

9-10-2010

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COLLEGE OF THE HOLY CROSS

Seventeenth Annual Undergraduate
Summer Research Symposium



September 10, 2010
Hogan Ballroom

Dear Members of the Holy Cross Community,

Welcome to the 2010 Undergraduate Summer Research Symposium. Now in its seventeenth 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 2010. 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.

Pr. Sarah Webster, Department of Biology

Pr. Gregory DiGirolamo, Department of Psychology

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The summer research program was organized by the College Science Coordinator, Pr. Daniel Bitran, and the Coordinator of the Summer Research Experiences in Humanities and Social Sciences, Pr. Mary Ebbott. Further support for the summer research program was provided by the Offices of the President, Provost, and Dean, and the Office of Grants and Corporate and Foundation Giving.

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Poster 1

Something Old, Something New: marrying preservation and discovery in a 10th-century Iliad manuscript

Melissa Browne, Frankie Hartel, Mary Ebbott and Neel Smith
Department of Classics, College of the Holy Cross

The Venetus A manuscript, hand-written by a 10th-century scribe in Greek, is the oldest complete manuscript of the *Iliad*. It is housed in Venice and in 2007 a team of scholars captured and published (www.homermultitext.org) high-resolution digital photographs which provide widespread accessibility to the manuscript's contents.

Our research concentrated on Books 3 & 4 of the *Iliad*. We used these images to create a digital inventory of the Homeric scholia, or commentaries on the main *Iliad* text, as well as other symbols and marks which appear on each page, or "folio" side. We then transcribed the scholia into machine-readable Greek. Using these transcriptions, we created XML documents that present these texts complete with searchable tags denoting details such as abbreviations, quotations within the text, personal names, and place names. We also verified the main text of the *Iliad* in this manuscript for its digital edition.

Previous publications of the scholia of the Venetus A are incomplete, and have been edited in a way that does not fully represent the manuscript's content. Our project has recovered over 20% of the manuscript's scholia—scholia which were previously unpublished. This recovered information will provide new insights into how we have the *Iliad* we have. In the future, this type of research may serve as a model for further new discoveries both in the Venetus A and other manuscripts, in a centuries-old discipline which is far from exhausted.

We thank the The Andrew W. Mellon Foundation and the Alumni / Parent Summer Research Scholarship, Deborah C. and Timothy W. Diggins '80 for financial support of this project.

Poster 2

Syndecan-1 as a Potential Driver of Mammary Epithelial Tumorigenesis

M. Fortunato, J. Ye, and R. Bellin

Department of Biology, College of the Holy Cross

It has been shown that significant cross-talk occurs between the epithelial cells and fibroblasts of mammalian tissue; interactions between these tissues can determine the fate of undifferentiated epithelial cells and have been proposed to play a role in the development of breast cancer. In our studies, we are seeking to understand the role that this communication plays in the formation and proliferation of mammary carcinomas with respect to the transmembrane heparan-sulfate proteoglycan syndecan-1. In published studies of tissue biopsies from breast cancer patients it has been shown that syndecan-1 is actively expressed in tumor associated fibroblasts. We therefore hypothesize that syndecan-1 based cross-talk between epithelial cells and fibroblasts plays a role in promoting epithelial cell tumorigenesis by increasing FGF-based cell proliferation.

In previous work we showed that NIH-3T3 fibroblasts actively express and shed syndecan-1 ectodomain in culture. We have now generated a method for purifying these shed ectodomains so that we can test the effects they have on the rate of proliferation of normal and tumor-derived epithelial cells in culture. We have also developed a method for quantifying the proliferation of epithelial cells and have begun to study the effects that both syndecan-1 ectodomain and FGF2 have on the proliferation of different epithelial lines. We are hopeful that identifying syndecan-1 shedding as a driver of breast carcinoma proliferation could provide numerous future therapeutic benefits.

We would like to thank Dean and Victoria Boylan and the Alumni/Parents Summer Research Scholarship for financial support.

Poster 3

Euclidean and Non-Euclidean Geometry

Marisa Zemsky '11

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

With attempts to prove the parallel postulate in Euclidean geometry, ideas emerged about the existence of non-Euclidean geometries such as spherical geometry and hyperbolic geometry. This summer Professor Cecil and I began to build the foundation of our work by first studying Euclidean geometry and the transformations that can be obtained as a product of a finite number of reflections in lines: the identity transformation, reflections, translations, rotations, and glide reflections. We proved that in the Euclidean plane, every isometry, i.e., an onto mapping T from the Euclidean plane to itself that preserves distance, must be one of these types of transformations.

We continued our research by analyzing spherical geometry. Using our knowledge of the Euclidean plane we were able to study transformations on the sphere S^2 as well. Similar transformations to those in the Euclidean space are defined on the sphere. We proved our main theorem in spherical geometry: For every isometry T_0 of S^2 there is an orthogonal transformation T coinciding with T_0 on S^2 . By proving this theorem we were also able to prove that every isometry of S^2 is one of the five transformations we studied, the identity transformation, a reflection, a translation, a rotation, or a glide reflection.

I sincerely thank the Alumni / Parents Summer Research Scholarship and Dr. Dan Kennedy '68 for financial support of my research project and Professor Thomas E. Cecil who guided me throughout the course of the research.

Poster 4

Medicinal Applications of $\text{Re}(\text{CO})_3^+$ Chemistry

Kathryn Kennedy and Richard S. Herrick

Department of Chemistry, College of the Holy Cross

Prior experiments on rhenium tricarbonyl compounds suggest that new $\text{Re}(\text{CO})_3\text{L}$ compounds would have significant, practical applications in bioorganometallic chemistry. The study of this chemistry is facilitated by the ready availability of $[\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3]\text{Br}$, which is prepared from refluxing aqueous $\text{Re}(\text{CO})_5\text{Br}$. The $\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3^+$ cation is stable in water and air and undergoes substitution of the water ligands at a fast rate, which make experimenting with its bonding reasonable. It is an attractive way to search for promising radiopharmaceutical candidates, due to its similarity to $^{99\text{m}}\text{Tc}$, which is widely used in nuclear medicine.

In the body, target-specific rhenium compounds can be used for imaging or therapy. Attaching different ligands to the rhenium tricarbonyl cation leads to compounds that target different areas of the body. Attaching a sulfonamide complex to the rhenium tricarbonyl cation was envisioned because it is a likely candidate for targeting and inhibiting Carbonic Anhydrase IX, an unusual isozyme of Carbonic Anhydrase found on the outside of certain tumor cells.

The binding of $\text{Re}(\text{CO})_3(\text{H}_2\text{O})_3^+$ with proteins is also important to the study of the biological processing of Tc/Re imaging agents and the interactions of organometallic compounds with proteins. Lysozyme crystals were grown to continue research started by the Herrick/Zeigler collaboration.

Future work in this area will involve further attempts to grow crystals with rhenium bound to proteins including myoglobin, ferritin, and glucose isomerase. Success with these proteins will lead to the exploration of more ambitious targets.

We thank the Arnold and Mabel Beckman Foundation Summer Research Scholars for their financial support.

Poster 5

Mutations in *Drosophila* synaptotagmin I and IV were combined to test genetic interactions

Jessica Sansoucy, Thomas O'Brien and Sarah Webster

Department of Biology, College of the Holy Cross

Synaptotagmin plays a key role in aiding the vesicle release of neurons by mediating vesicle fusion upon the binding of calcium ions. If synaptotagmin plays a role with neuropeptide release specifically, then synaptotagmin mutants should have an effect on neuropeptide release. Thus far, neuropeptide release is shown to be decreased in both synaptotagmin 1 (Syt I) and synaptotagmin 4 (Syt IV) mutants individually. Therefore, if both mutants are involved in this pathway, a double mutant of both synaptotagmin I and IV should have a larger impact on neuropeptide release.

In order to test this we first had to create the fly stocks needed. First we made stocks of the single synaptotagmin mutants with balancers: Syt I^{AD1}/Cyo; Dr/TM3Sb and Sp/Cyo; Syt IV 43^{Δ66}/[TM3Sb]. Then we crossed both of them together to get the double mutants over balancers: Syt I^{AD1}/Cyo; Syt IV 43^{Δ66}/[TM3Sb]. Finally we will cross them with another set of double mutants (Syt I^{AD4}, elavgal4, UAS ANF GFP (AEA)/Cyo; Syt IV 43/TAG Ser) to get a transallelic double mutant of synaptotagmin I and IV: Syt I^{AD1}/AEA; Syt IV 43^{Δ66}/Syt IV⁴³.

