rajendra Sawh-Martinez, and Christopher Breuer, Department of Surgery, Yale University School of Medicine, New Haven, CT.*
59. **The Mediating Effects of Motivation on Adolescents' Achievement and Well-Being**, *M. Richards and A. Ludden, Department of Psychology, College of the Holy Cross.*
60. **Superheated Water Chromatography: Column and Mobile Phase Investigation**, *Ann Kotze, Department of Chemistry, College of the Holy Cross, and Shangming Kao, Pfizer Global Research and Development.*
61. **Coordination of Behavioral Waves in Natural Interactions**, *Samantha Morr, Department of Psychology, College of the Holy Cross. Faculty Advisor: Dr. Richard Schmidt.*
62. **Protein Splicing Via an Alternative Mechanism: A Directed Evolution Approach**, *Adam Nadelson, Daniel York, Julie Reitter, and Professor Kenneth Mills, Department of Chemistry, College of the Holy Cross.*
63. **A Tale of Two Isoforms: Exploring the Function of the Argonaute CSR-1 within the RNAi Machinery of C. elegans**, *E. Morse<sup>1,2</sup>, J. Claycomb<sup>1</sup>, and C. Mello<sup>1</sup>, <sup>1</sup>Program in Molecular Medicine, University of Massachusetts Medical School, <sup>2</sup>Department of Biology, College of the Holy Cross.*
64. **Multi-Frequency Laser Diodes**, *Joshua Ryor '10, Professor Paul Oxley, and Professor Timothy Roach, Department of Physics, College of the Holy Cross.*
65. **Are Skin Prick Tests or Wheal Sizes Prior to 24 Months of Age Associated with Allergic Sensitization at 36 Months?** *Bridget A. Whitehead, College of the Holy Cross, Patrick H. Ryah, Ph.D., Jeff W. Burkle, Christopher D. Codispoti, M.D., M.S., and Grace K. LeMasters, Ph.D., Department of Environmental Health, University of Cincinnati, OH.*
66. **Modeling Deeply Knotted Proteins**, *Matthew Brady and Professor David Damiano, Department of Mathematics and Computer Science, College of the Holy Cross.*

67. **Index of Insect Biodiversity in Central and Western Massachusetts**, Andrea Everhart, *Department of Biology, College of the Holy Cross.*
68. **The Physics of Baseball: Spin Decay**, Kevin Sullo, Tom Morell, M. B. Koss, J. Singleton, and Z. Donahue, *Department of Physics, College of the Holy Cross.*
69. **Diagnostic Imaging: Creating unnatural amino acids with novel starting materials**, Joseph Lopez and Professor Richard Herrick, *Department of Chemistry, College of the Holy Cross.*
70. **Impulsivity influences Unconscious Perception and Control**, Brian Becker, Dr. Clare L. Blaukopf, and Dr. Gregory J. DiGirolamo, *Department of Psychology, College of the Holy Cross.*
71. **Arousal influences involuntary actions more than voluntary actions**, Neha Patel, Dr. Clare L. Blaukopf, and Dr. Gregory J. DiGirolamo, *Department of Psychology, College of the Holy Cross.*
72. **The State of Autism and other Neuropsychological Research in the Developing World: A Literature Review of Research in Latin America, China and Southeast Asia and the Middle East**, Jessica Napolitano, *Department of Biology, College of the Holy Cross*, and Michael Rosanoff, *Science Department, Autism Speaks.*

## Poster 1

### The Art of iRobot Programming and Guidance

C. D'Ambrogio, L. King and V. Kumar  
*Department of Mathematics and Computer Science  
 College of the Holy Cross*

The Department of Mathematics and Computer Science will incorporate programmable *iRobot Create* robots into the introductory course beginning this Fall. In this project, we developed software and teaching materials for the *iRobot*, studied the guidance mechanism, and developed robust exploration techniques.

Our first contribution was a high-level interface that allows novice programmers to write simple programs. We created two labs to familiarize students with this interface, and a project skeleton that students can build upon in the introductory course. Since the *iRobot* lacks a screen to output data, we developed a format for displaying numbers in binary using the built-in LEDs.

Our second contribution was an investigation of robust techniques for *iRobot* guidance. The *iRobot* has inaccurate sensors for distance and angle. We therefore developed techniques to solve two fundamental guidance problems with minimal dependence on sensors: (i) detecting a corner, and (ii) measuring its angle. Our solutions require only a *single* initial calibration for distance and angle.

Finally, we demonstrated the robustness of our two solutions with the following sample applications:

- (1) Identify the (interior or exterior) shape of an  $n$ -sided polygon (where  $n = 3, 4$  or  $5$ ). Our solution requires a single user-input.
- (2) Identify the interior shape of an  $n$ -sided polygon ( $n = 3, 4$  or  $5$ ). Our solution requires no user input.
- (3) Play "tag" with two *iRobots*, where one robot emits a signal the other can sense. Our contribution here is a technique to learn the *direction* of the emitted signal from its presence and shape.

We thank the Sherman Fairchild Foundation for financial support.



## Poster 2

### Development and Optimization of a Continuous Point-to-Grid Corona Discharge Ionization Source for Ion Mobility Spectrometry

*Anthony J. Metrano and Jude A. Kelley*  
*Department of Chemistry, College of the Holy Cross*

Ion mobility spectrometry is a technique for separating analyte ions on the basis of their gas phase mobilities, which has gained popularity in the field of contraband detection. Every ion mobility spectrometer (IMS) requires an ionization source to generate the analyte ions from the sample molecule of interest. The traditional IMS ionization source is a radioactive isotope of Nickel,  $^{63}\text{Ni}$ , which emits  $\beta$ -particles to effectively ionize the sample. However, we were interested in developing a non-radioactive ionization source that operates with the same efficiency as the  $^{63}\text{Ni}$ . A point-to-grid corona discharge ionization source compatible with the structure of our IMS was developed and optimized under various ambient conditions. A corona discharge occurs when a high electrical potential builds on one electrode compared to another, creating an electrical discharge that ionizes nearby molecules. A corona, or blue-violet plasma generated when a high-potential electrode superheats and ionizes the surrounding fluid, can be seen at the tip of the high-potential electrode.

The corona discharge ion source provides effective ionization without the complications associated with radioactivity, and it will expand the experimental boundaries of our IMS, allowing us to effectively ionize biomolecules and make the IMS portable. The current behavior of the corona discharge in air, both stagnant and flowing, was effectively characterized at different voltages and interelectrode distances in order to optimize the ionization efficiency for use in the IMS. These data will be compared with future data in nitrogen to determine which gas better supports the corona discharge ion source within the IMS.

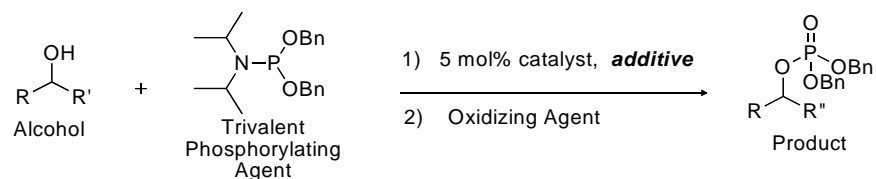
We would like to extend our sincerest thanks to the Sherman Fairchild Foundation for its financial support.

## Poster 3

### Catalytic Phosphorylation of Trivalent Phosphorous Compounds

*Elizabeth M. Morris, Owen S. Fenton, and Bianca R. Sculimbrene*  
*Department of Chemistry, College of the Holy Cross*

Research focused on the development of a more efficient means of introducing phosphate functional groups onto alcohols, a reaction called phosphorylation. This would allow facile creation of a gamut of natural products, such as DNA, proteins and small molecules. Phosphorylation also can impart solubility in aqueous solvents, a key feature missing in many drug delivery models. The method studied involved reacting alcohols with commercially available trivalent phosphorous compounds. Under the current conditions, a byproduct created during the phosphorylation reacts with the catalyst deactivating it from undergoing future rounds in the catalytic cycle. By introducing an additive to selectively react with the byproduct, the catalyst could regenerate. In order to test this hypothesis, two reactions were set up simultaneously where one served as a control reaction and the other contained the additive. Upon screening various conditions, a robust reaction was developed that utilizes different trivalent phosphorous compounds and a variety of primary, secondary and tertiary alcohols. Now that the catalytic cycle has been perpetuated, focus will shift to the development of chiral catalysts to perform the reaction asymmetrically.



I would like to thank the Pfizer Prepare Grant for a summer fellowship as well as the Camille and Henry Dreyfus Foundation for their support of this research.

#### Poster 4

### Psychophysics of Moving Object Detection by a Moving Observer: The Effect of Speed

*K. Moore and C. Royden*  
*Department of Math and Computer Science,*  
*College of the Holy Cross*

The human ability to detect moving objects when humans, themselves, are moving is instrumental to their success in navigating various environments. What are the most important factors that signal motion of another object, and how strong must these factors be in order to be useful to us? Image motion on the retina, or the “optic flow field,” forms a radial pattern for an observer moving in a straight line. Angular deviation of an object from this pattern is a known factor in detecting moving objects. Speed deviation, then, might also be a factor. Both cause disruptions in the optic flow fields generated by an observer moving through a scene. These disruptions could be detected by human observers. In this experiment, we psychophysically tested human accuracy for detection of an object moving at a different speed than the rest of the objects present.

The study consisted of observers viewing a computer simulation of their motion towards a plane of circles 1000 cm in front of them. The 25 circles used moved in a radial flow pattern, and in half of the trials, a target circle was present, deviating in its speed relative to the rest of the flow pattern. The target moved faster, 1.1 to 1.5 times as fast as the rest of the circles, or slower, 0.3 to 0.9 times as fast, depending on the block of trials. Each trial lasted 1 second, and each condition was tested 10 times.

Results reveal that observers detect a target circle with a threshold level of 75% accuracy at factors of 1.4 for fast motion and .47 for slower motion. Accuracy of moving object detection tended to increase as the difference in speeds between the target circle and the other circles increased. Thus, speed deviation, along with angle deviation, appears to be a significant factor in moving observers’ detection of moving objects.

Supported by National Science Foundation (NSF) grant  
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#### Poster 5

### Detecting Moving Objects: A Computational Model

*M. Holloway and C. Royden*  
*Department of Math and Computer Science,*  
*College of the Holy Cross*

The detection of moving objects is a pivotal part of every person’s ability to move through the world. Past research has proven that the global pattern affects the perception of moving objects. As an observer moves through the world, a radial pattern projects onto the back of the retina creating an optic flow pattern. In the brain, there are millions of neurons that process this optic flow pattern to determine the structure of the visual scene. We have taken this research further and have produced a model that examines an optic flow field that would be generated by an observer moving toward a scene to determine whether there is a moving object within the scene. We wanted to know what visual cues the brain uses to distinguish a moving object from the rest of the scene. The model uses operators that respond to motion similarly to neurons in the primate visual cortex to compute the direction of observer motion. We expanded our model to use speed, angle differences, and a combination of both to pick out the object. We tested how well the model could identify a moving object in a simulated scene in which the observer approached two planes of dots with a moving object in front. We tested a variety of object positions and observer motions, including conditions in which the observer was rotating. The model successfully identified the borders of the moving object for most of the conditions tested. From the model output we concluded that, for the conditions tested, the model primarily uses speed to pick out the moving object and that angle differences are not very prominent in the detection of moving objects.

Supported by National Science Foundation (NSF) grant  
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## Poster 6

### Laser Induced Breakdown Spectroscopy

*B. O'Leary and J. Kelley*

*Department of Chemistry, College of the Holy Cross*

Laser Induced Breakdown Spectroscopy (LIBS) uses high-power infrared laser pulses focused to a small point in space above the surface of a sample. A plasma plume is created in this spot and emits visible and ultraviolet light of frequencies characteristic of the atoms (or molecules) of which the plasma is comprised. This light is then collected by a CCD array within an Ocean Optics HR2000+ spectrometer, which sends signals to a computer for analysis.

A LIBS apparatus was built and used to build a spectral database of approximately thirty elements. A Labview analysis program was designed which, combined with the spectral database, provides for fast elemental analysis on the magnitude of minutes, despite low resolution compared to many other LIBS instruments. This program employs Welch's Method of estimating power spectra to make autocorrelation estimates.

Current efforts are going into two main areas. The first is an assessment of the parameters of the instrument in order to optimize the signal while minimizing the damage done to the sample surface. This includes investigations into the quantum broadening of peaks, the laser interaction with surfaces at various powers, and a timeline of the life of the plasma. This will lead to more quantitative data, and the feasibility of elemental analysis of historic artifacts. The second is an exploration of carbon and silicon plasma chemistry, tracking emissions from their atoms and diatomic molecules over a range of laser powers in the plasma.

We would like to thank the Sherman Fairchild Foundation for financial support.