We want to test neuropeptide release of the double mutants, but unfortunately the flies are not viable into adulthood. Death can be one measure of the genetic interaction of these two mutations. Therefore we need to count how many embryos survive to larvae stages on day four. We hypothesize that the double mutants will have a higher death rate than either single mutants or wild-type controls.

We thank the Stransky Foundation Summer Research Fellowship, Alumni/Parents Summer Research Scholarship, James C. '75 and Jane Colihan, and the Batchelor Ford Summer Fellowship for financial support.

Poster 6

Establishing a pilot screen for mutants with a defect in mechanosensation in *Drosophila Melanogaster*.

Thomas O'Brien, Jessica Sansoucy, and Sarah Webster
Department of Biology, College of the Holy Cross

Mutations that are normally homozygous lethal can now be studied in *Drosophila* using mosaic analysis with a repressible cell marker or MARCM protocol. As we are interested in the mechanosensory system, this technique is particularly useful because many homozygous mutations of this system kill flies before they can be studied. Over the summer, we prepared two separate fly lines which will be crossed to create a MARCM ready stock. This final stock contains five different genetic elements on two non-homologous chromosomes.

The first line contains three of the genetic elements on the X chromosome. The second line contains the remaining two genetic elements on the 2nd chromosome. To prepare for these two lines to be crossed, each line was manipulated through a series of crosses in order to pair the chromosome containing the genetic elements with a chromosome that would functionally prevent recombination due to numerous DNA inversions. The latter chromosome, referred to as a balancer chromosome, is easily traceable with a specific phenotypic trait and insures that the desired genetic elements remain together as a single unit. The cross manipulation was also necessary to position balancers on the companion chromosome for each cross.

When the two lines are crossed this will allow the genetic elements on the both X and 2nd chromosome be paired with a balancer to insure that all elements stay together on their chromosomes. This stable MARCM ready stock will allow us to test a random assortment of lethal mutations for their effect on mechanosensory behavior. We will study the mutations that cause defects in the mechanosensory system in further detail.

We thank the Stransky Foundation Summer Research Fellowship, Alumni/Parents Summer Research Scholarship, James C. '75 and Jane Colihan, and the Batchelor Ford Summer Fellowship for financial support.

Poster 7

Do College Athletic Programs Satisfy Generally Accepted Accounting Principles?

*Victor Matheson, Debra O'Connor, and Joe Herberger
Department of Economics, College of the Holy Cross*

This paper examines the profitability of Division I athletic programs at colleges and universities in the United States under a variety of accounting definitions of profit. The data identify several broad themes. First, a majority of athletic departments rely heavily on direct and indirect subsidization of their programs by the student body, the institution itself, and state governments in order to balance their books. Without such funding, less than a third of BCS athletic departments and no non-BCS departments are in the black. Second, athletic programs rely heavily on contributions to balance their books. Donations to athletic department may serve as a substitute for donations to the rest of the university, lowering giving to other programs. Third, football and men's basketball programs are generally highly profitable at BCS schools, but below this top tier, fewer than 10% of football programs and 15% of men's basketball programs make money.

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

Poster 8

How the Brain Identifies Objects in Motion

Joshua Travatello, Daniel Parsons and Constance Royden

Department of Mathematics and Computer Science,

College of the Holy Cross

In all aspects of life, humans must process objects in motion and make decisions accordingly. When a person moves in a straight line, the image velocities of stationary objects in front of the observer form a radial pattern. Objects that are nearer to the viewer have faster image velocities than those that are more distant. Therefore, objects whose images are moving faster than the images of the other objects in the radial pattern may either be moving with respect to the other objects or they may be stationary and closer to the observer. To detect the presence of moving objects, the brain must make this key distinction.

We tested if certain visual cues to depth aided in distinguishing whether an object was moving relative to other objects in the scene. We did so by creating a computer program to test the accuracy of observers' responses to stimuli that contained objects whose images were moving faster or slower than the other objects in the scene. We tested scenes in which the objects were at constant or varied depths on a horizon line using three different cues to depth. First, objects were solid disks on the horizon with no connection to an underlying ground plane. Second, the disks were connected to a ground plane with thin lines and third, objects were textured rectangles connected to a ground plane. The data show that observers' responses were the most accurate when making decisions on the textured objects that were connected to the ground, and therefore had the strongest depth information, and the least accurate when making decisions on the disks that were not connected to the ground nor textured, and thus had the least depth information. These results suggest that depth information is important for detection of moving objects by a moving observer. This gives us some insight into how the brain processes motion and moving objects for a moving observer.

Supported by National Science Foundation grant IOS-0818286 to Professor Royden.

Poster 9

Correlation of the Chemical Fingerprint of Biodiesel to Fuel Efficiency using GC-MS and Chemometric Methods

Sarah Boehm, Amber M. Hupp

College of the Holy Cross, Worcester, MA 01610

Biodiesels derived from various feedstocks, such as soy, canola, and tallow, often have different chemical composition and concentration. These differences lead to differences in fuel quality and efficiency when burned in a traditional diesel engine. To this end, gas chromatography coupled with mass spectrometry detection (GC-MS) was utilized to provide a chemical profile for the fatty acid methyl esters (FAMES) present in biodiesel created from various feedstocks.

A thorough investigation of separation quality with various temperature programs and column polarities was performed. A standard reference material (SRM 2377, NIST) was used to assist the identification and quantitation of 26 different FAMES. The internal standard method, was utilized. Using response factors calculated from analysis of SRM 2377, concentrations of many of the compounds in the various biodiesels could be obtained. These concentrations were determined with strong certainty, as the percent errors ranged from 0.04 to 3.3%. Although the optimization of the temperature program resulted in a consistently poor resolution of octadecanoic acid methyl ester and its unsaturated derivatives, all other peaks were well resolved using the optimal column, a polar bis-cyanopropyl polysiloxane.

In an effort to associate the chemical profile to the fuel efficiency, the heat of combustion was calculated for each biodiesel sample using bomb calorimetry. A statistical method, Pearson Product Moment Correlation, was used to determine the relationship of fuel efficiency to FAME composition in the biodiesel.

Special thanks to Jacqueline H. and George A. Paletta, Jr., M.D. '84 for their support in funding this Alumni/Parent Summer Research Fellowship.

Poster 10

Determining the Size of the Hydration Sphere Surrounding Myoglobin

D. Balyozian and S. Petty

Department of Chemistry, College of the Holy Cross

A protein's structure is determined by intermolecular and intramolecular forces. The intermolecular forces are between either protein and protein or protein and water, while intramolecular forces are only within the protein. In solution, a "hydration sphere" of water forms around the protein impacting its structure. There is a constant balance between increasing enthalpy and decreasing entropy as proteins shift from a more disordered state to a more compact one. However, as the protein becomes more ordered and compact, fewer water molecules interact with the protein in the hydration sphere, decreasing the entropy of the protein and increasing the entropy of the water. Thus, knowledge of the size of the hydration sphere and number of water molecule interactions with the protein will help us understand the balance of entropy and enthalpy that control protein structure.

Previous data showed an inverse linear relationship between concentration of Myoglobin and water-water interactions at low concentrations with a plateau beginning around 7mg/mL. However, significant errors and lack of data at low concentrations left much room for improvement, which was the goal for this project. We controlled for temperature, corrected for fluctuations in instrument output, and used serial dilutions to improve on the standard deviation of the data. We also took data at 45°C, 25°C and 10°C to examine the impact that temperature had on the hydration sphere. While we did improve the accuracy of the data, solubility issues presented themselves throughout the experiment. We also found that the plateau occurred at around 20mg/mL, rather than 7mg/mL.

In the future, we hope to improve our dissolution technique and more accurately model the size of hydration spheres for both Myoglobin and more complex proteins.

The authors gratefully acknowledge the Sherman Fairchild Foundation Summer Research Scholarship for funding their project.

Poster 11

The Effect of Disasters on Marine Organisms with Planktonic Dispersal Stages

A. Cervin and J. Pringle

Institute for the Study of Earth, Oceans, and Space, University of New Hampshire

Marine organisms with planktonic dispersal stages move passively in the ocean. Since they cannot swim on their own, where they settle depends on various factors such as current strength, larval development time, and growth rate. In addition, they have upstream and downstream edges, the further most locations upstream and downstream where the organism can exist. I combined these aspects as well as density dependence to model these marine organisms along a coastline of arbitrary length. I then simulated a disaster starting at each location that kills off all the organisms for an arbitrary length. From this model, I analyzed populations with different growth rates, mean dispersal distances, and standard deviations of the dispersal distance. I measured the impact on the population from the disaster as well as the time it took for the population to recover from the disaster. The effect of the disaster on future generations of the population was also analyzed. The model shows that organisms are most sensitive to disasters at the upstream edge, where they are recruitment limited. Additionally, marine life is most sensitive when mean dispersal distance is high, standard deviation is low, and growth rate is low. My results are important to help with placement of Marine Protected Areas. However, further research on species' dispersal abilities is needed to more accurately model the impact of disasters on marine life.

We thank NASA and University of New Hampshire's Research and Discover program for financial support.

Poster 12

Orienting Gas Phase Molecules

Fallon Laliberte; Vinod Kumarappan

Department of Physics, Kansas State University

James R. Macdonald Lab: Atomic, Molecular, Optical Physics

The goal of our project is to non-adiabatically align and orient iodobenzene molecules using a titanium doped sapphire crystal from the Kansas Light Source. Alignment of the iodobenzene molecules is measured in two experiments: a velocity map imaging experiment (VMI) and a degenerate four wave mixing experiment (DFWM). Orientation is studied in the two-color velocity map imaging experiment.

In the DFWM experiment, the molecules are non-adiabatically aligned using a red (800nm) pump beam. Alignment is measured using three probe beams, which by degenerate four wave mixing—create a signal beam. The signal beam is analyzed by calculating the change in the susceptibility tensor ($\chi^{(3)}$).

In the two-color VMI experiment, the pump beam (800nm) non-adiabatically aligns the molecules, while the probe beam coulomb explodes the molecules. The second harmonic is produced using a BBO crystal, while temporal overlap is established using a 600 μ m calcite plate. Orientation is calculated using a program written in LabVIEW.

While we were not able to measure alignment of iodobenzene in the DFWM experiment due to time constraints, we were able to align N₂. We attained a maximum alignment of iodobenzene of 0.673 from the VMI, and were able to establish red-blue overlap. However, due to a lack of time, we were not able to attempt orientation of iodobenzene with the two-color experiment.

We thank Kansas State University, U.S. Department of Energy, and the National Science Foundation for their financial aid.

Poster 13

Synthesis of Hydrogen Bonding Scaffolds and Their Application to Nitrosugar Syntheses

Anthony J. Metrano and Brian R. Linton

Department of Chemistry, College of the Holy Cross

The Henry reaction has a proven versatility in organic synthesis. However, the reaction is relatively slow and nonselective, forming four stereoisomeric β -hydroxynitro compounds in relatively equal proportions. Thiourea-based hydrogen bonding scaffolds have been designed to bind the reactive nitronate intermediate of the reaction. Hydrogen bonding interactions stabilize the nitronate anion, decreasing the required activation energy of the rate-determining step. The catalytic effect of these scaffolds has been determined in the kinetic experiments reported below. Furthermore, another scheme for the efficient synthesis of these thiourea-based scaffolds has been developed, which allows for more versatility than the previous scheme. These scaffolds will be applied to a novel synthesis of pharmacologically important nitrosugars, the individual steps of which have been preliminarily explored.

We would like to thank the American Chemical Society Petroleum Research Fund and the National Science Foundation for financial support.

Poster 14

The Ins and Outs of Writing a Scientific Publication: “Fluoxetine Increases Prepulse Inhibition: Evidence for the Roles of 5-HT_{1A}, 5-HT_{1B}, and 5-HT_{2A/2C} Receptors”

D. Bitran, B. Myers, L.Loci

Department of Psychology, College of the Holy Cross

Data from five experiments conducted from summer 2008 to spring 2010 were compiled to write a research paper on determining the mechanism(s) by which fluoxetine alters acoustic startle response (ASR) and prepulse inhibition (PPI). We spent the summer organizing and analyzing the relevant data. A thorough review of the experimental protocols led us to write the methods section of the paper. We subsequently constructed graphs of the data and wrote a narrative describing the results. The introduction and discussion section required a mastery of the published literature – a process that is never-ending. The manuscript has been submitted to *Psychopharmacology* for publication. The following is a synopsis of the research project described therein: PPI is used as an animal model for various psychiatric disorders that involve a “gating” mechanism, most notably schizophrenia. Whereas dopamine agonists and glutamate NMDA receptor antagonists disrupt PPI, manipulations of brain serotonin (5-HT) produce equivocal effects. Untreated baseline PPI is an important variable. Working with animals with low levels of PPI, we found that fluoxetine increased PPI. In four additional experiments, we found that pretreatment with 5-HT_{1A} or 5-HT_{1B} receptor antagonists, as well as by 5-HT_{2A/2C} agonists dose-dependently prevented the effects of fluoxetine. Results were further discussed in the context of endophenotypic differences that may underlie the divergent behavioral responses to serotonergic manipulation.

This project was funded by the Alumni / Parents Summer Research Fellowships. In particular, we thank John F. Power '80 and Mary Figge Power '83, P12, P09 for supporting Lorena Loci, and Linda and Christopher Cheney, M.D., P10 for supporting Brenden Myers.

Poster 15

Ester-linked Beta-sheet Mimics and the Quantification of Hydrogen Bonding Strength in Small Peptides

Rio S. Nomoto and Brian R. Linton

Department of Chemistry, College of the Holy Cross

In our post-genomic world, the whole human genome and amino acid sequences of various proteins have been identified. However, we have yet to understand the molecular forces that control protein folding and aggregation. Aggregation of beta-sheets have been linked to a variety of diseases such as Alzheimer's, Huntington's, AIDS, and cancer. Beta-sheets are one of the secondary structures of protein we use to study protein interactions.

Since beta-sheets are difficult to isolate, we are developing small ester-linked beta-sheets that mimic natural beta-sheets. An ester-linked beta-sheet contains two important modifications: 1) the addition of an ester-linked tether for stability and 2) the replacement of hydrogen donors (amide) with ester-link to inhibit aggregation. By studying these artificial beta-sheets, we hope to gain insight into beta-sheet interactions and begin to think about how we can inhibit excessive beta-sheet aggregation in biological systems.

In addition to mimicking beta-sheets, we also studied the effect of functional groups and ring size on the strength of hydrogen bonding in small peptides through the use of concentration studies and hydrogen-deuterium exchange. Quantifying the strength of these hydrogen bonds helps us make predictions about their properties in beta-sheets.

We thank the National Science Foundation for financial support.

Poster 16

Cell-type specific expression of microRNAs in the early postnatal mouse inner ear

Andrew Biedlingmaier¹, Siaw-Lin Chan¹, Rani Elkon², David J. Eisenman¹, Scott E. Strome¹, Ronna Hertzano¹

1. Department of Otorhinolaryngology/Head and Neck Surgery, University of Maryland, Baltimore, MD, USA 2. The Netherlands Cancer Institute Division of Gene Regulation, Amsterdam, The Netherlands

MicroRNAs (miRNAs) are small RNA molecules that bind to the three prime untranslated region (3'UTR) of messenger RNA (mRNA), preventing translation of mRNA to protein. MiRNAs have recently been shown to play a role in proper inner ear development and function. Mutations in the *Mirn96* gene, a gene coding for miRNA-96 (miR-96), result in hereditary non-syndromic hearing loss in humans and mice. Our laboratory has recently developed a protocol that allows us to separate and collect different cell types from the mouse inner ear. A bioinformatic analysis of mRNA expression profiles from the sorted cells suggested the presence of two new miRNAs in the inner ear: miR-200b and miR-124a. We used whole mount and section *in situ* hybridization on the inner ears of newborn mice to study the expression patterns of miR-200b and miR-124a. MiR-182, a miRNA known to be expressed in the hair cells of the mouse inner ear, was used as a positive control for the *in situ* hybridization experiments.

We thank the Deafness Research Foundation for financial support.

Poster 17

Unraveling the Mechanism of Protein Splicing of a Hyperthermophilic Intein

*Michelle Marieni. Lauren Duffee. Deirdre Dorval. Julie Reitter.
Kenneth Mills.*

Department of Chemistry, College of the Holy Cross

An intein is an intervening polypeptide sequence that facilitates its own excision and the ligation of the flanking polypeptides, or exteins, through a four-step process called protein splicing. The intein that interrupts the DP2 subunit of the DNA polymerase II protein in *Pyrococcus abyssi* can be induced to splice in certain conditions and cleave in others. We have focused on the effect of particular mutations in two distinct regions: the N-1 amino acid and the TXXH box in the intein. Different mutations of the N-1 amino acid, the C-terminal residue of the N-extein, change the native asparagine to isoleucine, glutamic acid, or valine. Each mutation slowed the first step of the splicing reaction. Mutations in the conserved TXXH box in the intein show that particular mutations of both the threonine at amino acid 90 and the histidine at amino acid 93 to alanine prevent the intein from facilitating the first step of splicing. Mutations in the histidine at amino acid 173 and 184 to alanine slow the rate of the third step of splicing.