## Poster 7

### Quantitative Analysis of Illicit Drugs

*L. Tonge, O. Fenton and K. Frederick*

*Department of Physics, College of the Holy Cross*

Street drugs are typically mixtures of illicit drugs such as cocaine or heroin and are diluted with powders called cutting agents. In order for the justice system to correctly punish someone with drugs in their possession they need to know precisely how much of the drug is in the mixture and how much is just harmless cutting agent. To solve this problem, we have employed Raman spectroscopy. Raman spectroscopy uses a laser to produce a unique spectrum for each molecule. By looking at the peak positions and intensities, we can determine how much drug we have and how much cutting agent. We prepared calibration samples with a single drug surrogate and one, two, or three cutting agents which included baking powder, baking soda, corn starch, mannitol, methylsulfonylmethane (MSM), lactose, procaine, and sugar. Spectra were acquired on both homebuilt and commercial (Ahura) Raman instruments. The spectra were then processed using a variety of different methods including smoothing, differentiation, spectral averaging, and mean centering. Finally, the quantitative model was developed using partial least squares regression which created a model that compared the known concentration of the drugs with the concentration predicted by the model. The better the calibration set predicted, the better the model will work in the real world. We also designed a test set of samples again using one drug and one, two, or three cutting agents. Comparing the calibration set and the test set, we were able to predict the concentration of the test set within three or four percent. Thus, the model would in all likelihood work well to predict the concentration of unknown mixtures of drugs, thus helping the justice system.

We thank the Sherman Fairchild Foundation for financial support.

## Poster 8

### **Impulsivity, Mindfulness, Eating Expectancies, and Bulimic Symptoms: A Pilot Study**

*A. Sica, E. Panza, and J. Hayaki*  
*Department of Psychology, College of the Holy Cross*

Previous research indicates that high levels of impulsivity and low levels of mindfulness constitute risk factors for many forms of psychopathology including eating disorders, where these traits have been associated in particular with bingeing behavior. In addition to these global personality traits, recent research has implicated a number of cognitive risk factors for bulimic symptoms, namely, expectations that eating will a) help manage negative affect or b) lead to feelings of dyscontrol have been implicated in bulimic symptomology. However, it remains unclear whether these eating expectancies specifically contribute to bulimic symptoms above and beyond the presence of impulsivity and mindfulness, which have also been implicated in other forms of psychopathology. The purpose of the present investigation was to replicate previous findings regarding the influence of impulsivity and mindfulness on bulimic symptoms and to examine the unique contribution of eating expectancies after controlling for impulsivity and mindfulness.

Participants were 22 female undergraduate students who completed a battery of self-report instruments assessing demographics, impulsivity, mindfulness, eating expectancies, and bulimic symptoms. Results from a Pearson correlation analysis demonstrated modest support for our hypothesis, with significant associations between bulimic symptoms and mindfulness ( $r = -.44, p < .05$ ) and the out of control eating expectancy ( $r = .64, p < .01$ ). Further, the out of control eating expectancy uniquely contributed 26 % of the variance in bulimic symptoms after controlling for impulsivity and mindfulness ( $F(6,15)=6.80, p < .001$ ). These findings suggest that, among individuals who exhibit low levels of mindfulness, those who additionally expect eating to produce feelings of dyscontrol may be especially at risk for the development of disordered eating.

We are grateful to the Richard Fisher Fellowship for financial support.

## Poster 9

### **Using Three Dimensional Laser Imaging to Quantify Keel Shape of the Bird Breastbone**

*M. Krzyzak and R. Martínez*  
*Department of Biology, College of the Holy Cross*  
*Faculty Advisor: Leon Claessens*

The morphology of avian species is influenced by their habitats and the behaviors required to survive in those environments. Birds display a wide range of locomotive behavior. They can run, fly, swim, dive, or combine various behaviors. Employing non-contact 3D laser scanning, we attempt to quantify different trends in the morphology of the breastbone. A point of focus on the bird sternum is the keel, which serves as the major attachment site of the muscles used in flight. We have examined sterna with thin, thick, round, and sharp keels. By juxtaposing sterna from birds which utilize different means of locomotion, we can see that sterna have varying morphologies that are influenced by means of locomotion. However several species we observed that are closely related show little variation in sternal morphology and mainly differ in body size. Emus are incapable of flight and lack a sternal keel. In contrast, geese use their wing muscles to migrate thousands of miles each year and have sterna with prominent keels. Penguins are flightless, but use their wings to propel themselves through the water and require a sternal keel for muscle attachment. Using Rapidform XOR, a program suited for editing and analyzing data from 3D scanners, we are able to compare 3-D models using precise mathematical measurements and calculations. With Rapidform we can establish planes to cross section the keel and get an accurate outline for measurements. We can create circles to best fit sternal keel shape that yield sequential perpendicular cross-sections along the curve.

We thank the Richard Fisher Fellowship and the Sherman Fairchild Foundation, which helped fund our summer research.

## Poster 10

### Development of a Catalytic Reaction for the Phosphorylation of Alcohols

*Owen S. Fenton, Elizabeth M. Morris,  
and Dr. Bianca R. Sculimbrene*

*Department of Chemistry, College of the Holy Cross*

A novel, catalytic reaction for the phosphorylation of 2° was developed. Previous attempts at introducing phosphate groups into complex molecules such as DNA are plagued by inefficient catalyst turnover, largely due to the fact that the tetrazole catalyst is deactivated by an amine byproduct generated during the reaction. However, introduction of an isocyanate additive to the reaction effectively “scavenges” amine byproduct and allows for the turnover of the tetrazole catalyst.

In this experiment, phosphorylation reactions with and without the addition of the phenylisocyanate additive were studied for a variety of alcohols, and the efficiency of these reactions was evaluated based on <sup>1</sup>H NMR conversion. The reaction was optimized and conversions between 83-99% and 7-31% were observed for reactions run with and without the phenylisocyanate additive respectively. Yields on pure, phosphorylated alcohols were also observed between the ranges of 74% and 88%.

Attention is now being focused on the development of chiral versions of the tetrazole catalyst. A library of C<sub>2</sub> symmetric and amino-acid-based catalysts is being synthesized, and promising preliminary results demonstrate that these molecules function as catalysts in the developed reaction.

The authors would like to thank the Camille and Henry Dreyfus Foundation for both a summer research fellowship and financial support for this project.

## Poster 11

### A Universal Coating for the Modification of Microfluidics

*A. Buga, S. Crowley, and K. Frederick*

*Department of Chemistry, College of the Holy Cross*

Microfluidic chips are desirable because they make it possible to run tests using only a small amount of sample. There are many types of chips varying in composition and price such as expensive glass chips to other types of inexpensive plastics. As microfluidic chip technology is maturing, chips are being produced commercially. There are many factors such as durability and long-term stability that must be considered and examined when producing chips commercially. Different companies and research groups are using chips made out of different plastics which result in varying chip behavior. In order to regulate chip performance, there is a need for a common coating which will allow chips of various materials to yield the same results. We have chosen to study polyelectrolyte multilayer (PEM) coatings, which are alternating layers of positively and negatively charged particles. We are focusing on those composed of alternating layers of the cationic poly(diallyldimethyl ammonium) (PDADMA) and the anionic poly(styrene sulfonate) (PSS). We have tested these coatings on different chips including poly(dimethylsiloxane) (PDMS), poly(methyl methacrylate) (PMMA), and cyclic olefin copolymer (COC). The studies presented here focus on evaluating the coating's long-term stability, the effect of organic modifier in the running buffer and long-term storage.

We thank the Sherman Fairchild Foundation and a grant from the National Science Foundation (NSF) for financial support.

## Poster 12

### X-Ray Bursts of Neutron Star 4U 1728-34

*Michael Fask, Joe Palmieri, and Tom Narita*  
*Department of Physics, College of the Holy Cross*

We observed several X-Ray bursts from Neutron Star 4U 1728-34. From theoretical studies, high energy photons are expected to travel faster than low energy photons under the influence of extreme gravity. We compared high energy and low energy photons at the start of approximately ten bursts. Preliminary results appear to reveal that high energy photons emerge earlier than low energy photons. With conclusive results, we will be able to gain a better understanding of the neutron star atmosphere.

We thank the Massachusetts Space Grant for financial support.

## Poster 13

### Sex and Genetic Effects on Social Interaction in Mice

*Alex Newbury<sup>1</sup> and Jun Xu<sup>2</sup>*  
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*<sup>2</sup>Tufts University Cummings School of Veterinary Medicine, North Grafton, MA*

Autism Spectrum Disorders are characterized by three specific anomalies: aberrant social behavior, deficiencies in communication, and a propensity for repetitive activities. These symptoms can range from mild to severe with males accounting for a majority of the cases. Despite the overwhelming prevalence of Autism in males, there is no published research conducted investigating the sex-specific vulnerability in social behaviors. Using inbred and transgenic mice, we tested juvenile play behavior in 32-day old mice. In this test, interactions (push/crawl, front approach, and nose-nose sniffing) between two stranger mice of the same sex were examined. Any given behavioral sex difference could be potentially attributed to differences between the two sexes in sex hormones (the physiological sex difference between testosterone in males and estrogens in females) or sex chromosomes (the genetic sex difference between XY in males versus XX in females). In order to test simultaneously the two mechanisms, i.e. sex hormone versus sex chromosome complement, we employed the XY<sup>Sry</sup> mouse model. This mouse model contains males and females with either XX or XY sex chromosomes, namely XX female, XX male, XY female, XY male. A two by two analysis was performed on the behaviors tested. We found that XY males and XY females were significantly more likely to engage in frontal approach and nose-to-nose sniffing than XX mice, irrespective to their gonad phenotype. In contrast, sex hormones did not seem to make an impact on these behaviors. This preliminary finding suggests that genes on the sex chromosomes, the X and Y chromosome, may play a role in social interaction in mice.

Supported by a Tufts University seed grant (JX).

## Poster 14

### **Aldosterone and amiloride reduce the rise of intracellular sodium concentration in ouabain-treated MDCK cells**

*M. Sallah and M. L. S. Ledbetter  
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Ouabain is a drug known to inhibit the Na<sup>+</sup>/K<sup>+</sup> pump and intercellular communication through gap junctions. The ouabain-driven increase in sodium is hypothesized to cause the loss of cell-to-cell communication. Treatment with aldosterone or amiloride reverse the effects of ouabain on cell-to-cell communication (as demonstrated by dye transfer) and the surface localization of the gap-junction protein Connexin43 (in immunofluorescence experiments).

Using radioactive <sup>86</sup>Rb<sup>+</sup> as an analog of K<sup>+</sup> allowed us to trace changes in cellular K<sup>+</sup> in response to drug treatments. This should be an indirect way of studying the simultaneous increase in sodium that results from inhibition of the Na<sup>+</sup>/K<sup>+</sup> pump. Ouabain treatment inhibited cellular K<sup>+</sup> by about 90%. Adding aldosterone or amiloride to ouabain-treated cells did not restore normal K<sup>+</sup> levels, however, suggesting that in this case the change in communication is not a result of changing K<sup>+</sup> levels, unexpected since ordinarily Na<sup>+</sup> and K<sup>+</sup> are affected in opposite directions by physiological stimuli.

To measure cell Na<sup>+</sup> in living cells is difficult. We used the indicator dye CoroNa Green, which fluoresces when bound to Na<sup>+</sup>, to estimate directly fluctuations in cellular Na<sup>+</sup>. Cells treated with ouabain exhibited much higher fluorescence than untreated cells, indicating the expected high level of Na<sup>+</sup> when the pump is inhibited. Na<sup>+</sup> levels were reduced, however, when ouabain-treated cells were also treated with aldosterone or amiloride. The former promotes Na<sup>+</sup> exchange while the latter blocks channels that allow leakage of Na<sup>+</sup> into cells from the external medium. These findings support the hypothesis that gap junction communication is highly sensitive to changes in sodium concentration.

We gratefully acknowledge a grant from the National Science Foundation for support of this work.

## Poster 15

### **The Effect of Buffer on the Aggregation of Human- $\gamma$ -C Crystallin**

*Amy Trojanowski and Sarah Petty  
Department of Chemistry, College of the Holy Cross*

Crystallins are soluble, structural proteins found in the lens of the eye. Their aggregation leads to Cataract formation, a condition that affects 50% of people over the age of 65 and is the leading cause of blindness worldwide.

Our experiments focus on Human- $\gamma$ C-Crystallin, the primary sequence of which comprises 14% positively charged amino acids; hence the tertiary structure may be stabilized by buffering anions.

The aggregation of H $\gamma$ C-Crys has been studied using infrared (IR) spectroscopy. The exact frequency of the Amide I band provides information about the secondary structure of the protein, since it is due primarily to the C=O stretching vibration. Our experiments show that as H $\gamma$ C-Crys aggregates, a conversion occurs from soluble globular  $\beta$ -sheet, characterized by an IR band at 1636 cm<sup>-1</sup>, to an amyloidogenic cross  $\beta$ -structure (IR band at 1616 cm<sup>-1</sup>). Temperature, concentration, solvent and pH all play a role in H $\gamma$ C-Crys aggregation, strongly affecting the kinetics of the process.

The solvent environment was varied, exposing H $\gamma$ C-Crys to citrate, malate and acetate buffers. The buffering anion has an effect on the rate at which aggregates form in addition to the amount of aggregate present once equilibrium is reached. It is hypothesized that the three negative charges on the citrate anion stabilize the intermediate on the pathway to aggregation, thus increasing the rate at which aggregates form. In contrast, the larger IR signal at 1616 cm<sup>-1</sup> observed at equilibrium in malate, and indicative of increased amounts of cross  $\beta$ - structure, may indicate that the two negative charges in malate bridge positive charges in the final aggregate conformation, although the kinetics of this transformation were slower.