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

Poster 18

Exome Sequencing Reveals a Novel Causative Gene for Familial Amyotrophic Lateral Sclerosis

*John Landers, Ph.D., Patrick Lowe, Ashley Lyn LeClerc, Pamela
Keagle, Max Koppers*

Department of Neurology, University of Massachusetts

The search for causative genes in the inherited familial form of amyotrophic lateral sclerosis (fALS) has uncovered a variety of genetic foundations for the disease. SOD1, TARDBP, FUS/TLS, VAPB and ANG are examples of genes in which mutations have been found that correlate with disease. One approach taken to identify possible candidate genes is the sequencing and analysis of the exome of a single family in which the disease is prevalent and familial.

The single family approach provides an opportunity to discover a novel candidate gene in more than one person. Because families frequently share large identical portions of the exome, however, two distally related affected family members will have fewer areas of overlap while still presenting possible regions of disease causing mutation. Linkage studies were completed and showed four regions that were not known to contain previously discovered ALS genes and that presented LOD scores greater than 2 (one region on Chr1, two on Chr12, and one on Chr20). Two relatives were therefore selected for exome sequencing. Through this sequencing, one SNP encoded a nonsynonymous amino acid and segregated properly throughout the family. This gene's essential role in the RNA pathway sheds further light onto the developing pathological trend of amyotrophic lateral sclerosis, as seen in zebrafish models and cell cultures.

We thank the University of Massachusetts for financial support.

Poster 19

Executive Power Surge: Congressional Delegation of Authority and Tariff Politics in the Late Nineteenth Century

*Kevin M. Wallace and Professor Daniel Klinghard
Department of Political Science, The College of the Holy Cross*

After years of tightly controlling the tariff-writing process, between 1887 and 1897 Congress began debating the process of delegating power to the executive branch to determine tariff rates through a process of negotiating bilateral reciprocal trade agreements. This debate culminated in the extension of a limited delegation of power to the president in the 1897 Dingley Tariff Act.

Although this development has traditionally been understood as a response to the US's growing dependence on international trade, we place the debate over congressional delegation of power in the growing sense of the president's role as a national party leader better capable of reconciling conflicting claims of interest groups than is Congress; in short it was a political, rather than merely an economic decision.

By a careful study of congressional debates and interest group testimony, we also challenge the traditional view of tariff policy as determined largely by interest groups, and demonstrate the agency of politicians in re-shaping the policy process to suit their political interests.

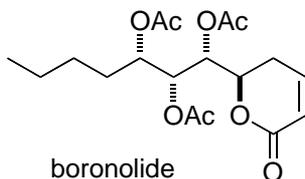
We would like to share our sincerest gratitude with The Andrew W. Mellon Foundation for their financial support.

Poster 20

Efforts Toward a Total Synthesis of (+)-Boronolide

Andrew J. Polio and Kevin J. Quinn

Department of Chemistry, College of the Holy Cross



Boronolide is an antimalarial natural product isolated from the leaves and branches of *Tetradenia fruticosa* and *Tetradenia barberae*. We have developed an efficient approach to the synthesis of the carbon framework of boronolide using olefin metathesis as a key step. Specifically, a tandem ring-closing/cross metathesis/alkene isomerization sequence has been employed to construct the α,β -unsaturated lactone and append a suitably functionalized sidechain in a one-pot procedure. Our approach is enantioselective and relies on the use of Sharpless oxidation reactions to establish all four stereocenters.

Financial support from Sherman Fairchild Foundation Summer Research Scholarship is gratefully acknowledged.

Poster 21

Characterization of Obelisc R Zwitterionic Stationary Phase

Brian Blum, Amber M. Hupp

Department of Chemistry, College of the Holy Cross

Reversed phase liquid chromatography (RPLC) was utilized to characterize the stationary phase Obelisc R produced by Sielc. This innovative stationary phase contains an anionic group connected by a hydrophobic chain to a cationic group at the surface of the support. It offers improved separation for polar and basic compounds in RPLC, although little is known about the retention mechanism.

A conventional LC system with ultraviolet detection (254 nm) was utilized. An isocratic methanol mobile phase was employed, where the percent water was increased stepwise from 0 to 25 percent. The retention factor and the USP peak tailing factor of basic (amitriptyline, nortriptyline, propranolol) and neutral hydrocarbons (benzene, toluene, ethylbenzene, and quinizarin) were measured and compared between the zwitterionic and a traditional octadecyl silica phase (C18).

The retention mechanism for the C18 phase displays an increase in retention factor according with an increase of water mobile phase percentage, for the neutral hydrocarbons. However, basic solutes were not retained by the C18 phase. Similar retention factors for the neutral compounds were obtained with the Obelisc R phase. However, basic solutes were retained by the zwitterionic phase, showing an increase in retention factor as percent water increased. Additionally, the difference in tailing factor for these solutes provides insight into the retention mechanism for this material.

We thank the Northeastern Section of the American Chemical Society for financial support.

Poster 22

Spay and Neuter Mandates: Are They Effective?

M. Boyle and M. Stevens

Department of Economics, College of the Holy Cross

Across America, counties have instated mandates requiring the surgical alteration of household pets. In California, five counties currently mandate spaying/neutering for dogs and cats and controversial pending legislation would create the first statewide spay and neuter mandate. Supporters of these mandates claim that they will reduce the population of stray animals, thereby lowering the number of shelter intakes and euthanasias performed annually. These reductions will likely lead to a decrease in taxpayer expenditures on animal shelters. However, those opposing such legislation believe it will result in an increase in abandoned animals and a reduction in adoptions, leading to an unintended increase in taxpayer spending on animal shelters.

Utilizing data on public animal shelters from 1995 through 2008, we test the impact of the county-level mandates in California. In a difference-in-differences regression framework, we compare shelter outcomes (including the number of animals entering, adopted, and euthanized) for counties with and without mandates before and after the mandates are passed. Preliminary results do not show statistically significant reductions in shelter intakes or euthanasias as a result of the mandates, calling into question the effectiveness of these laws. To further this research we plan to refine our control group using statistical matching techniques.

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

Poster 23

The Editing and Antiviral Activity of Apobec3G, an Anti-HIV Protein

Emily Kinn, Melissa A. Farrow, and Ann M. Sheehy
Department of Biology, College of the Holy Cross

Apobec3G (A3G) is a human protein that has been shown to inhibit the Human Immunodeficiency Virus (HIV), the virus that causes Acquired Immunodeficiency Disease (AIDS). A3G is a cytidine deaminase that inhibits HIV-1 by destructively hypermutating the viral genome during HIV reverse transcription. When A3G is packaged into the budding HIV virions, it interferes with the successful completion of the HIV reverse transcription process in the next round of target cells, thereby preventing the viral life cycle from progressing. Therefore, A3G's ability to be packaged into the HIV virions and to edit the viral genome are both important components of its antiviral activity. To identify the basis of A3G's antiviral activity, a comprehensive structure and function analysis of A3G was undertaken. A library of 135 A3G mutants were created and tested for their antiviral activity, their ability to mutate DNA *in vitro*, and their ability to be packaged into HIV virions. In this project, sixteen A3G mutants that have lost their antiviral activity, maintain the ability to mutate DNA *in vitro*, and are able to be packaged into HIV virions are tested for their ability to edit the HIV genome *in vivo*. This will provide further insight into which domains of A3G are important for its antiviral activity. A thorough understanding of these domains is necessary for future novel therapeutic interventions.

We thank the Arnold and Mabel Beckman Foundation Summer Research Scholarship for financial support.

Poster 24

Endogenous Small Interfering RNAs in *C. elegans*

L. Tonge and E. Youngman

Department of Biology, Univ. of Massachusetts Medical School

In the most basic sense, cancer occurs when cells that should have stopped dividing continue to divide. In the human body, this occurs when the proliferating cells divide to create two proliferating cells, instead of one that has a specific function and one that continues to divide. Usually, cell division is tightly controlled using many different mechanisms. In addition to regulatory proteins, small RNA molecules can also play an important role in gene regulation. MicroRNAs, for example, have been found to have a crucial role in gene regulation in many cancers, such as breast cancer and leukemia. Therefore, we hypothesize that other small RNA molecules may have similar roles in gene regulation. Of particular interest is a group of small RNA molecules called endogenous small interfering RNAs or endo-siRNAs. Endo-siRNAs are small RNA molecules that are encoded in the genome of all known animals. Little is known about how endo-siRNAs originate and how they function. My project focused on understanding the function of endo-siRNAs that target protein-coding genes in the nematode *C. elegans*. Toward that end, we have been creating a set of transgenic worms carrying “reporter genes” that will allow us to examine gene expression in the presence and absence of endo-siRNAs. We first fused our gene of interest, where we suspected endo-siRNAs to function with Green Fluorescent Protein (GFP). Then, the fused gene was injected into the germline of *C. elegans*, so that most of their progeny would contain the transgene. We used a protocol that allowed us to screen for worms that carried a copy of the transgene integrated into the genome at a defined site. These worms will be examined for GFP expression using fluorescence microscopy in both wild-type worms and worms that lack endo-siRNAs. This will allow us to characterize the function of endo-siRNAs and identify the cell types in which they function. Understanding how and why endo-siRNAs work, will allow us to apply this knowledge to gene regulation and cancer prevention.