The author acknowledges financial support from the Becton Dickinson Corporation.

## Poster 16

### **Acute Blockade of the Serotonin Transporter Increased Acoustic Startle Response and Prepulse Inhibition in the Female Mouse**

*Maryann Manatt, Michael J. Dean, Emily Cupelo  
and Daniel Bitran*

*Department of Psychology, College of the Holy Cross*

An absence of pre-pulse inhibition (PPI) can be a major indication of schizophrenia. PPI is a decrease in the startle response to an acoustic stimulus that is preceded by a prepulse of a low intensity. PPI is thought to reflect a sensorimotor gating function that permits selective attentional phenomena. Drugs that affect the serotonin neurotransmitter system have been shown to alter PPI, though not always in a predictable fashion. Moreover, estrogen, a steroid that affects serotonergic neurotransmission in the brain, has also been shown to affect acoustic startle response (ASR) and PPI. Our long-term goal is to clarify the role of serotonin in mediating PPI, and in identifying the estrogen receptor subtype that can modify serotonergic effects on PPI. As a first step, in a randomized repeated measures design, this experiment assessed the effects of a single injection of fluoxetine (0, 10, or 30 mg/kg, IP), a selective serotonin reuptake inhibitor (SSRI), on the ASR to a pulse of 115 dB, and PPI in intact adult female mice. We found that both doses of fluoxetine increased the amplitude of the ASR and also increased the average PPI across prepulse intensities (2, 4, 8, 12, and 16 dB). A closer examination of the data revealed that in mice with a low baseline (vehicle) PPI, fluoxetine did not affect ASR, and that only the low dose of fluoxetine increased PPI. In mice that showed a high baseline PPI response, only the low dose of fluoxetine increased ASR, with no effects at either dose of fluoxetine on PPI. The results show that the effects of fluoxetine on ASR and PPI are dissociable. These data are also discussed in light of the presumed biochemical effects of fluoxetine on the serotonergic system.

This research was supported by funds from the Richard Fisher Fellowships (MJD and EC), and the Sherman Fairchild Foundation (MM).

## Poster 17

### **Sleep Environment, Regular Bedtimes, and Young Adolescents' Sleep Patterns**

*Kledia Spiro, Mary Getz, Julia Amrhein  
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Faculty Sponsor: Amy R. Wolfson*

Presleep routines are an important part of sleep for the young adolescent. Some behaviors may be more relaxing than others, influencing sleep quantity, quality, and hygiene of middle schoolers. Research suggests having a positive bedtime routine and a consistent bedtime improves sleep (Christodulu & Durand, 2004). The current study investigated how in the same bed and having a bedtime sleep/wake patterns. Participants were recruited from 2 public middle schools in an urban, New England city. 7th grade (N = 155) participants were part of a longitudinal study of sleep and daytime functioning. Baseline, students completed the School Sleep Habits Questionnaire, School Day Routine Scale, and Adolescent Sleep Hygiene Scale.

Sleeping in the same bed and having a regular bedtime significantly affected school/weekend night bedtimes, daytime sleepiness, sleep/wake behavior problems, sleep hygiene, and caffeine use. Students who slept in the same bed had earlier school/weekend bedtimes, less delayed sleep schedules, less daytime sleepiness, and used caffeine less frequently in comparison to those who varied where they slept. In addition, maintaining a regular bedtime positively influenced young adolescents' sleep/wake behaviors. 7<sup>th</sup> graders who reported having a regular bedtime had significantly earlier bed/rise times, longer total sleep times, and less delayed sleep schedules on school nights and used caffeinated products less often. Regular bedtimes did not affect sleep patterns. Not surprising, findings demonstrate that young adolescents who sleep in the same bed and have a regular bedtime use fewer caffeinated products, have earlier school-night bedtimes and report less daytime sleepiness and sleep problems.

We thank a grant from the National Institute of Child Health and Development (NICHD) and the Richard Fisher Fellowships (JA and MG) for financial support.



## Poster 18

### Implicit Learning in Cotton-top Tamarins

*L. Radville and T. Cormack*

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*Faculty Advisor: Charles Locurto*

Implicit learning occurs when an individual is repeatedly exposed to patterned information, and without explicit instructions to do so, learns this information. Implicit learning was examined in a group of three Cotton-top tamarins (*Saguinus Oedipus*). During training, a five-element pattern was presented that consisted of the same icon shown serially at different locations on a touch screen. The animals were required to touch each stimulus in the pattern and were rewarded at the end of each five-element pattern. Following training, the tamarins' knowledge of the chain was tested using pair-wise tests, a wild-card test, a running start test, and a random test. These tests assessed factors such as preference for certain stimuli and comprehension of the ordinal position of the elements in the chain.

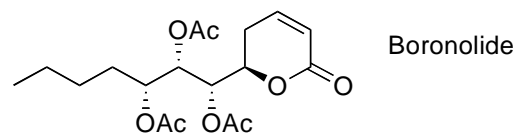
We thank the Richard Fisher Fellowships and a grant from the National Science Foundation for financial support and the New England Regional Primate Research Center for this research opportunity.

## Poster 19

### Synthetic Studies on (+)-Boronolide

*Kevin P. McGrath, John M. Cutro, and Kevin J. Quinn*

*Department of Chemistry, College of the Holy Cross*



Boronolide is a natural product possessing a six-membered,  $\alpha, \beta$ -unsaturated lactone, a structural component of many biologically active natural products. We will describe an efficient approach to the synthesis of boronolide in which asymmetry is introduced by Sharpless asymmetric oxidation reactions. The key step in this approach is a tandem ring-closing/cross metathesis/alkene isomerization in which both lactone formation and side chain appendage are achieved.

Financial support from the American Chemical Society Petroleum Research Fund is gratefully acknowledged.

## Poster 20

### An Infrared Study of Structure in Polyglutamine Aggregates

*Kelly Lyons and Dr. Sarah Petty*  
*Department of Chemistry, College of the Holy Cross*

Huntington's Disease is a neurodegenerative condition resulting in a loss of functional motor skills and decisive abilities. Symptoms of the disease are associated with an expansion of polyglutamine (pQ) at the N-terminus of the Huntingtin protein and its ability to aggregate. Research has shown that age of onset of the disease correlates to the number of glutamines present [1]; the pathogenic threshold is about 35 residues.

The goal of our research is to determine the relationship between protein secondary structure and the length of the pQ. Polyglutamine proteins above and below the pathogenic threshold (pQ43 and pQ32) were expressed fused to a small ubiquitin modifying protein (SUMO) to prevent aggregation. Purification of the proteins was conducted using Nickel affinity chromatography and was confirmed via SDS/PAGE electrophoresis. The protocol for cleavage of the SUMO group was optimized to ensure maximum yields of isolated pQ. The protein was then concentrated; both the pQ32 and pQ43 formed observable aggregates at this time.

Infrared Spectroscopy was used to examine the structure of pQ32 and pQ43 aggregates in the solid phase, in D<sub>2</sub>O and in mixed D<sub>2</sub>O/DMSO solvents. Similar IR bands were seen in D<sub>2</sub>O for pQ32 and pQ43 indicative, in both cases, of disordered and helical structure. In the solid phase, a prominent  $\beta$ -sheet signal was observed for both strands. In mixed DMSO, hydrogen bond disruption resulted in a larger disordered component within both pQ32 and pQ43 aggregates.

The author acknowledges the Sherman Fairchild Foundation for financial support.

1. Nagai, Yoshitaka. *et al. Nature Structural and Molecular Biology* **14** (2007): 332-340.

## Poster 21

### Rhenium Chemistry: Bidentate Complexes to Rhenium Centers

*Americo Gambella and Richard S. Herrick*  
*Department of Chemistry, College of the Holy Cross*

Technetium, in the form of <sup>99m</sup>Tc, is the most commonly used nuclide in diagnostic imaging. Recently, <sup>188</sup>Re has shown potential for possible tumor radiation therapy as a  $\beta^-$  emitter. Rhenium, whose chemical properties closely resemble those of technetium, can also be used as a cold analogue of technetium in the laboratory to test suitable biomolecules and ligand systems for their ability to chelate to the metal.

Unnatural amino acids and dimethyldithiocarbamate are useful ligands to attach to a rhenium metal center as they form neutral systems. The bifunctional agents have nucleophilic atoms which can coordinate easily to the metal rhenium center in a bidentate complex. Once in the human body, they target specific locations. Target-specific agents can be used for imaging or as a radiopharmaceutical in different areas of the human body. Different unnatural amino acid ligands were studied with different functional groups off the  $\alpha$ - carbon. As the number of natural amino acids is limited, to further the study in this area we have conducted research with unnatural amino acids such as aminocyclopentane, aminoisobutyric acid, and  $\alpha$ -methyl phenylalanine. Dimethyldithiocarbamate was also studied as a bidentate ligand with the ternary organophosphorous ligand 1,3,5-triaza-7-phosphadamantane (PTA) attaching as the sixth ligand.

Future work in this area can include varying the sixth ligand of water in the unnatural amino acids. Other syntheses will be to attach pyridine, N-Methyl Imidazole, thiocyanide, and tert-butyl cyanide.

We thank the Sherman Fairchild Foundation for financial support.

## Poster 22

### Geometry of Clairaut Metrics

*James M. Antonio and Prof. Andrew D. Hwang*  
*Department of Mathematics and Computer Science*  
*College of the Holy Cross*

Let  $M$  be a real differentiable manifold and let  $\langle \cdot, \cdot \rangle_p$  define an inner product on the tangent space  $T_p M$  at every point  $p \in M$ . The set of all inner products on  $M$  is called the *Riemannian Metric*. A manifold equipped with a Riemannian metric is all that is needed to define geometric notions such as angle and arclength. Now, let  $U \subset \mathbf{R}^2$  be a parameter domain equipped with metric tensor  $g = Edu^2 + F(du \otimes dv + dv \otimes du) + Gdv^2$ . In general, geometric conditions may be expressed as partial differential equations.

Sometimes, special coordinate systems expedite calculation of things like curvature and geodesics. Our project focuses on a special class of Riemannian metrics called *Clairaut Metrics*, where  $E$  and  $G$  are functions of one variable and  $F=0$ . Our study has resulted in a theorem that classifies geodesics on  $U$  equipped with a Clairaut metric. Furthermore, the Gaussian curvature of a metric in *action-angle* coordinates ( $EG=1$ ) is given by an easy formula. In particular,  $g$  has constant curvature if and only if  $G$  is a polynomial of degree at most 2. For constant curvature Clairaut metrics in action-angle coordinates, the geodesic equations are completely integrable in elementary terms.

Finally, translation in  $v$  is obviously an isometry of a Clairaut metric. Can the intrinsic geometry of  $(U, g)$  be isometrically immersed in  $\mathbf{R}^3$  so that translation in  $v$  is realized by one-parameter group of ambient isometries? Subject to an inequality, the answer is yes. This has resulted in another theorem and the construction of *pasta surfaces*.

We gratefully acknowledge the Richard Fisher Summer Research Fellowship for funding this project.

## Poster 23

### Effects of NaCl Concentration During Sporulation on Properties of *Bacillus subtilis* Spores

*K. Riddle with Peter Setlow*  
*Department of Molecular, Microbial, and Structural Biology*  
*University of Connecticut Health Center*

Although already thoroughly studied, there is still much to learn about *Bacillus subtilis* spores and their properties. One area that was further explored was the effect of preparing *B. subtilis* spores in varied concentrations of NaCl. *B. subtilis* spores were prepared twice in 0, 0.5, and 1.0 M NaCl on plates and in liquid, resulting in duplicate preps of 6 different spore types. Several tests were run with these spores including germination with L-alanine, AGFK, and with dodecylamine, spore viability, and wet heat resistance. Results show that germination in L-alanine, AGFK, and dodecylamine was similar for spores prepared at varied NaCl concentrations, and the viability of these spores was also similar. Finally, increase in the NaCl concentration during spore preparation did not seem to greatly affect the spore wet heat resistance.

Thanks to the University of Connecticut Health Center for financial support.

## Poster 24

### Building and Testing a Lock-In Amplifier

*Miguel Juarez '09 and Professor Paul Oxley  
Department of Physics, College of the Holy Cross*

The lock-in amplifier is a versatile electronic device that is used in a wide range of physics experiments. It can detect, isolate, and amplify very small AC electrical signals that may be buried in substantial amounts of electrical noise.

We have carefully planned out, constructed, and tested a compact lock-in amplifier with readily available electronic components. When connected together, six types of circuits, which we have designed and built, make up our lock-in amplifier. They include the following: an AC amplifier, a phase-shifter, a mixer, low-pass and high-pass filters, and a DC amplifier. These circuits have been tested both individually and collectively, and they performed as expected.

Our lock-in amplifier has been used to stabilize the frequency of a diode laser to an electronic transition in lithium. Its performance was comparable to that of a commercial lock-in amplifier, though our amplifier costs significantly less than a commercial unit.

In this presentation, we provide a thorough overview of how, in principle, a lock-in amplifier works. We also supply details of the circuits that we have built and tested that, together, make up our lock-in amplifier.

This project will develop further into a College Honors thesis that will discuss how the signal from our lock-in amplifier can be fed back to a diode laser in order to stabilize its frequency to a transition in the iodine molecule.

We are very grateful to the Richard Fisher Summer Student Research Fellowship Fund for its financial support and to the Holy Cross Summer Research Program for making our work possible.

## Poster 25

### Elliptic Curves: Groups, Fields, and Cryptography

*S. Frechette and J. Madore  
Department of Mathematics & Computer Science  
College of the Holy Cross*

Cryptography has become increasingly important in our information-driven society. The efficient and secure exchange of information over insecure channels is important for military and government communications, as well as the transfer of sensitive personal and financial information. As older methods of information security become outdated, new methods are needed to keep pace with developments in cryptanalysis. One class of modern cryptosystems involves elliptic curves.

An elliptic curve  $E$  may be defined by an equation of the form  $y^2 = x^3 + ax^2 + bx + c$ , with  $a, b, c$  integers. The set of points with rational coordinates on an elliptic curve forms an abelian group. Its *torsion subgroup* contains all the points of finite order. Similarly, the points on an elliptic curve defined over a finite field  $F_p$  form a finite abelian group. This group, denoted  $E(F_p)$ , is useful for elliptic curve cryptography.

Specifically, using the group structure of  $E(F_p)$ , we can encode messages by embedding a message in the  $x$ -coordinate of a point on the curve. Messages are then encrypted by performing certain operations with points on the curve. The strength of these cryptosystems lies in the difficulty of the elliptic curve discrete logarithm problem. In our research, we explored the use of elliptic curves in ElGamal encryption schemes, the security of elliptic curve systems in comparison to RSA, the use of digital signature verification schemes, and the speed of encryption compared to RSA. For future research, we plan to continue these studies and examine speed improvements for elliptic curve systems offered by Edwards coordinates and Inverted Edwards coordinates.

With thanks to the Richard Fisher Fellowship for financial support.

## Poster 26

### **An Examination of Excess Endowments at Private Liberal Arts Institutions**

*K. Sweet, K. Teitel and R. Baumann  
Department of Economics, College of the Holy Cross*

College endowments have been called into question lately due to the high tuition rates and lack of student aid. Since institutions aren't making payouts, the question has arisen, where is all of this money going? The Senate Committee on Finance has begun its own inquiry into excess endowments; however they have yet to find any prominent results. Our model begins to examine these excess endowments and possible explanatory variables.

Prior research regarding excess endowments has been previously conducted; however, this research mainly focuses on not-for-profit organizations as a whole rather than colleges and universities specifically. The most prominent research has been conducted by Core, Guay and Verdi (2006) who consider the relationship between excess endowments and agency problems, citing three possible explanations for the existence of excess endowments in not-for-profit firms: growth opportunities, monitoring and agency problems.

Our model begins to examine these excess endowments and possible explanatory variables. The data set follows the Carnegie 200 from the year 2000 over the years 1997-2005. It includes 1,306 observations and schools from 34 different states. First, we replicate the Core, Guay and Verdi study, applying this model of nonprofit excess endowments to private liberal arts colleges. Future research includes adapting the model to better suit the data set, using different means to measure endowments, eliminating access to debt and replacing it with level of debt, and including other variables such as religious affiliation, endowment per student, age of school and the U.S. News and World Report college ranking.

We thank the Richard Fisher Fellowship for supporting this research.

## Poster 27

### **How Do Professional Sports Franchises Affect Housing Values?**

*Katherine Kiel, Associate Professor, Victor Matheson, Associate Professor  
and Christopher Sullivan, Class of 2009  
Department of Economics, College of the Holy Cross*

In the last twenty years, stadium building has become a billion dollar industry. Proponents on both sides have argued whether public subsidization of these projects is justified economically. Researchers have tried to find direct economic benefits but have been unable to prove any strong connection. Recently, research has focused on indirect or quality of life effects of a franchise, hypothesizing that sports franchises make a city more attractive to live in and therefore raises the value of houses in the city.

In our research we look at all four major sports leagues in the US: Major League Baseball, National Football League, National Hockey League, and National Basketball Association. Studying housing values in major U.S. cities during the period of 1985 to 2005, we test whether the presence of franchises affects the value of houses, while controlling for time, house, and city specific variables.

This research is important in determining whether cities are financially justified in subsidizing the cost of stadium construction in trying to lure franchises to their city. Our preliminary results show that the presence of an NFL franchise in a city increases housing values, while the presence of an NBA or NHL franchise hurts housing values in a city. The presence of an NHL franchise does not have a statistically significant affect on housing values.

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

## Poster 28

### The Present State of China's Banking Sector

*Professor Thomas Gottschang and Eric Wester Class of 2009  
Department of Economics, College of the Holy Cross*

Reforms to China's banking system began in the late 1970s by separating the function of creating monetary policy from the function of lending. Reforms accelerated in the 1990s when China transformed the four largest state-owned banks into commercial institutions. New commercial banks with joint private and state ownership were also created during this era. Drastic changes continued in December 2001 when China joined the World Trade Organization. Accession hinged on China liberalizing many segments of its economy, and the agreement included a five-year program to open up the banking sector. Due to this agreement, foreign banks may now offer complete services in the local currency (renminbi), which has allowed them to become full-scale competitors with domestic banks.

The changes in the banking sector are far from complete, but we attempted to provide a description of its current form. Much of the literature focuses on the potential impact of foreign bank entry into the market, so we researched foreign banks that are currently operating in China in order to determine their offerings and the size of their operations. Additionally, we investigated the services of domestic banks, both state-owned and joint-stock. We wanted to discover how their operations have changed in the recent years; specifically, we researched the availability of mortgages and credit cards, both of which are relatively new products. State-owned banks still dominate the sector, but they have taken significant steps towards acting commercially and providing new services. Foreign banks, on the other hand, remain minor figures, and it is unclear whether they will ever become true challengers for the market share of domestic banks.

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

## Poster 29

### Copyright Protection for the Visual Arts

*Melissa Boyle, Assistant Professor  
Debra O'Connor, Assistant Professor  
Stacy Nazzaro, Class of 2010  
Department of Economics, College of the Holy Cross*

In 1990, the Visual Artists Rights Act (VARA) was passed in the United States. This law added to copyright law the rights of attribution and integrity, under which an artist can claim authorship of a work and protect the work from future alterations. It was the result of the United States' new membership in the Berne Convention, an international copyright treaty between nations that required member countries to pass a minimum level of moral rights legislation.

In order to study the economic efficiency of VARA, we will empirically test the economic effects of state-level moral rights legislation before VARA. Landes (2001) predicted that these laws would harm artists because of contracting costs and lowered demand for artwork that cannot be changed in any way. Landes (2001) empirically tests this hypothesis using cross sectional data, but does not produce significant results. We will use a more controlled method to test these same predictions. Using 1980 and 1990 US Census data and a difference-in-difference regression strategy, we test the effect of moral rights legislation on artist income, artists per capita, and art expenditures. We also regress the moral rights variable on state characteristics in order to determine the types of states that pass these laws. To perform a similar analysis with individual-level data, we use Current Population Survey data in a triple difference regression. This regression controls for in-state effects of the labor market, in addition to time fluctuations. With these controls, we find that artists in states with moral rights laws after the laws are passed will earn significantly less income.

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

### Poster 30

#### Forensic Economics and Assessing Personal Injury and Wrongful Death Damages in New Hampshire

*David Schap, Professor and Kevin Meives Class of 2009  
Department of Economics, College of the Holy Cross*

Forensic economists apply economic principles and methods to calculate pecuniary damages in personal injury and wrongful death actions (in addition to other areas of litigation). Courts or litigants often hire them to provide expert testimony and reports describing the nature and extent of the damages owed to the plaintiff, with their testimony helping to form the basis of the jury's verdict. The rules and standards governing what damages are recoverable and in what way, however, vary from state to state. Forensic economists, naturally, must hew to the standards of the states in which they are testifying when producing their reports. In an effort to make the process easier, other researchers have studied the case law and statutory law of certain states and compiled the information in a series of articles. We have done the same for New Hampshire, and will expand on our research by examining law review articles and New Hampshire's civil jury instructions.

To provide a representative example, lost earning capacity is a principle element of damages for wrongful death actions in New Hampshire. Forensic economists will examine the decedent's prior work experience, disposition to work, and probable earnings—to name just a few of the relevant factors—in order to assess the amount of damages owed to the decedent's estate. Some states, New Hampshire among them, require that this award be discounted to its present value (to account for interest which will accrue over time); others do not. Thus, forensic economists must use the tools of economics in accordance with the rules of the state to make their calculations.

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

### Poster 31

#### The Structure of Acquisition in Aged Mice

*Taylor Cormack and Laura Radville  
Faculty Sponsor: Dr. Charles Locurto  
Department of Psychology, College of the Holy Cross*

Previous studies conducted in our lab have shown that in many types of learning tasks, mice performed as well at 18 months as at 3 months. The one exception was in a working memory task, where mice retested at 18-months performed worse than they had when first tested at 3-months. This finding suggests either an age effect, or perhaps an effect of proactive interference. As an extension of that prior study, we attempted to determine the reasons for the discrepancy between naïve and retested mice.

Our study explored the age-related deficit in working memory. To determine the cause of this deficit, we developed a battery of three tasks through which we ran a colony of 12-month old mice. These tasks were the Detour task, Win-shift task, and Four Arm task. Half of this colony had been previously run through a similar battery at the age of 3 to 4 months. Our design exposed our test mice to two working memory tasks, one they had experienced before at 3 months and one new task. They also received the detour task, a measure of reference memory, which they had also experienced at 3 months.

We thank the Richard Fisher Fellowships and a grant from the National Science Foundation for financial support.

### Poster 32

#### **Murine model antibody response during intranasal colonization by *Streptococcus pneumoniae***

*Aaron Goodwin (College of the Holy Cross), Nang Maung (University of Massachusetts Graduate School of Biomedical Sciences), John Leong (University of Massachusetts Graduate School of Biomedical Sciences)*

*Streptococcus pneumoniae* is responsible for approximately 1 million deaths every year, mostly children in developing countries. Most infected individuals, however, are able to control infection, because *S. pneumoniae* naturally colonizes the upper respiratory tract of roughly 40% of the population asymptotically. To better understand the immune response elicited by asymptomatic infection, mice colonized by nasopharyngeal inoculation were analyzed for pneumococcus-specific IgM and IgG in the blood. To determine if this immune response was protective, the mice were challenged by intraperitoneal infection. We were able to determine the titer of antibodies produced after asymptomatic infection and later lethal challenge.

Source of funding: University of Massachusetts Chancellors Challenge Fund.

### Poster 33

#### **The Impact of Unemployment, Income and Poverty on Crime**

*Robert Baumann, Assistant Professor  
Department of Economics, College of the Holy Cross  
Chihiro Muroi, College of the Holy Cross (Class of 2009)*

The correlation of crime with unemployment, median income, and poverty have been studied by many economists but there is no consensus. It has been established theoretically that wealth (as measured by median income, poverty rate, and unemployment) and crime have a negative relationship, e.g. more wealth, less crime. This is caused by low wages from working which makes crime more appealing. Using two types of crime and three proxies for wealth, we estimate the relationship between wealth and crime and find the effect of wealth on crime is not always negative. In most cases, the effect of wealth could be positive or negative depending on the level of wealth. In general, the negative effect of wealth on crime only holds for rich counties. This may be because of lower reporting rates in poor areas.

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



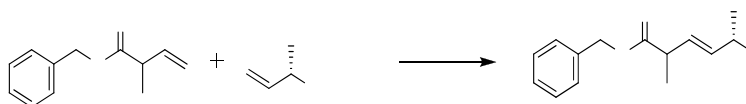
## Poster 34

### Formation of Peptide Isosteres Via Olefin Cross Metathesis

*Jennifer Beaudoin & Bianca Sculimbrene*  
*Department of Chemistry, College of the Holy Cross*

Molecules that mimic other molecules in their three dimensional structure, but differ in their electronics are known as isosteres. A common isostere of the amide bond found within peptides is a trans-alkene. Peptide isosteres allow one to better understand specific chemical interactions such as hydrogen bonds, in a pharmacological setting.

Our focus is to synthesize a peptide isostere through using olefin cross metathesis. The key cross metathesis step utilizes a carboxy terminus (C-terminus) and an amino terminus (N-terminus). We are particularly interested in synthesizing the alkene peptide isostere for the D-ala-D-ala peptide sequence, in order to study the interactions of Vancomycin, a last resort antibiotic. The C-terminus is formed in two steps, whereas the N-terminus is generated in four steps from commercially available materials. Significant time has been spent optimizing the synthesis of the N-terminus. With the completion of the synthesis of both termini, attention will now focus on the key cross metathesis step.

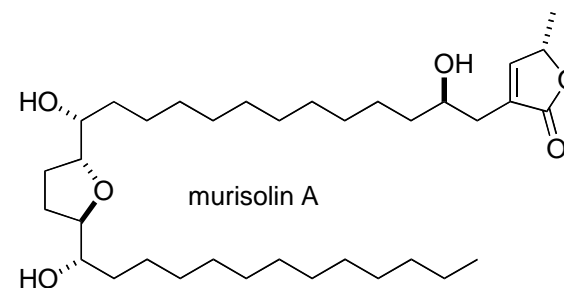


Thanks to the Becton Dickinson Corporation for financial support.