The authors would like to thank the American Cancer Society for their financial support.

Poster 25

Neutrophil Gelatinase-B Associated Lipocalin (NGAL): A Proposed Inflammatory Marker of Heart Failure

*Jacqueline Imse, Detlef Wencker M.D., Cara Statz, Ph.D.
Hartford Hospital Heart Failure and Transplant Center*

It has been suggested that Neutrophil Gelatinase-B Associated Lipocalin (NGAL) may be a marker of inflammation in congestive heart failure patients. Studies have shown that NGAL may be involved in cell survival, inflammation, and cell degradation. Though levels of NGAL in urine and serum have been shown to be an indicator or biomarker for Acute Renal Failure (ARF) associated with heart diseases, the role and systemic presence of NGAL as an inflammatory biomarker for heart failure is not as well studied. Therefore, because inflammation plays a significant role in the progression of heart failure, we are interested in determining whether there is a higher level of NGAL present in heart muscle and skeletal muscle of heart failure patients at the time of Ventricular Assist Device (VAD) insertion. We are also investigating the level of NGAL in the urine and serum of heart failure patients seen in the Hartford Hospital Infusion Center. Specifically, higher levels of NGAL in serum may indicate NGAL is expressed more systemically and circulates throughout the body upon disease or injury, rather than simply a biomarker of worsening renal failure. Moreover, this study aims to suggest that the presence of NGAL in heart muscle of patients compared to normal healthy controls is a potential pro-apoptotic stimulus. Myocyte cell loss is due to apoptosis, proposed to be the central mechanism involved in heart failure progression. Thus it is hypothesized that heart failure patients will have an increased presence of NGAL in heart and skeletal tissues and in their urine and serum samples, versus normal controls. Furthermore, we predict serum levels of NGAL will be higher than urine as serum is systemic and circulates throughout the body.

Poster 26

Studying the Aggregation of Glutamine and Alanine-Based Tripeptides Using Infrared Spectroscopy

K. Gilmore and S. Petty

Department of Chemistry, College of the Holy Cross

Huntington's disease is a neurological disorder associated with an extension of the glutamine repeats at the N-terminus of the Huntingtin protein which leads to a change in the protein's structure. Similarly, the Prion diseases are caused by a structural change in the Prion protein that appears to be nucleated by β -sheet formation in residues 113-120, AGAAAAGA. When these proteins form β -sheets, which then aggregate to form amyloid fibrils, the proteins are unable to function, resulting in a diseased state. In this study, we analyzed which features of glutamine and alanine-based tripeptides lead to the formation of stable β -sheets. Of those that form stable β -sheets, we began analyzing the ability they have to induce β -sheet formation in those dipeptides and tripeptides that would not produce β -sheet on their own.

Tripeptides containing glutamine and alanine were synthesized in such a way that they mimic the presence of these peptides in a much larger protein. The ability of each of these tripeptides to form stable β -sheets was monitored by studying the temperature dependence of each of the peptides at pH7 at varying concentrations and in different buffers via infrared spectroscopy. We have found that while tri-glutamine and tri-alanine are able to form β -sheets, combinations of glutamine and alanine only form β -sheets under specific conditions.

Future work will include synthesizing longer peptides in order to better mimic the form of a pathogenic stretch of a protein.

The authors thank the Sherman Fairchild Foundation Summer Research Scholarship for funding this project.

Poster 27

Proposal for a Corrections-Based Work Program with Earnings Conditional on Good Behavior

R. Baumann, B. Engelhardt, M. Morgano

Department of Economics, College of the Holy Cross

High recidivism rates are an issue for concern because of the large cost associated with running prisons and the cost of a crime to a victim. Corrections-based work programs and transfer payments to ex-inmates are both potential ways to reduce recidivism. Currently, these two components are loosely connected as those who participate in work programs save a fraction of their earnings and spend it after their release from prison.

We propose an enhancement to the current structure of the savings account. Inmates should be required to save a larger fraction of their wages, paid the interest and portion of the principal uniformly after release, and forgo their remaining savings if convicted of a new offense. The spread out payments of the savings account will increase the opportunity cost of committing a crime to the ex-inmate, because they will not only risk going to prison again but also the remaining amount that is in their savings account. This money forgone due to recidivism can be transferred to participants to increase the wages of other inmates and further reduce recidivism.

We would like to do additional research on the exact impact of this program by conducting a randomized study with an experimental group of participants who work in corrections-based programs, but also save and get paid the interest and the principal of their savings account after release.

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

Poster 28

Investigating Controlling Products in Chemical Syntheses

Justin R. DeFrancisco and Brian R. Linton

Department of Chemistry, College of the Holy Cross

Chemical reactions often yield multiple products, although generally only one of those products is desired. Hydroxybenzotriazole is commonly used in peptide synthesis to improve yields. Reacting this with an acyl halide leads to two isomeric products. We were able to identify and isolate these two similar products. Using some of our newfound knowledge with HOBt, we sought to improve upon our synthesis of benzoylnitroethane, a molecule used in our stereoselectivity studies.

We are working on being able to control the three-dimensional structures of our products. We worked on selectively acetylating one of two possible hydroxyl groups on the same molecule, with the thought that we could design a way to selectively acetylate a molecule in such a way as to give the desired three-dimensionality. Our group has already shown ways to control the stereochemistry of the products of Michael additions. We are now working on Michael reactions with cyclopropanations, where a chain on the product closes to form a three-carbon ring. We will soon be trying to get these products to exhibit stereoselectivity.

We thank the American Chemical Society Petroleum Research Fund for financial support.

Poster 29

TCR-repertoire of CD4⁻CD8⁻ double-negative (DN) T lymphocytes in sooty mangabeys

Meagan Montesion^{1,2}, Namita Rout¹, Amitinder Kaur¹

¹Division of Immunology, New England Primate Research Center, Harvard Medical School, Southborough, MA 01772; ²Department of Biology, College of the Holy Cross

Sooty mangabeys are one of several African non-human primate species that are a natural host of the simian immunodeficiency virus (SIV) but typically do not progress to AIDS. One important way they differ in comparison with AIDS-susceptible hosts, such as rhesus macaques, is the presence of significantly higher frequencies of CD4⁻CD8⁻ double-negative (DN) T lymphocytes in their peripheral blood. While a small fraction of DN T lymphocytes in sooty mangabeys are natural killer T (NKT) and gamma delta ($\gamma\delta$) T lymphocytes, the function of the majority of DN T lymphocytes remains unknown. The purpose of our study was to investigate the T cell receptor (TCR) repertoire of DN T lymphocytes and determine whether it showed the same diversity as is classical for CD4⁺ and CD8⁺.

RNA was extracted from purified DN, CD4⁺ and CD8⁺ T lymphocyte populations obtained from the peripheral blood of one SIV-negative sooty mangabey by flow cytometry sorting. TCR α - and β -chains were generated by rapid amplification of 5' complementary DNA ends (5' RACE) with gene specific 3' primers in the constant region of TCR α and TCR β . The RACE PCR products were cloned and 30 clones per reaction were sequenced. The CDR3 region of the TCR sequence was then analyzed, showing DN T lymphocytes to have a different TCR repertoire from CD4⁺ and CD8⁺.

We thank the New England Primate Research Center, Harvard Medical School for financial support.

Poster 30

Tourism's Contemporary Impact on Bali's Geringsing Double-Ikat Weaving: A Fieldwork Study

Robin Cumella and Prof. Susan Rodgers

Department of Sociology and Anthropology, College of the Holy Cross

Bali's ancient double-ikat textile, the geringsing, has been extensively studied for its technical aspects, much as Bali itself has been studied as a true tourist mecca. However, there is a gap in the scholarly literature when it comes to the nature of the impact that tourism has had on this 'magical' textile. For the summer of 2010, Professor Susan Rodgers and student Robin Cumella embarked to Indonesia for four weeks to research this very gap, traveling to Tenganan, the one village in Bali where geringsing is patterned, dyed, and woven. Together, with the assistance of Rodgers's fluency in Bahasa Indonesia, they did fieldwork interviews and observations, culminating in insights as to how geringsing has both resisted and thrived under Bali's over-heated tourist industry.