## Poster 35

### Efforts Towards a Convergent Synthesis of Murisolin A

*Brendan L. Mackinson, Stacy A. Powell and Kevin J. Quinn*  
*Department of Chemistry, College of Holy Cross*



Murisolin A is a natural product belonging to a class of compounds known as Annonaceous acetogenins. Murisolin A is known to be biologically active, exhibiting specific cytotoxicity against several different cancer cell lines. We will outline a convergent synthesis of murisolin A in which the carbon backbone is constructed in an efficient route via multiple cross metathesis reactions and ring formation is achieved by oxidative cyclization. This modular route should provide ready access to murisolin A and analogues for biological testing.

Financial support from the Becton Dickinson Corporation is gratefully acknowledged.

### Poster 36

#### Small molecule modeling of protocatechuate 3,4-dioxygenase

*J. Niconchuk, T. Fussell, E. Yoon and J. Farrell*  
*Department of Chemistry, College of the Holy Cross*

We are continuing our work using Mannich condensations to build a library of new aminoalcohol ligands. Mannich condensations are multi-component reactions that combine primary or secondary amines, formaldehyde, and in our case a disubstituted phenol to make new C-C and C-N bonds. We have expanded our project to include 1,4-diaminobutane as the amine starting material in order to study the effect of the carbon chain length of the starting material on the final product distribution. Using this new starting amine we are reporting the synthesis of five new compounds to add to our library of ligands.

We also continued work in the analysis of the reactivity, electrochemistry, and spectroscopy of our Fe(III)-ligand complexes. These small molecules have been shown to both structurally and functionally model the enzyme protocatechuate 3,4-dioxygenase, an intradiol catechol dioxygenase which performs a vital role in the bacterial degradation of aromatic compounds. By varying the steric and electronic properties of the starting ligand (DCDM, DCDTB, DMDTB, and DMDM) we can observe differences in the spectroscopic and electrochemical data for the four complexes. We would like to continue expanding the library and varying the starting ligand to observe further variability and better model the structure and activity of the enzyme.

We thank the Research Corporation for financial support.

### Poster 37

#### Regional examination of cirque patterns and distributions, Glacier National Park, Montana, USA

*N. Shea and S.G. Mitchell*  
*Department of Biology, College of the Holy Cross*

For some mountain ranges that are high enough to be glaciated, the altitude of peaks appear to be limited to a certain height above the glacial equilibrium line altitudes (ELAs). This phenomenon, called the “glacial buzzsaw,” exists because glacial erosion is thought to be highly effective above the ELA. To test for this phenomenon at Glacier National Park, Wyoming, USA (GNP), I used an integrated Geographic Information System (GIS) to identify 96 cirques, bowl-shaped landforms created by glacial erosion, to use as proxies for past glacial ELAs. I then overlaid the cirque data points with altitude, precipitation, geology, and current glacial extent data sets to search for the patterns which would indicate that glaciers are limiting peak altitudes. The presence of a buzzsaw is typically indicated by cirques receiving increasing amounts of precipitation at decreasing altitudes, the opposite of which is found at GNP. The results revealed that the position of cirques do not correlate with altitudes of glaciers or peaks, indicating that other environmental factors such as wind or underlying bedrock geology may be altering the expected locations of glaciers and thus producing an irregular pattern of cirque formation. 51% of the cirques are located on NE (downwind) sides of ridges, indicating that windblown snow is creating more erosive glaciers on those leeward slopes. An equation which models snow accumulation zones was compared against actual glacial extent to observe the effects of wind-blown snow on ELAs. These results show that not all glaciated mountain ranges are clearly limited in height by glacial erosion. Minor influencing factors such as wind-blown snow can affect glacial mechanics in such a way to make the resulting landforms (e.g., cirque and peak altitudes) not follow expected trends.

We would like to thank the Richard Fisher Fellowship for financial support.

### Poster 38

#### **The Role of Gesture in Lexical Retrieval: Does Gesturing Make a Difference?**

*Pamela Doig, '09*  
and *Samantha Grossmith, Wellesley College, '11*  
Advisor: Professor Jennie E. Pyers,  
Department of Psychology, Wellesley College

Gesturing appears to be entwined in most, if not all, forms of speaking. Little is known, however, to what extent gesturing actually allows the speaker to retrieve a desired word. Previous studies have found mixed results, which stem from various methodological problems within the studies. To remedy these discrepancies, we attempted to experimentally control for some of the confounds observed in previous studies in order to examine whether gesture aids in word retrieval.

In the current study, 40 undergraduate participants (39 F, 1 M) ranging from the ages of 18.15 to 23.01 (years; months) were randomly assigned to two groups: "Gesture Allowed" (GA) and "Gesture Inhibited" (GI). The GA group was allowed to gesture, while the GI group was inhibited from gesturing by placing their hands in gloves attached to a board. All participants were shown 52 pictures consisting of low frequency target words, likely to elicit "Tip of the Tongue" (ToT) experiences. We predicted that those in the GI condition would retrieve fewer words and have more ToTs than those who were allowed to gesture. We found that the two groups did not differ in the number of correct retrievals or the number of ToTs. However, those who were allowed to gesture were more likely than those in the GI condition to resolve their ToT states, eventually retrieving the correct word. Our findings indicate that gesturing plays a very specific role in helping us resolve ToT experiences.

Funded by the Office of the Dean of the College, Wellesley College and the Council for Undergraduate Research, Summer Research Fellowship in Psychology.

### Poster 39

#### **Standardized Method for the Screening of Packaging Materials for Extractables Using Thermal Desorption GC/MS**

*Patricia Gumbley*  
*College of the Holy Cross*  
*Everett Wilhelm*  
*Pfizer, Inc. Groton, CT.*

Packaging materials for products and devices are changed up to a thousand times a year by Pfizer Global Manufacturing, requiring time consuming and costly extractables and leachables studies to ensure that compounds do not leach from the material into the product at levels that alter the safety, purity, or efficacy of the drug.

An efficient and inexpensive method for screening packaging materials for extractables using thermal desorption GC/MS was developed as a way for Pfizer to complete these screenings quickly. In addition to a set of standardized conditions, a user library of common additive standards was developed as a tool to be used to identify unknowns encountered during screening.

We thank the Pfizer, Inc. for financial support.

## Poster 40

### The Development of a Portal Preconcentrator and a Quartz Ion Mobility Spectrometer

*L. Kopsick and J. Kelley*

*Department of Chemistry, College of the Holy Cross*

The core of our research this summer has been aimed at the detection of trace amounts of drugs and explosives. While constructing many devices, the development of a portal preconcentrator and an Ion Mobility Spectrometer (IMS) were most important. After testing a person in the portal, the contaminated sheet of steel mesh needs to be removed and placed within the preconcentrator. This is the most important step of the portal process for it is here where the molecules are vaporized before being sent to the IMS. While constructing the preconcentrator, the minimization of volume was the most important factor because the gas vapor needed to be concentrated with the molecules of drugs and/or explosives. The vapor is then pushed to the IMS. If the vapor is concentrated, the size of the signals should increase and be clearer. Our previous IMS was assembled from Teflon rings alternating with steel rings and then finally wrapped together with Teflon tape. The problem with this model is that a signal would appear on the oscilloscope upon the firing of the laser even when no analyte was present within the IMS tube. It appeared that the laser was ionizing the walls of the IMS. However, once the analyte entered into the IMS tube, two signals would be present. Therefore, it was crucial to remove the first signal and start out with a baseline across the oscilloscope. We managed to construct an IMS using a quartz tube, copper tape, and resistors. The copper tape was wired to produce a decreasing electric field to guide the ions down the tube towards a detector plate. Without any analyte present in the tube, we were able to successfully produce a baseline without any signals.

We thank the Sherman Fairchild Foundation for financial support.

## Poster 41

### *mor* 2.0 - Automation of Phylogenetic Analyses

*T. Heider*<sup>1</sup>, *C. Ha*<sup>2</sup> and *D. Hibbett*<sup>3</sup>

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

<sup>2</sup>*Department of Computer Science, Clark University*

<sup>3</sup>*Department of Biology, Clark University*

With the exponential growth of biological information, it is increasingly common that new information surfaces before analyses of that information can finish. To account for that growth, it is essential to automate these analyses. One area challenged by this problem is the classification of an organism through its DNA. To meet this need, *mor* was developed as a modular software package to glue together phylogenetics programs (such as MAFFT and PAUP\*) for studying a class of mushroom-forming fungi called Homobasidiomycetes.

*mor* was enhanced with the addition of three new functions (*morMatches*, *morBlast* and *morCluster*) and a new database structure. The *morCluster* function provides a method of analyzing highly variable genes by clustering sequences based on similarity to a reference sequence. *morBlast* is a web-accessible tool that allows users to BLAST the *mor* LSU and ITS databases to find similar sequences. The *morMatches* script detects same species or specimen connections between sequences in multigene data sets. The new database was based off of a GenBank flat file.

These scripts provide tools for studying the environmental diversity of a location, and studying the evolutionary relationships using multigene datasets. *mor* is not limited to analyzing Homobasidiomycetes, it can be set up for any organism and gene.

We thank the National Science Foundation for financial support.

## Poster 42

### Correlation Studies in PGS/IPFL Counterfeit Viagra Internet Investigations

*Emily Samartino and Amy Callanan  
AS&T/IPFL, Pfizer Global Manufacturing*

I worked with the IPFL group at Pfizer to assist the Pfizer Global Security in an internet survey that is being conducted to ensure the products distributed through online sources are authentic. My project focused on validating the Near Infrared Spectroscopy technique as an efficient way to test for counterfeit drug products.

Through testing done on the dosage forms and the actual packaging, I was able to identify the counterfeit products from authentic using NIR. The information was validated through the IR technique that is currently used in the lab. The data shows that IR can be used to test samples entering the lab and that packaging can be tested analytically instead of using only physical evaluations.

My project also focused on looking at a set of counterfeit products that were sent to the lab that displayed similar characteristics. I tested these samples in an attempt to connect them back to a single distributor. Pfizer Global Security is now using this information to accurately identify the sources of counterfeit products.

I would like to thank Pfizer, Inc., for financial support.

## Poster 43

### Rhenium Chemistry: The Use of Dioxime Compounds as Bidentate Ligands

*Harun Rafi and Richard S. Herrick  
Department of Chemistry, College of the Holy Cross*

Technetium Chemistry has been studied by inorganic chemists because it is the most commonly used element in diagnostic imaging scans. In our lab, Rhenium chemistry has been studied because the two elements are in the same group and the lanthanide contraction, means that rhenium can be studied in place of the radioactive technetium. Recently,  $\beta^-$ -emitting nuclides of rhenium are becoming readily available and have suitable properties that enable the possible development of compounds to be used for tumor radiative therapy.

The chemistry of rhenium compounds with bidentate ligands was explored using a [2+1] methodology. The major advantage of using a bidentate ligand over a tridentate ligand is that a wide range of possible combinations are available and they are available commercially with minor synthetic modifications.

Dimethylglyoxime was attached to  $\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3^+$  by heating the solution at reflux in water for 5 minutes. After this step, the 6<sup>th</sup> ligand was added into the solution. Various 6<sup>th</sup> ligands used include: Iodide, Bromide, Chloride, pyridine, N-Methyl Imidazole, t-butyl isocyanide, triphenylphosphene, and PTA, a strongly binding phosphine. We also attached different glyoxime compounds to the metal. These bidentate compounds include 2-syn-pyridinealdoxime, pyridylamidoxime, diphenyl glyoxime, and dihydro-glyoxime. Future work in this area will include attaching Di-2-pyridyl ketone oxime. Our spectroscopic characterization has led us to believe that we are making the desired products, but we are awaiting crystals to be solved using X-ray crystallography for full confirmation.

We thank the Research Corporation for financial support.

## Poster 44

### Older Men and Heart Health

*Stefanie Tedesco and Katie Guardino*  
*Department of Sociology, College of the Holy Cross*  
*Faculty Advisor: Ed Thompson*

Although much has been published regarding older women's health, in the form of comprehensible articles and books, which carefully guide women towards aging gracefully, very little literature of this type is accessible for older men. In a society where men are pressured to live up to a standard of masculinity that details projecting an image of strength, risk taking, and independence, older men often find themselves in poorer health than women. The masculine ideals that continually govern what a "real man" takes part in have been proven to be counteractive to seeking medical help. Keeping this in mind, our research gathered information about men's physiological, biological, and psychological aging, and we framed these data in terms of men's continuing experiences with masculinity expectations. This work contributes to a book on older men's health.

Our poster focuses on older men's heart health, detailing the lifestyle habits that put men at risk for cardiovascular problems as they age. We present an overview of major cardiovascular events in later life, including arteriosclerosis, heart attack, heart disease and heart failure, and the older male's distinct experience with such problems. But more importantly, we focus on identifying the corrosive masculinity ideals we found to be active agents in lowering men's life expectancy. In response to the evidence that older men either ignore their heart health or lack a comprehensive source for learning about heart health, we present this detailed review of current research as an attempt to inform and, we hope, reduce the likelihood of heart problems as men age. Our contribution aims to make health, in general, a priority for men just as it is for women.

We thank the Richard Fisher Fellowship for financial support.

## Poster 45

### Synthesis of Amino-Phenol/Thiophenol Ligands

*T. Fussell and J. Farrell*  
*Department of Chemistry, College of the Holy Cross*

This summer, we worked on expanding our library of novel amino-phenol and amino-thiophenol ligands. Toward the goal of increasing the steric bulk and solubility of the compounds we have been working with, we investigated the utility of 2,4-di-tert-amylphenol in Mannich reactions. Using a variety of diamine starting materials (ethylenediamine, 1,3-diaminopropane, 2,2'-dimethyl-1,3-propanediamine, 1,4-diaminobutane), we examined chain length's role in product determination. By altering the stoichiometry, chain length, and reaction conditions, we were able observe formations of diphenols, tetraphenols, benzoxazines, and hexahydropyrimidine ring systems. The compounds were characterized using  $^1\text{H}$  NMR,  $^{13}\text{C}$  NMR, melting point, FTIR, elemental analysis, and High Resolution Mass Spectrometry. In all, eight novel compounds were produced and characterized over the past ten weeks.

In the upcoming academic year, we plan on using these new ligands to model the active sites of metallo-enzymes and proteins.

We thank the Sherman Fairchild Foundation for financial support.

## Poster 46

### **Evaluation of Coating Performance in Capillary Electrophoretic Separations by Monitoring Electroosmotic Flow**

*S. Crowley and Prof. K. Frederick  
Department of Chemistry, College of the Holy Cross*

Capillary electrophoretic (CE) separations have played a key role in the Human Genome Project, helping to map out the genes of the human genome much more quickly and effectively than expected. Now CE separations are being applied on a wider scale, but these separations are plagued by inconsistency from capillary to capillary due to numerous factors. One method to address this problem is to apply a coating on the inner wall of the capillary, thereby regulating the flow of liquid through the capillary known as the electroosmotic flow (EOF).

As CE is employed more and more, a means of quality control in pre-coated capillaries is necessary. To do this, we have monitored the electroosmotic flow during the coating procedure and correlated this flow profile to separation performance.

A fused silica capillary was modified with an UltraTrol® pre-coating thereby suppressing the EOF. The changing EOF was monitored to establish a coating profile. A fluorophore test mixture was used to establish whether or not similar coating profiles yielded similar separations in different capillaries. Similar coating profiles were observed in different capillaries, suppressing the EOF to around  $50 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$  consistently.

In capillaries that exhibited dissimilar coating profiles, the retention times of the fluorophores varied as much as 30%. However, in similarly coated capillaries, the EOF observed after an UltraTrol® coating was found to have a difference of around 6%. This corresponded to the observed difference in the retention times of the fluorophore separation mixture, suggesting that similar coating profiles do in fact yield similar separations.

We thank the National Science Foundation for financial support.

## Poster 47

### **The Physics of Baseball: Building the Drag Coefficient vs. Reynolds Number Curve**

*J. Singleton, Z. Donahue, K. Sullo, T. Morell, and M. Koss  
Department of Physics, College of the Holy Cross*

A baseball flying through the air experiences 3 major forces: the lift force, the drag force, and the gravitational force. While the gravitational force is easy to measure, the other two forces are dependant on many other factors including the ball's velocity, the properties of the air it is moving through, and the way the ball is rotating. These factors vary at every point of the ball's trajectory, making the lift force and drag force very difficult to measure. In our model of a batted baseball we use the Reynolds number to calculate the coefficient of the drag force. The Reynolds number describes how an object is going to act in the fluid it is traveling in (in our case a baseball in air).

We know that the drag coefficient is directly related to the Reynolds number, and there are many theories about what this curve may look like, but there is little experimental evidence proving the shape of this curve. One of the projects the Physics of Baseball Team has worked on this summer was to extract this curve from images of a baseball being shot from a pitching machine.

From the images we found equations estimating the position of the ball depending on time. We were then able to find the forces on the ball and extract the drag coefficient and Reynolds number. So far our results are consistent with the curve we are using in our model, which is a hybrid of a variety of theories from different studies.

We would like to thank the Massachusetts Space Grant Consortium (KS and MT) and the Richard Fisher Fellowships (JS and ZD) for financial support, as well as Diane Jepson and Richard Miller for help with supplies and equipment.

## Poster 48

### Hiatal Hernia Repair at the Initial Laparoscopic Adjustable Gastric Band Operation and its Effect on Gastroesophageal Reflux Disease Symptoms

*Ela Banerjee, Dr. Papasavas  
Hartford Hospital*

*Introduction:* Laparoscopic Adjustable Gastric Band (LAGB) is a commonly performed weight-loss surgery. It involves placing a silastic band around the top part of the stomach. Presence of hiatal hernia may complicate placement of LAGB and lead to band slippage. The purpose of this study is to examine the sensitivity of barium esophagram in identifying hiatal hernias preoperatively and to examine if repairing hiatal hernias at the time of LAGB reduces GERD symptoms and GERD medication use after surgery.

*Methods:* Retrospective chart review study on all patients undergoing LAGB at Hartford Hospital and prospective phone interview on patients with hiatal hernia repair.

*Results:* 421 patients underwent LAGB from 2005-2008. The mean weight and BMI were 283.4 kg and 47.1 kg/m<sup>2</sup>, respectively. Complete data were available for 403 patients. Preoperative barium esophagram was positive for hiatal hernia in 29% of patients; however, during surgery 50% of patients were diagnosed with hiatal hernia and underwent laparoscopic repair. 102 patients with hiatal hernia repair were contacted after surgery and 73.5% reported improvement in their GERD symptoms.

*Conclusion:* Preoperative barium esophagram is not sensitive for diagnosing hiatal hernias in morbidly obese patients. Hiatal hernia repair at the time of LAGB helped reduced GERD symptoms.

## Poster49

### Investigations of Collinear Central Configurations

*Shea Sennett and Prof. Gareth Roberts  
Department of Mathematics, College of the Holy Cross*

The n-body problem is one of the classic problems of celestial mechanics. The problem deals with an arbitrary number of masses located in space in any arrangement and their ensuing interactions according to Newton's law of gravitation. As more bodies are added, the n-body problem becomes more difficult to solve. We focused on a particular solution to the n-body problem called a collinear central configuration (c.c.c) where the n bodies are lined up in a special manner.

While a c.c.c is a special solution of the n-body problem, well known examples exist. The first solution we focused on was the three-body c.c.c. We found that the three bodies lined up on the line proportionally by their masses. The more varied the masses, the more varied the distances between the bodies were. Using Maple, we wrote a program for three-body c.c.c.'s demonstrating how the configurations change with the masses. From this, we found that solutions exist for any choice of positive mass for each of the bodies.

Our final topic focused on five-body collinear central configurations. To solve this problem we used an inverse method, first specifying the distances between the masses symmetrically and then determining the correct choice of masses to construct a c.c.c. We found the values of the masses reflected this symmetry. In further research, we predict that we will be able to find more symmetry in collinear central configurations as we add more bodies.

Funding for this research was provided by a grant from the National Science Foundation (DMS-0708741).



## Poster 50

### Timing and Spectral Analysis of the Neutron Star X0921-630

Joseph Palmieri, Michael Fask and Tom Narita  
*Department of Physics, College of the Holy Cross*

Using the Rossi X-Ray Timing Experiment (RXTE) and X-Ray Multi-Mirror Mission Newton (XMM-Newton) satellites, we seek to confirm the orbital period of this neutron star as well as find any additional suborbital periods.

We studied the photon emission from X0921 through two observations in the x-ray energy band. A timing analysis of the data suggested there to be a 9 day orbital period. We also discovered a possible 3000s suborbital period during the RXTE observation and a 7000s suborbital period in the XMM-Newton data. The spectral analysis suggests that changes in luminosity could be related to changes in the black body emitting region.

We thank the Massachusetts Space Grant for financial support.

## Poster 51

### *Drosophila melanogaster* as a Model Organism for X-Linked Spinal Muscular Atrophy and Other Neurodegenerative Diseases

J. Ghobrial, H. Liu and C. Pflieger  
*Department of Oncological Sciences,  
Mount Sinai School of Medicine*

X-linked spinal muscular atrophy (XL-SMA) is an X-linked genetic disease characterized by hypotonia, areflexia, and multiple congenital contractures (arthrogryposis). Males inheriting this condition from their carrier mothers die before the age of two via progressive loss of anterior horn cells located in the ventral side of the spinal cord.

XL-SMA, similar to other neurodegenerative diseases, may arise in part from protein aggregation, typically resolved by the ubiquitin-pathway system. An ubiquitin-activating enzyme (E1) uses ATP as a substrate to catalyze the formation of a thioester bond between itself and ubiquitin. We hypothesized that mutated E1 would yield impaired ubiquitin pathway function, and promote neurodegeneration. Furthermore, by generating different mutations of the E1 cognate gene, we modeled XL-SMA and other neurodegenerative diseases involving impaired ubiquitination in *Drosophila melanogaster*.

We tested the motor function of the mutated E1 in *D. melanogaster* versus wild type over a 20-day period via climbing assays. We found a significant decrease in motor function amongst the homozygous and heterozygous mutants compared to the wild type in a dose dependent manner. We also observed that the mortality rate amongst the genotypes was affected by E1 expression levels.

These preliminary studies allowed us to develop the first animal model in which to study XL-SMA. Further studies following the heterozygotes to later time points will help to establish whether “carriers” are at risk for earlier effects of aging or neurodegeneration.

We thank the National Institutes of Health for financial support.

## Poster 52

### Neurogenesis in Adult Mice in the Neocortex

*M.Hausse, M.Rizzi, M.Vornle von Haagenfels and S.Moncada  
Wolfson Institute and UCL*

Since the discovery of neurons more than a century ago, scientists have believed that no new neurons develop in adult life. A number of papers, however, have been published in the last decade suggesting that new neurons are instead being generated throughout adulthood. The results suggest adult neurogenesis in the neocortex which is perhaps the most exciting, as this is the site of most brain functions, and it is the first target for many diseases. Unfortunately, multiple labs have been unable to confirm such findings. This may mainly be due to technical problems; for example, commonly used techniques of labeling 'new neurons' does not allow identification of their highly characteristic processes, such as axons and dendrites.

To prove that new neurons are being produced, I used brain sections from transgenic animals expressing GFP in stem/progenitor cells. these cells with NeuN antibody suggested that these may be newly generated neurons. To give unequivocal evidence for this, I injected a lipophilic dye, DiI, in the putative 'new neurons'. DiI spreads throughout the cell membrane and allows identification of neural structures, including 1 um thick dendritic spines (site of communication with other neurons). The identification of adult neurogenesis in the neocortex offers great promises to help us understand processes such as the storage of new memories. It could also lead to the repair of neurodegenerating brains and perhaps even substitute damaged parts of the cortex which could result, for example, from a stroke.

I would like to thank The Wolfson Institute for Biomedical Research in London, England, for their support.

## Poster 53

### The Mutagenic Capacity of the Anti-HIV Protein APOBEC3G

*Michelle Arata, Natasha Tobarran, Melissa Farrow  
and Ann Sheehy  
Department of Biology, College of the Holy Cross*

The human cytidine deaminase APOBEC3G (hA3G) is an intracellular protein which exhibits potent anti-HIV activity. Previous studies concluded that hA3G's anti-viral function is attributed to its cytidine deaminase activity; deamination of cytidine creates a uracil, introducing a mutation and, in this infection setting, fundamentally alters the genetic material of the virus. Essentially, during reverse transcription, when the HIV RNA genome is synthesized into host-friendly DNA, hA3G deaminates cytidines to uracils, resulting in significant base substitutions. The produced viral DNA is hypermutated, and viral replication is crippled. In the evolutionary arms race between pathogens and hosts, the HIV viral protein, Vif (viral infectivity factor) is the virus' counterattack against hA3G. To further characterize and understand the molecular details of hA3G's anti-viral function and interactions with Vif, a library of 135 mutant hA3G constructs was created. In an initial screen, 43 of the mutants no longer suppressed HIV infection. These mutants were then further screened to characterize enzymatic capacity; 22 mutants retained enzymatic function while 21 did not. These findings show that the loss of anti-viral activity does not necessarily reflect a loss of hA3G's mutational capacity leading to the possibility of an alternate hA3G pathway to anti-viral activity.

We would like to thank the Center for AIDS Research (CFAR) at the University of Massachusetts, The Medical Foundation, and the Becton Dickinson Foundation for financial support.

## Poster 54

### **The Importance of Viral Packaging of the anti-HIV protein APOBEC3G**

*Michelle Arata, Justin Rucci, Melissa Farrow, and Ann Sheehy  
Department of Biology, College of the Holy Cross*

The human protein APOBEC3G (hA3G) exhibits an innate anti-viral activity against HIV-1 by causing mutations during reverse transcription of the viral RNA. To exert its antiviral response, it is essential that hA3G be packaged into budding virions. However, HIV-1 expresses the viral protein Vif (viral infectivity factor), which specifically targets hA3G for cellular degradation, thereby effectively preventing this critical packaging.

A set of 43 hA3G mutants, which have lost their ability to act as anti-viral agents, were screened in a virion packaging assay. 10 of the hA3G mutants were no longer found in virus particles. Follow-up experimentation is underway to determine if manipulating this packaging can rescue hA3G antiviral function. Combined results from these assays may delineate specific domains that are critical for proper packaging of hA3G, consequently offering a direction for future therapeutic interventions.

We would like to thank Center for AIDS Research (CFAR) at the University of Massachusetts, the Medical Foundation, and the Becton Dickinson Foundation for financial support.