In their travels, Rodgers and Cumella collected several of these extraordinary textiles for the College of the Holy Cross's Cantor Art Gallery, to be added to the Study Collection, and to be exhibited to the College and outside community in a hallway show curated by Rodgers and Cumella in February and March, 2011. This will be the first step as Rodgers works towards a larger exhibition in 2013 called *Transnational Ikat*, which will highlight ikats throughout Southeast Asia.

We thank the Andrew W. Mellon Foundation and the College of the Holy Cross Dean's Office for their generous financial support.

Poster 31

Managing medical uncertainty: doctors' and patients' perspectives of mild cognitive impairment

Tara Neary ('11) and Renee Beard, PhD

Department of Sociology, College of the Holy Cross

As the number of seniors continues to rise and the baby boomer generation grows older, Alzheimer's disease (AD) will continue to impact more lives. Through their efforts to fully understand the exact nature and etiology of Alzheimer's, researchers and clinicians have expanded diagnostic categories of dementia to include several cognitive disorders. Currently, 'mild cognitive impairment' (MCI) is the most widely accepted diagnosis among medical practitioners to describe impairment or decline in cognitive function that is detected in the non-demented elderly. MCI is most often used in clinical practice as a potential precursor to AD. However, diagnostic criteria for MCI and the utility of such a label remain heavily debated by those in the medical community responsible for evaluating patient accounts of memory loss.

This study draws on interviews with neurologists, neuropsychiatrists, geriatricians and general practitioners to investigate the social and clinical implications of employing a diagnostic label of mild cognitive impairment. The interviews reveal a lack of scientific consensus concerning the clinical challenges, appropriateness and ethical implications of using this label in clinical practice. These findings reflect the ambiguity reported by diagnosed individuals themselves and the potential social stigma they feel as a result of the association between MCI and Alzheimer's. This study helps us understand the differences between doctors' perspectives of diagnosing MCI and the personal accounts of living with the diagnosis.

We thank The Greisch Family Summer Research Fellowship Fund for Students in Sociology for financial support.

Poster 32

Two Faces of Early-Onset Alzheimer's: experiences of diagnosed individuals and their family members

R. Beard and M. Conner

Department of Sociology, College of the Holy Cross

Although Alzheimer's most commonly occurs in seniors, a growing number of individuals are being diagnosed younger, with what is called early-onset AD (EOAD). In-depth qualitative interviews (N=16) were conducted to learn about life with EOAD. This research delineates the unique experiences of early-onset AD, from both the perspective of those diagnosed and their family members. Grounded theory methods were used to collect, code and analyze data into common themes, which will be presented here. In comparison to stories of 'typical' Alzheimer's, when individuals are over 65, these narratives highlight the special needs and circumstances of families living with EOAD. After outlining the similarities between these respondents and those with AD, the significant differences will be highlighted, including clinical barriers, social obstacles, and interactional tensions. The distinct societal expectations and everyday interactions that complicate personal, intimate and social relationships will be discussed. These findings help us dispel the social perception that AD only happens to older people and can help improve Alzheimer care practices and services aimed at individuals with EOAD.

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

Poster 33

Novel Antifungal Activity of *Escherichia coli*

Mary Bonnet¹, Peter Belanky², Ruben Morones², James Collins²

¹College of the Holy Cross, ²Howard Hughes Medical
Institute/Boston University

Candida albicans is a human commensal yeast that can cause systemic infections in immuno-compromised patients, accounting for an average of 30,000 deaths a year. *C. albicans* is part of a larger human intestinal flora community, consisting of approximately 10 fungi and 1000 bacteria species, including *Escherichia coli*. We chose to study the competitive interaction of these two species in order to identify novel antifungal or antibacterial agents. We discovered that *E. coli* rapidly kill yeast when both organisms are grown together in the same synthetic environment. We found that the killing of yeast is caused by a soluble factor that is produced after four hours of co-culture. Interestingly, the actual killing of yeast is delayed until six hours of co-culture, implying that yeast need to reach stationary phase in order to become susceptible to the antifungal agent produced by *E. coli*. We determined that magnesium limitation in the growth medium is critical for yeast to induce stationary phase and become vulnerable to the antifungal agent. As a result magnesium supplementation blocks the killing effect of *E. coli*. Finally, we identified that two porin genes, *ompC* and *ompF*, are critical for the antifungal activity of *E. coli*. This is further indication that the toxic agent is an antifungal secreted by the bacteria. Identifying this molecule may lead to critical antifungal therapies and treatments.

This work was supported by the National Institute of Health and Howard Hughes Medical Institute.

Poster 34

Coral Reef Algal Interactions: Changing in a Time of a Climate Change

Christine Milne

*With thanks to Mark and Diane Little, Department of Botany,
Smithsonian National Museum of Natural History*

Coral reefs are complex ecosystems that are in need of ecosystem level preservation. Climate change is being questioned daily by top scientists around the world, but the effects of increased temperature and CO₂ on coral reefs endangerment has become obvious. Algae competition with the reefs as a result of imbalanced top-down and bottom-up ecosystem controls, and when algae wins the reef ecosystem as a whole loses. In reefs with top-down controls the biodiversity lost as a result of a changing climate could mean millions of dollars of economic revenue lost as rare species of fish are nearing extinction and tourism collapses. In bottom-up controls nutrients are advantageous for algal growth and out-compete coral for resources. This leads to a decimated reef bleached of all life except algae. Although action is being taken to preserve these coral reef ecosystems, more research and preservation efforts need to be done. Finding a way to keep the tipping point of the algal-coral interactions at the necessary levels is one of many solutions from preventing reef extinction. There are many solutions to help prevent reef extinction, however, one of the most important will be finding the delicate balance of the algal-coral interactions and maintaining that balance in order to keep it from tipping too far in either direction.

“In a nutshell”:

- Coral reefs rely on a balance with algae to maintain healthy species diversity and water quality, without this balance coral reefs are dying.
- Coral reefs are becoming endangered ecosystems from anthropogenic actions like over fishing and pollution.
- The changing climate affects reefs health greatly, with an increase in temperature or decrease in pH the coral-algae relationship is altered and the reefs health suffers.

Poster 35

Syndecan-4 as a Potential Anchor for Intermediate Filaments at Focal Adhesions

Jonathan Ye, Marisa Fortunato, Robert Bellin
Department of Biology, College of the Holy Cross

A focal adhesion complex is formed by a group of proteins that support the connection between a cell and a surface. Our recent studies have focused on the attachment of intermediate filaments (IFs) to focal adhesions in wildtype fibroblasts and syndecan-4 knockout fibroblasts. Previous work demonstrated that vimentin networks in knockout fibroblasts collapsed around the nucleus whereas the networks in wildtype fibroblasts were found to extend to the cell periphery to focal adhesion sites. In our current efforts, we attempted to determine if the large IF protein nestin is involved in this phenotypic difference.

Vimentin and nestin were determined to be present in both the wildtype and syndecan-4 knockout fibroblasts through the use of Western blotting. Immunofluorescent staining was then used to visualize the pattern of vimentin and nestin in these cell lines. Cells were grown to high density on coverslips and then stained for the proteins. In both the wildtype and knockout fibroblasts, nestin and vimentin were found to be co-localized in IF networks which were collapsed around the nucleus.

Based on these initial experiments, we conducted an expanded study to see how syndecan-4 might affect the process of IF anchoring during cell adhesion. Cells were fixed and stained at three and six hours after plating. The resulting slides did not show a difference in the pattern of IFs in the cell. Our lab group hopes to continue following this lead during the school year by looking at the IF networks a shorter time after plating and by staining for additional IF proteins family members.

We would like to thank Alumni / Parent Summer Research Scholarship, James F. Mooney III '90 and Lisa Reed Mooney for their donation to make this work possible.

Poster 36

Overtwisted Contact Structures

D. Scully and D. Damiano

Department of Mathematics, College of the Holy Cross

A *contact structure* on a 3-dimensional manifold is a completely non-integrable plane field. In this project we study *overtwisted* contact structures, that is, which contain overtwisted disks. Contact structures without overtwisted disks are called *tight*. In particular we consider the complements of closed curves tangent to the contact structure in Dymara's overtwisted three-dimensional sphere. The goal of this project is to prove that the complement of certain closed curves tangent to Dymara's contact structure has no overtwisted disks.