## Poster 55

### **The Search for the Holy Grail: Assay for a dominant-negative APOBEC3G mutant that is active against wild-type HIV**

*Justin Rucci, Melissa Farrow, and Ann Sheehy  
Department of Biology, College of the Holy Cross*

The human protein APOBEC3G (hA3G) provides a cellular immune response against several viruses, including HIV. However, in a viral counter-response, HIV-1 expresses Vif, (viral infectivity factor) a protein with the ability to blunt the antiviral function of hA3G. In the laboratory, elevated levels of hA3G are able to suppress the Vif viral response, resulting in the dominance of anti-viral activity against wild-type HIV. Previous clinical investigations have also suggested that increased levels of hA3G expression may be partially responsible for the enhanced resistance to HIV progression found among patients classified as long-term non-progressors (LTNP).

We are currently evaluating the antiviral function of a library of hA3G mutants in the context of HIV infection. We hope to identify mutants that function independently of Vif and maintain their endogenous antiviral function even in the presence of a viral suppression factor. At present, 8 of the 135 mutants have been analyzed for antiviral capacity, with 1 potentially acting as an antiviral against wildtype HIV. Discovery of mutant hA3G proteins that provide an antiviral response against wildtype HIV infection would offer meaningful insight into the development of novel antiviral therapies.

We would like to thank the Center for AIDS Research at the University of Massachusetts and the Medical Foundation for financial support.

## Poster 56

### Interacting with Others: A Comparison of Face-to-Face and Electronic-Mediated Communication

*C. Spilka and P. Kramer*

*Department of Psychology, College of the Holy Cross*

Recent research has compared face-to-face (FTF) communication, which provides extensive information about the emotional state and personality of those engaged in an interaction, to electronic modes of communication (Anderson, 2006; Doherty-Sneddon et al., 1997; O'Malley et al., 1996). To assess how communication mode influences people's rating of the quality of an interaction and their ability to make inferences about others' personalities, 216 college students (with minimal acquaintance) worked in pairs on two activities (task-oriented, socially-oriented) in one of four modes of communication (FTF, video-mediated, audio-mediated, and instant messaging). As predicted, participants in FTF completed the task-oriented activity more efficiently and judged their partners' personality more accurately than those in the electronic modes. However, the superiority of FTF was not evident for many socially-oriented aspects of the interaction.

Further, to assess how the conversations' characteristics influenced these results, we transcribed the task- and socially-oriented conversations. Adapting the research of Carletta et al., 1996 and Doherty-Sneddon et al., 1997, we developed a coding scheme to analyze the conversations. Conversations are being coded on a variety of factors (e.g. social communication, informative communication, emotionality, formality, and cooperation). Our goal is to 1) determine how the factors vary by mode, by gender, and by type of conversation and 2) investigate a relationship between the factors and efficiency, perceived social presence, and perceived personality attributes.

We thank the Richard Fisher Fellowship for financial support.

## Poster 57

### Access to care for rheumatic diseases: a private / public discrepancy

*Lesley Bautista, Yatesh Setty, Rose Ardern, Proton Rahman*  
*Memorial University of Newfoundland*

We set out to examine the demographic and disease related characteristics in rheumatoid arthritis (RA) and psoriatic arthritis (PsA) patients accessing anti-TNF (anti-tumor necrosis factor) therapies through public as compared to private insurance plans. In a retrospective study, charts of patients starting anti-TNF therapy were systematically reviewed with a standardized protocol from two rheumatologists' clinics at Eastern Health in St. John's NL. In total 58 RA patients and 49 PsA patients were identified.

With respect to RA, 22 patients (38%) were covered by government or other compassionate drug programs (public plans) and 36 patients (62%) had private insurance. Patients acquiring anti-TNF agents through public plans as compared to private insurance were exposed to a greater number of DMARDS (disease modifying anti-rheumatic drugs) prior to initiation of anti-TNF therapy: median 3 (range 2 to 6) vs. median 2 (range 1 to 4); had a greater disease duration 14.5 years (sd 11.2) vs. 6.6 years (sd 7.7);  $p=0.01$  and a greater number of active joints 17.7 (sd 8.1) vs. 9.9 (sd 5.7);  $p=0.0003$ . With respect to PsA patients, 8 were covered through public plans and 41 patients had private insurance. Patients acquiring anti-TNF agents through public plans as compared to private insurance were exposed to a greater number of DMARDS prior to initiation of anti-TNF therapy: median 2 (range 2 to 4) vs. median 1 (range 1 to 3); had a greater disease duration 18.8 years (sd 16.0) vs. 10.4 years (sd 8.1);  $p=0.17$  and a greater number of active joints 12.8 (sd 8.6) vs. 6.1 (sd 4.7);  $p=0.06$ . The lack of statistical difference in the PsA patients is likely due to the small number of patients receiving anti-TNF therapies (8) from public plans.

Patients with inflammatory arthritis initiating anti-TNF therapies on public plans were on greater numbers of DMARDS, had greater disease duration and active joints as compared to those with private plans.

## Poster 58

### Cytokine Expression of Seeded Tissue Engineered Vascular Grafts

*Ani Nalbandian, Rajendra Sawh-Martinez, Christopher Breuer  
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Congenital heart disease is the leading cause of infant mortality, affecting approximately 1% of all newborn children. Surgical correction employs prosthetic vascular grafts (i.e. Gore-Tex®) which often requires further surgical intervention due to this graft's inability to grow or remodel. Tissue engineering offers a viable alternative to address these shortcomings, by using biodegradable materials (polyglycolic acid – PGA) and autologous tissue (human bone marrow mononuclear cells – hBM-MNC) to create surgically implantable vascular grafts. Previous work has shown that these grafts undergo extensive remodeling in animal recipients and appear to develop into living blood vessels. Ongoing human clinical trials have demonstrated the safety and efficacy of this new approach. Despite these successes, little is known about the molecular mechanism by which these grafts remodel.

In this study, we examined the expression of 18 cytokines from hBM-MNC's after seeding onto PGA scaffolds for 48 hours. Cytokine quantification was performed using Luminex xMAP technology via a multiplex assay. Supernatants of the experimental group hBM-MNC seeded PGA scaffolds, were compared to controls (*unseeded PGA scaffolds and hBM-MNCs in culture*). hBM-MNCs seeded onto PGA scaffolds express Monocyte Chemoattractant Protein-1 (MCP-1) at a 7-fold higher concentration (347,000 pg/ml +/- 17,205) relative to the other cytokines examined. Cross comparisons accounting for reported physiologically bioactive levels was also carried out. Interleukin-6 (IL-6) and Macrophage Inflammatory Protein-1-alpha (MIP1-alpha) were also among the highest in expression level to bioactivity ratio. The relative expression levels of these cytokines provides the first reported data on the physiologic stimulus that leads to neotissue formation.

This work was supported by a K08 grant from the National Institutes of Health.

## Poster 59

### The Mediating Effects of Motivation on Adolescents' Achievement and Well-Being

*M. Richards and A. Ludden  
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Adolescents' perceptions of their environments undoubtedly have a central role in determining the ways in which they behave, achieve, and feel about themselves and the world around them. However, more evidence is needed to make conclusions about the specific relationships that may exist among adolescents' actions and their perceptions of themselves and their environments. The current study expands upon research on adolescent motivation by examining how the effects of perceived context on well-being, academics, and school misbehavior are mediated by adolescents' levels of motivation, specifically, their academic self-concept and self-efficacy.

Early adolescents (N= 683) from rural schools in the Midwest were surveyed on how they felt about their parental, school, and social contexts, as well as their self esteem, depression, academic achievement, and school misbehavior. Results indicated that adolescents' well being and achievement were enhanced when they perceived their parents, peers, and school positively. It was also found that in many cases, academic self concept and self efficacy mediated the relationships found between contexts and outcomes. This suggests that improving an adolescents' motivation, as well as helping adolescents' find environments that enhance their motivation, may be some of the most efficient ways to change their well-being, achievement, and behavior for the better.

We wish to acknowledge financial support from the Richard Fisher Fellowship and the Spencer Foundation.

## Poster 60

### Superheated Water Chromatography: Column and Mobile Phase Investigation

*Ann Kotze<sup>1</sup> and Shangming Kao<sup>2</sup>*

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*<sup>2</sup>Pfizer Global Research and Development*

Due to the undesirable nature of organic modifiers typically present within the mobile phases of reverse phase HPLC, superheated water chromatography has generated interest as a possible green chemistry improvement to the field. Indeed, with temperature as a solvent strength variable, isocratic superheated water methods have the potential to completely eliminate organic solvents from RP-HPLC. A temperature program ranging from 80 - 150°C was developed that yielded successful separation for a number of pharmaceutical compounds and reaction completion series. Investigation has furthermore demonstrated that the Waters C-18 X-Bridge and Selerity Blaze 200 columns are both suitable for work performed in this high temperature range, though column lifetime remains undetermined. By enabling the reduction if not complete elimination of organic modifier from the mobile phase, this project thus highlights the potential of superheated water chromatography as a viable green chemistry improvement to RP-HPLC.

Funding provided by Pfizer Global Research and Development.

## Poster 61

### Coordination of Behavioral Waves in Natural Interactions

*Samantha Morr*

*Faculty Advisor – Dr. Richard Schmidt*

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Previous research has determined that when individuals interact, they move rhythmically in time and space characterized by coupled behavioral waves. Research that has focused on more natural interactions has previously only been able to utilize labor-intensive methods in order to code and quantify movement synchrony (e.g., the Eshkol-Wachman movement scale). The current pilot study attempted to obtain behavioral waves through the use of a perceived movement scale and modern graphics programs. This was done by recording two people reciting knock-knock jokes to one another, and then coding the video based on the total amount of perceived movement for each participant. The results indicate that the current methodology produces equivalent behavioral wave patterns to those seen in previous studies, and interactors showed significant inphase coupling above chance levels. These results suggest that the behavioral waves of naturalistic interactions can be extracted through the use of the less labor-intensive perceived movement scale and the waves have the same dynamical organization as that found in more-stereotyped interpersonal interactions.

We thank the Richard Fisher Fellowship for financial support.

## Poster 62

### Protein Splicing Via an Alternative Mechanism: A Directed Evolution Approach

Adam Nadelson, Daniel York, Julie Reitter, and  
Professor Kenneth Mills  
Department of Chemistry, College of the Holy Cross

Inteins are intervening polypeptides within a protein. They are able to direct their excision from the flanking polypeptides, called exteins, as well as facilitate the ligation of the exteins. This process, called protein splicing, produces the ligated, functional protein. Although a standard splicing mechanism has been established, we want to determine if alternative methods of splicing may exist.

Using the RecA intein from *Mycobacterium tuberculosis* we have mutated amino acids within the intein through site directed mutagenesis (SDM). First, to prevent splicing, a mutation of the N-terminal cysteine to alanine was performed to block the first step of splicing. Then, our goal was to discover a complementary mutation to recover splicing activity. Using SDM, mutator red cells, and error prone PCR, mutants have been made and subjected to a genetic screen to identify substitutions that may allow the modified intein to facilitate splicing.

To select for complementary mutants, *E. coli* harboring a plasmid with the kanamycin resistance gene, which is interrupted by the RecA intein, were grown on agar plates with increasing concentrations of kanamycin. Because the intein interrupts the kanamycin resistance gene, bacterial growth requires efficient protein splicing. We have been able to mutate the RecA intein and select mutant plasmids that allow for growth on kanamycin. This suggests that we may have selected for inteins that can splice by bypassing the first step of splicing, although we must confirm this result with a biochemical assay.

We thank the National Science Foundation for their financial support.

## Poster 63

### A Tale of Two Isoforms: Exploring the Function of the Argonaute CSR-1 within the RNAi Machinery of *C. elegans*

E. Morse<sup>1,2</sup>, J. Claycomb<sup>1</sup> and C. Mello<sup>1</sup>  
<sup>1</sup>Program in Molecular Medicine, UMASS Medical School  
<sup>2</sup>Department of Biology, College of the Holy Cross

RNA interference (RNAi) is a naturally-occurring process of gene silencing that has become increasingly prevalent as a powerful laboratory tool for studying gene function. The process of RNAi is triggered by double-stranded RNA (dsRNA) that is complimentary to a given target mRNA sequence. This dsRNA is then processed into smaller, short interfering RNAs (siRNAs) that catalyze various reactions, all of which lead to inhibition of gene expression.

This summer, we investigated the role of one particular RNAi protein, CSR-1 (Chromosome Segregation and RNAi deficient), using the model nematode, *Caenorhabditis elegans*. CSR-1 belongs to the Argonaute protein family, whose members directly bind to siRNAs and their target mRNAs to cause silencing. The *csr-1* gene encodes two isoforms of the protein that differ in length near their N-termini, but the exact functions of these isoforms in RNAi and development has not been elucidated. To understand the expression and localization of CSR-1 in *C. elegans*, we have created GFP-tagged versions of the two *csr-1* isoforms and have introduced these isoforms separately into the *C. elegans* genome by biolistic bombardment. We have obtained a number of GFP-CSR-1 expressing *C. elegans* lines and have observed by fluorescent microscopy that CSR-1 is expressed in germ cells and embryos. These strains will be powerful tools for biochemical assays examining CSR-1 function, which will shed light on the process of RNAi and provide insight into how RNAi can be harnessed for applications such as novel anti-cancer therapies.

We would like to thank the American Cancer Society and the Howard Hughes Medical Institute for their support of our work.

## Poster 64

### Multi-Frequency Laser Diodes

*Joshua Ryor '10,*

*Professor Paul Oxley and Professor Timothy Roach  
Department of Physics, College of the Holy Cross*

The main goal of our research was to effectively and stably produce two frequencies of light from one laser diode. This is important for our research because it allows us to use a single laser to excite electrons from, or to, two different atomic states. Excitation from two atomic states prevents atoms accumulating in an undesirable state, and excitation to two different atomic states will allow us to make a precise determination of the energy separation of the two states.

Diode lasers can be made to emit light at multiple frequencies when a DC and an AC current are simultaneously passed through the laser. Then laser light is produced at one main frequency and two other frequencies equally far, in opposite directions, from the main frequency. (For our applications only one of the two sidebands are needed.) The difference in frequency between the main frequency and the two others (also known as "sidebands") is equal to the frequency of the AC current.

We have tested two different laser diodes and three different AC frequencies. We have investigated several relationships, including: how the AC frequency compares to the actual frequency at which the sidebands are observed, how the amplitude of the sidebands vary with AC frequency and amplitude, and how the DC current affects sideband amplitude and frequency. This presentation will give an overview of the results we found between these relationships and will detail the apparatus used to produce these results.

Acknowledgment is made to the Richard Fisher Fellowship and the Research Corporation for financial support of this research.

## Poster 65

### Are Skin Prick Tests or Wheal Sizes Prior to 24 Months of Age Associated with Allergic Sensitization at 36 Months?

*Bridget A. Whitehead<sup>1</sup>, Patrick H. Ryan PhD<sup>2</sup>, Jeff W. Burkle<sup>2</sup>, Christopher D. Codispoti MD MS<sup>2</sup>, Grace K. LeMasters PhD<sup>2</sup>*

*<sup>1</sup>College of the Holy Cross, Worcester, MA <sup>2</sup>University of Cincinnati, Cincinnati, OH, Department of Environmental Health*

The most commonly used procedure to diagnose allergic sensitization is the skin prick test (SPT), although SPTs are not commonly conducted on young children. The association between SPT results or wheal sizes during early childhood with later sensitization has not yet been fully examined.

Participants in The Cincinnati Childhood Allergy and Air Pollution Study (CCAAPS) are tested annually for allergic sensitization to 17 allergens using an SPT. The relationship between a positive SPT to 5 standardized allergens prior to 24 months and allergic sensitization at 36 months was investigated and adjusted for gender, race and season of birth. Logistic regression was performed to determine the association between wheal size prior to 24 months and SPT results at 36 months and are adjusted for potential covariates.

Results indicate there is a significant association between a positive SPT prior to 24 months with a positive SPT at 36 months for cat, dust mite, timothy, and meadow fescue. We also found that severity of SPT results prior to 24 months of age has clinical implications for continued sensitization for cat allergen. No association was observed between SPT severity and persistent sensitivity for dust mite, timothy or meadow fescue. Ragweed sensitization prior to 24 months of age was unlikely to remain positive at 36 months.

CCAAPS funding is provided by NIEHS ES11170. I would also like to thank the Summer Undergraduate Research Fellowship for their financial support.



## Poster 66

### Modeling Deeply Knotted Proteins

*Matthew Brady and Prof. David Damiano  
Department of Mathematics and Computer Sciences,  
College of the Holy Cross*

Using different methods, protein biologists have been able to identify the crystalline structure of proteins. This consists of the sequence of amino acids (primary structure), sheets and helices formed by the chain of amino acids (secondary structure), the folding of the chains and sheets (tertiary structure), and the arrangement of the folded chains (quarternary structure). Of interest to mathematicians, knots sometimes appear in the tertiary and quarternary structures of proteins.

In this project, we used the mathematical modeling program KnotPlot to identify knotting in proteins. For a large collection of proteins, we extracted the three-dimensional coordinates of the alpha-carbon backbone from the Protein Data Bank, translated the coordinates into a form readable by KnotPlot, and used KnotPlot to produce a stick model of the backbone. By a judicious use of KnotPlot's smoothing feature, we were able to identify dynamically and in real time deep (and shallow) knots in the carbon backbone. This replicates results obtained by different methods by Yan-Long Lai, et. al.

We thank the Sherman Fairchild Foundation for financial support.

## Poster 67

### Index of Insect Biodiversity in Central and Western Massachusetts

*Andrea Everhart  
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The Holy Cross Insect Collection is an anomaly among colleges comparable to Holy Cross, being unusually large, complete, and historic. Consisting of approximately 2,700 dry pinned and alcohol preserved specimens, it is a unique resource for our area, as it is largely a survey of insects native to Massachusetts. It consists mostly of student collected material, as well as donated specimens. Although used primarily as a teaching tool, this collection is a fundamental resource for basic research in biological systematics, evolution, and ecology. Such collections provide invaluable information to aid in identifying organisms, documenting their geographical distribution, and studying their biology and variation. The collection is also of crucial importance for applied biology, studies of biodiversity, and conservation efforts. These important benefits merit curating and increasing the diversity of taxa and life stages in the Holy Cross Insect Collection, in order to increase its utility.

I devoted much of my efforts to curating and repairing the collection by identifying previously misidentified and unidentified insects, reorganizing the collection to better reflect phylogentic relationships between orders and families, and repairing pinned specimens and specimens preserved in alcohol. I also increased the diversity of taxa and life stages of local specimens. I collected 6 families new to the collection, and increased the number of specimens in several other underrepresented families and orders. I also collected larval, pupal, or otherwise juvenile stage insects for at least 4 families which were previously unrepresented. I added approximately 425 insects to the collection.

I gratefully acknowledge the Becton Dickinson Corporation for their financial support.

## Poster 68

### The Physics of Baseball: Spin Decay

*Kevin Sullo and Tom Morell*

*M. B. Koss, J. Singleton, Z. Donahue*

*Department of Physics, College of the Holy Cross*

We know that there are many forces that act on a baseball in flight but how these forces affect the spin of the ball is relatively unknown. One of our main concerns on the Physics of Baseball Team this summer was to be able to quantify these affects and relate them to known standards. Our goal was to accurately recreate a ball in flight so that we could learn more about the overall flight of a baseball and the specific role spin plays in that flight.

For our experiment, we used a high speed camera to capture the relative position of a ball at known time intervals and a constant initial setting. This allowed us to use that position to calculate the revolutions per minute as the baseball as it flies through the air. We are then able to use the calculated final RPM value and the known initial RPM value to find the Tao value for that specific test. The Tao value then allows us to relate previously separate test runs.

Also, we changed the orientation of the baseball because the effect of the spin varies horizontally compared to vertically spun and there was a major difference in spin for two and four seam fastballs. The results of our experiments show that a four seam fastball is much more resistant to spin decay than the similar two seam pitch.

For all of our experiments it was important to eliminate the human elements as much as possible. Any discrepancy in the way an experiment was run could severely skew the results in one way or another. For this reason we used a pitching machine to introduce the spin and high speed camera to calculate the RPM. Future experiments will be done in an enclosed wind tunnel, eliminating outside variables.

We would like to thank the Massachusetts Space Grant Consortium for financial support, as well as Diane Jepson and Richard Miller for help with supplies and equipment.

## Poster 69

### Diagnostic Imaging: Creating unnatural amino acids with novel starting materials

*Joseph Lopez and Prof. Richard Herrick*

*Department of Chemistry, College of the Holy Cross*

In the medical world there is always need for new bioorganometallic imaging agents that are target specific. Currently the most widely used isotope used for diagnostic imaging is Technetium 99m. Due to the radioactive nature of  $^{99m}\text{Tc}$ , Rhenium can be used as a cold model for safety. It is possible to use Rhenium as a cold model for Technetium because of their similar properties due to the lanthanide contraction and being located in the same periodic column.

Previously, the majority of the research conducted used either  $\text{Re}(\text{CO})_5\text{X}$  or  $\text{fac}[\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3]\text{X}$ ,  $\text{X}=\text{Br}, \text{Cl}$ , as starting material, although the crystal structure of  $[\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3]\text{Cl}$  had not been previously solved. In order to further explore anionic contributions, various non-coordinating anions were added to the  $\text{fac}[\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3]^+$  complex, including sulfate and iodine.

Unnatural amino acids were also researched as possible bifunctional chelates to be attached to the Rhenium metal center. Bifunctional chelates are ligands that is attached to the metal center at one position and attached to a receptor specific ligand on the other. In-vivo the receptor specific ligand attaches itself to a specific complementary receptor cell in the body, cancer cells, tumors, and bone fractures for example. Unnatural amino acids are especially of interest because to their nontoxic properties in-vivo.

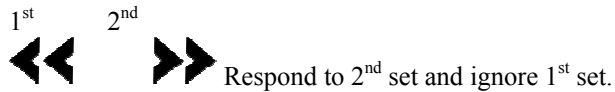
We would like to thank the Pfizer Connecticut Business and Industry Association (CBIA) for their financial support. We would also like to thank Chris Zeigler at the university of Akron for solving crystal structures and everyone involved in the summer research program for a great summer.

## Poster 70

### Impulsivity influences Unconscious Perception and Control

*B. Becker, Dr. Clare L. Blaukopf & Dr. Gregory J. DiGirolamo*  
*Department of Psychology, College of the Holy Cross*

People are slower at responding to the direction of arrows and more likely to make an error if previously presented arrows point in the opposite direction (conflict!).



This slowing is true even if subjects are unaware that the 1<sup>st</sup> set of arrows has been presented. The subjects' ability to overcome this unconscious conflict can be influenced by the amount of prior conflict presented. When a high percentage of conflicting trials are shown, subjects are improved at overcoming the interference from the conflicting information even if unconscious of the direction of the 1<sup>st</sup> set of arrows. These data suggest that we are able to apply an appropriate amount of control over behavior without conscious awareness!

We extended these findings to ask if this unconscious control would generalize to other tasks, interspersed with the unconscious stimuli, which required *conscious* control over conflict. Moreover, given the importance of impulsivity and control over behavior in clinical populations (e.g., addiction), we asked if these unconscious strategies were influenced by a subject's impulsivity. There were considerable differences among high- and low-impulsive subjects. Impulsivity scores moderated the ability of subjects to apply unconscious adaptation to situations requiring conscious control, with high impulsive subjects less able to control their behavior. These data suggest that impulsivity influences even unconscious control.

We thank the Richard Fisher Fellowship for financial support.

## Poster 71

### Arousal influences involuntary actions more than voluntary actions

*N. Patel, Dr. Clare L. Blaukopf & Dr. Gregory J. DiGirolamo*  
*Department of Psychology, College of the Holy Cross*

If we offered you a chance to win a \$10,000 but you only had one try to look away from a dot suddenly appearing on a computer screen, could you do it? Surprisingly, the excitement and arousal of the money would improve your performance, but it would make your errors faster!

A wide range of clinical populations, including bipolar disorder, attention deficit hyperactive disorder and addiction disorders exhibit impulsivity. A hallmark of this trait is a difficulty in inhibiting a well-learned response. Even preclinical populations with high impulsivity are also impaired on inhibiting a well-learned task under highly arousing conditions such as the possibility of high reward or high punishment.

The current study specifically investigated the effect of arousal and impulsivity in the anti-saccade task (where one has to look away from a suddenly appearing dot). When the involuntary, unplanned action overrides the voluntary action, subjects make an error and look at the dot (pro-saccade). Our main results demonstrated that arousal speeded significantly both voluntary (anti-saccades) and involuntary (pro-saccades) actions. However, involuntary actions were significantly more speeded than voluntary actions under conditions of high arousal. These data demonstrate that the efficacy of arousal is enhanced for involuntary, highly learned responses. These results have important implications for clinical populations (e.g., patients with substance addictions) and the critical role of involuntary, unplanned behavior driven by arousing situations.

We thank the Sherman Fairchild Foundation for financial support.

**Poster 72**

**The State of Autism and other Neuropsychological Research in the  
Developing World: A Literature Review of Research in Latin America,  
China and Southeast Asia  
and the Middle East**

*Jessica Napolitano, Michael Rosanoff*  
*Science Department, Autism Speaks*  
*Department of Biology, College of the Holy Cross*

Autism is a complex neurobiological disorder, affecting approximately 1 in 150 children in the United States alone. In most Western, developed nations, autism is recognized as a major public health issue and is being actively addressed. This is not the case in developing nations as a general lack of resources limit the capacity for effective research. This leaves many countries with a severe deficiency of available services for individuals with autism. Furthermore, the lack of awareness and understanding about autism often result in cultural stigmas that present a further challenge to address the issue.

This review addresses the current literature available regarding autism and other neuropsychological disorders from the developing nations in Latin America, China and Southeast Asia and the Middle East. As autism is a disorder related to social cues, it is necessary to investigate this disorder as well as others across all cultures. This allows exploration of possible etiologies and can lead to earlier intervention and better treatments. The most common limitations presented were inconsistency in diagnostic tools, small sample size, limited region base and lack of awareness. By addressing the current literature, Autism Speaks can make appropriate judgment of which regions need the most immediate assistance in conducting research that produces credible, reliable data.

We would like to thank the Holy Cross Leadership Council of New York for financial support.