Our method for proving the complement has no overtwisted disks is to decompose it by cutting along convex Seifert surfaces. A *Seifert surface* is a surface whose boundary is the closed curve in question. A Seifert surface is *convex*, if the contact structure is a product in a product neighborhood of the surface. Then we analyze the family of curves or foliation induced by the contact structure on the resulting boundary surfaces. Techniques that we have used in this process include simple perturbations and manipulation theorems from Eliashberg and Fraser.

We thank the Alumni / Parent Summer Research Scholarship, Richard K. ('80) and Lindsay Watson Jr. for their generosity and financial support.

Poster 37

Difficulties Accepting the Loss of a Spouse

Christine Moran and Andrew Futterman

Department of Psychology, College of the Holy Cross

Using the Texas Revised Inventory of Grief (TRIG)-Present to assess bereavement response in a sample of 212 older widows and widowers, we examined the temporal relationships among three core aspects of grief (Non-Acceptance, Thoughts, and Emotional Response) at 2 and 12 months after loss. A two-wave, cross-lag panel analysis demonstrated that Non-Acceptance at 2 months following loss predicted more intense Thoughts and Emotional Response at 12 months following loss. By contrast, Thoughts and Emotional Response at 2 months were not predictive of grief intensity at 12 months following loss. These results are consistent with a meaning-oriented conceptualization of grief, in which intense grief reactions stem largely from difficulties accepting the reality of a loss and prevent the individual from having a purposeful future. Individuals frequently identify acceptance as critical in order to “make sense” of stressors, like bereavement.

From a clinical standpoint, Non-Acceptance may present a more chronic and severe grief reaction. Therefore, clinicians should pay close attention to expressions of Non-Acceptance in the early aftermath of loss to provide proper care to those who may be at risk. These individuals can then benefit from care that focuses on the importance of accepting the death of a loved one.

We thank the Richard B. Fisher Summer Research Scholarship for financial support.

Poster 38

Effects of Sleep-Smart Program on Young Adolescents' Sleep Hygiene Practices and Perceived Sleep-Health Competence

*Elizabeth Harkins, '13, Neha Patel, '10, and Amy R. Wolfson
Department of Psychology, College of the Holy Cross*

Seventh graders from 2 urban schools were randomly assigned to an 8-session Sleep-Smart (SS) Program (n = 70) or a comparison group (n = 73). Early adolescents in the SS group were taught cognitive-behavioral strategies to promote healthy, consistent, sleep patterns and sleep hygiene practices. Self-reported sleep problems, sleep hygiene practices, and sleep-health competence were assessed at baseline and following the completion of the preventive intervention. Controlling for pubertal status and gender, results indicate that 7th graders in the SS group reported significantly greater sleep management competence and improved sleep hygiene practices than did the comparison 7th graders. As a secondary finding, female head of household's education (controlling for other social class variables) played a significant role in that Sleep-Smart 7th graders with more educated mothers reported more improved sleep-health competence than their other SS peers. Future analyses will examine the two groups sleep behaviors and sleep-health competence at assessments completed in 8th grade.

We thank the James and Jeanne Moyer for financial support for E. Harkins summer research and NIH, NICHD, 5 R01 HD047928-06 for funding of the Young Adolescent Sleep-Smart Pacesetter Program.

Poster 39

Prolonged PARP Inhibition Affects Fiber Type Composition and Enhances Muscle Contractility during the Regenerative Phase of Reperfusion Injury

P. J. Laub, H. Albadawi MD, M. T. Watkins MD

*Massachusetts General Hospital and Harvard Medical School,
Boston, MA*

Peripheral vascular disease is a disease condition that leads to hardening and narrowing of the major vessels in the patient's limbs resulting in inadequate or complete loss of blood supply to the affected tissue that lead to muscle necrosis. Clinically, these patients undergo open or endovascular interventions aimed at restoration of the blood flow in their limbs. These events are collectively known as ischemia-reperfusion injury (IR). Previous studies in mice demonstrate post-hoc Poly ADP-Ribose Polymerase (PARP) inhibition provides protection following acute hindlimb IR. We performed *in vivo* experiments to assess whether continuous PARP inhibition using a potent PARP inhibitor PJ34 or PARP-1 genetic deficiency (PARP-1 $-/-$) will modulate skeletal muscle function and fiber type distribution during the regenerative phase of reperfusion injury in the mouse model of IR. We employed functional scoring systems and physiologic tools to measure the progression of limb functional recovery. We also used microscopic evaluation to measure muscle fibers maturation and fiber type distribution during the study period. Our results indicated that at two weeks IR both PJ34 treatment and PARP-1 $-/-$ groups had significantly higher peak contractile forces compared to untreated Wild type controls ($p < 0.01$). PJ34 treated group had higher percentage of mature fibers compared to both PARP-1 $-/-$ and the control ($p < 0.01$). Compared to the uninjured hindlimb, both groups expressed higher percentage of slow-twitch muscle fibers in the muscle. Thus, PARP inhibition may be useful treatment strategy for improving limb performance and exercise capacity in patients during recovery from peripheral vascular interventions.

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

Poster 40

Using Mannich Condensations to model the structure and function of metalloenzyme active sites

P. R. Renehan and J. Farrell

Department of Chemistry, College of the Holy Cross

Many processes in the cell rely on enzymes to function. Our goal is to build compounds that mimic the structure and function of metalloenzyme active-sites. We have prepared a series of novel compounds that mimic several important features of the active-sites of metallo-enzymes (enzymes that bind metal ions). With these, we have the ability to control the properties of the ligand-metal ion interaction by altering (1) the number/type of heteroatoms in the ligand, (2) the relative electron density at those heteroatoms, and (3) the sterics of the interaction (the “bulkiness” of the groups involved in the reaction). Five di-amino, multi-dentate ligands were prepared using Mannich Condensation reactions. The overall syntheses occurred in two steps, inserting a different 2,4-disubstituted phenol to either end of N,N'-dimethyldiaminoethane. One of these hetero-ligands (Cl/t-bu) was previously prepared using the multi-step reductive amination. Our complimentary approach has fewer steps and uses simpler and less costly starting materials.

We thank the Arnold and Mabel Beckman Foundation Summer Research Scholarship for financial support.

Poster 41

Efficiency of cucumber pollinators in western Massachusetts

Craig Connolly, Paul CaraDonna, and Nicholas Barber
*Department of Plant, Soil, and Insect Sciences,
University of Massachusetts, Amherst*

Bees are essential pollinators in agricultural systems and contribute to the production of at least 90 crops in the United States. Animal-mediated pollination is critical for the production of cucurbit crops, yet the efficiency of these pollinators is poorly understood. To explore the relative importance of native and introduced pollinators on the pollination of cucumber (*Cucumis sativus*), we assessed the pollen transfer efficiency of different cucumber pollinators in western Massachusetts.

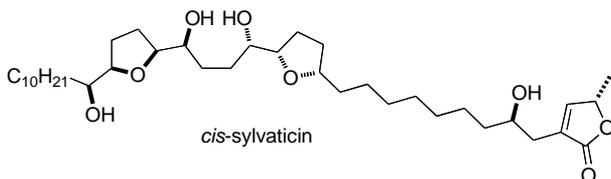
Our objectives were to determine (1) the most common pollinators at our field site, (2) the duration of each floral probe, and (3) how much pollen is deposited in a single visit by each pollinator species. This allowed us to compare the relative efficiency of native bees in the family Halictidae versus the domesticated honey bee (*Apis mellifera*). Overall, honey bees were the superior pollinator at our field site accounting for more than 70% of all visits and approximately 80% of all cucumber pollen transferred. However, probe duration and pollen deposition for two of the native halictid bees was similar to honey bees. These results suggest that native bees may be equally effective as the introduced honey bee if their abundance at field sites is increased. Furthermore, this information is important to farmers because it conveys the effectiveness of native and domesticated bees as pollinators in agricultural settings.

We thank the USDA and University of Massachusetts-Amherst for financial support.

Poster 42

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

Colin O. Hayes, Kathleen E. Shanley and Kevin J. Quinn
Department of Chemistry, College of the Holy Cross



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

Financial support from the National Science Foundation is gratefully acknowledged.

Poster 43

Effects of Alcohol on Cognitive Control Over Behavior

*Christina Kyriakos, '11, Neha Patel, '10,
Gregory DiGirolamo and Amy R. Wolfson*

Department of Psychology, College of the Holy Cross

Alcohol, at even low doses, results in cognitive impairments that impact one's ability to exert control over behavior. Control is not unitary, however, and can be divided into conscious control (effortfully exerted with the awareness of the stimuli) and unconscious control (automatic, unaware acquisition of the parameters that determine successful performance). This study asks whether alcohol equally affects how an individual exerts conscious and/or unconscious control. A within-subject design was used to examine the effects of a low dose of alcohol (.85 g/kg of weight-dependent vodka, containing 37.5% ethanol, compared to placebo) on the ability to perform a behavioral task. Preliminary results suggest that alcohol increases error rates when presented with contradicting information, as manipulated by two arrows pointing in opposite directions. Further, when the conflicting information is presented consciously, alcohol increases error rates. However, when presented unconsciously, error rates remain the same as placebo. Future work on the study will have significant implications for alcohol consumption and driving, which requires an ability to control processes even when conflicting information is presented (e.g. the ability to not turn right when the street sign says no right turn).

We thank the Alumni / Parent Summer Research Scholarship David M. '74 and Michelle Joy for financial support.

Poster 44

Preoperative Uterine Artery Embolization Prior to Hysterectomy

*Kerry Drury, E. Samartino, Dr. Hallisey, Dr. Greene, Dr. Sorosky
Hartford Hospital*

The objective of this study was to evaluate and assess the effectiveness of performing immediate preoperative uterine artery embolization (UAE) in the reduction of intraoperative and perioperative blood loss in women undergoing hysterectomy with large fibroid uteri. A retrospective study of 35 women who underwent preoperative UAE was performed to evaluate the postoperative and perioperative blood loss during hysterectomy for large fibroid uteri during a 4 year period. The patients all underwent UAE with spherical particles material using a microcatheter technique and a femoral artery approach. The patients then underwent surgery to remove the uterus by means of a total abdominal hysterectomy, a supercervical hysterectomy, or a vaginal hysterectomy. The age, height, weight, operating time, weight of uterus, estimated blood loss (EBL), transfusion volume, pre and post operative hematocrit, pre and post operative hemoglobin, length of stay, and complication rate were retrospectively collected from each patient's chart. This information was then compared to standards in the literature of women who had hysterectomies without UAE performed preoperatively.

The average blood loss for the patients was 477.9 mL, compared with 555.8 mL blood loss seen in the literature for a comparable average uterine weight. Most importantly, the complication rate for this study was 25.7%, versus 61.7% in the literature, when complications included EBL > 500 mL, perioperative transfusion, major organ injury, postoperative therapeutic antibiotics, and readmission. This study suggests that preoperative UAE reduces the intraoperative blood loss of patients who undergo hysterectomy, and shows a significant decrease in complication rate between the 35 patients who underwent UAE in this study compared to standards in the literature of patients with similar average uteri weight.

Special thanks to the physicians at Hartford Hospital for financial support of the Summer Student Research Fellowship Program

Poster 45

Analysis of Protein Splicing: Crystallization of *C. thermocellum* intein and Ligation of *Nsp-JS614* TOPRIM intein

George Savidis, Julie N. Reitter and Kenneth V. Mills

Protein splicing is the post-translational, self-directed excision of an intervening polypeptide sequence, also called an intein, from flanking polypeptides, or exteins. This process also entails the ligation of the exteins, following the excision of the intein. Protein splicing was analyzed by two different methods. We first attempted to find optimum crystallization conditions for the *Clostridium thermocellum* (Cth TerA) intein. Crystal screening of protein from competent *Escherichia coli* BL21(DE3) via the hanging drop method provided a possible means for determining the structure of the Cth TerA intein. In the second method, a ligation was performed in which the Nsp-JS614 TOPRIM intein from *Nocardioides JS614* was excised using endonucleases StuI and ClaI and inserted into the digested RIR1gst vector of competent Nova Blue cells. The ligation was not successful, thus far, as the transformation of the recombinant plasmid did not yield growth of bacterial colonies. Upon expression of successfully ligated DNA, we will perform a Western blot on the protein with His-tag and GST residues to determine if proper cleavage did indeed occur between N and C termini.

This material is based upon work supported by the National Science Foundation under grant MCB-0950245, the Camille and Henry Dreyfus Foundation, and a Sherman Fairchild Foundation Summer Research Scholarship.

Poster 46

Implicit interpersonal synchrony in social interactions

Caitlin Ward and R. C. Schmidt

Department of Psychology, College of the Holy Cross

Our daily, natural interactions with other people often involve the coordination of movements and behaviors. Past research indicates that both bodily and mental coordination are related and vital in successful interpersonal interaction. In this study participants told knock-knock jokes and played the game Pictionary. An analysis of video records revealed that participants significantly coordinated their movements during both tasks and that participants' behavior during joke telling was more synchronized when they faced one another than when they faced away. Also, a regression analysis revealed correlations between behavioral and mental measures: Bodily synchrony positively correlated with interdependence and negatively correlated with familiarity. The results illustrate that interacting individuals embody connectedness during social and communicative acts.

We thank the Holy Cross Alumni/Parent Summer Scholarship Fund, Samuel E. Krug, Ph.D. '65, the National Science Foundation (BCS-0750187) and the Agence Nationale de la Recherche (ANR-09-BLAN-0405-03) for financial support.

Poster 47

New Synthetic Routes to Re(I) d^6 Compounds

Bertha Baroody and Richard S. Herrick

Department of Chemistry, College of the Holy Cross

Recently, ^{186}Re and ^{188}Re β^- emitters have started to be considered for medical use. The use of organometallic compounds as tagging agents is a novel approach that may lead to new ways to treat and diagnose certain types of cancer. This research will assist in the development of new applications for diagnostic imaging or therapy. As a contrasting agent Re is a much better absorber of x-rays than iodine.

Also, exploring different compounds that can inhibit active sites of enzymes by binding them to the $\text{Re}(\text{CO})_3^+$ will allow the development and supply information for the biological processes of Tc/Re imaging agents.

New synthetic routes to Re(I) d^6 compounds are important to developing different organometallic compounds. While working with different compounds containing rhenium and pyridine carboxaldehyde, new crystal structures were determined from products of these reactions. Many different techniques were attempted to yield superior results of desired products. Once determined, these methods can then be used as a basis to build rhenium molecules that will in the future target specific areas in the body.

Future work in this area will involve refining experimental methods and solving the crystal structures of the spectrochemical series of the $\text{Re}(\text{CO})_3(\text{py-aldehyde})^+$ compounds. The development of these compounds will provide further understanding with rhenium and organometallic chemistry.

We would like to thank the Alumni/Parents Summer Research Scholarship, Edward A. Meyers, M.D. '46, P73 for financial support.

Poster 48

Syntheses of Rhenium Compounds as a Contrast Agent and Platinum/Palladium Compounds as Anti-Tumor Drugs

Javin Brita and Richard S. Herrick

Department of Chemistry, College of the Holy Cross

Currently, ^{99m}Tc is the most commonly used nuclide in nuclear medicine with over 50,000 applications occurring each day in the U.S. But unlike rhenium, technetium has no stable isotopes, so the study of rhenium shows promise for radiopharmaceutical and diagnostic imaging candidates. Rhenium has two β -emitting nuclides, ^{186}Re and ^{188}Re , and both may find clinical use. Diagnosis and therapy are combined by using $\text{M}(\text{CO})_3\text{L}$ ($\text{M} = ^{99m}\text{Tc}, ^{186/188}\text{Re}$) congeners for selective treatment of a tumor. However, for diagnostic imaging, $\text{Re}(\text{CO})_3\text{L}$ works as a contrast agent for CT scans, creating better images via contrast between the agent and body fluids or structures. Agents are sought to be non-toxic or less toxic than other agents, as well as water soluble. The use of 2-pyridinecarboxaldehyde and derivatives of sulfonic acid were studied to test the possible insertion of these ligands on the rhenium center. Creating an α -diimine using a $[\text{Re}(\text{CO})_3]^+$ center allows for new possibilities in support of rhenium-based contrast agents.

Platinum drugs became a highlight in cancer treatment since 1978, becoming the cornerstone of solid-tumor chemotherapy. Cisplatin has paved the way in the creation of new platinum drugs, as new compounds similar to it are being synthesized. Both Pt and Pd versions of the MCl_2 diimines have been confirmed by combining 2-pyridinecarboxaldehyde and an aminohexanoic ester as a ligand. For further study, more has been produced for elemental analysis.

We thank the Alumni / Parent Summer Research Scholarship, Edward A. Meyers, M.D. '46 for financial support.

Poster 49

Effect of Bacterial Variation on Dissolved Organic Carbon Metabolism

A. Crowley and W. Sobczak

Department of Biology, College of the Holy Cross

Previous research on Siberia's Kolyma River has found that in sampling locations across the watershed, the amount of carbon considered bioavailable, defined as the fraction consumed during the course of five day incubation, is quite consistently 5% during the summer months. The possibility of shifting bacterial populations across the region offers one potential explanation. Bacterial samples from lakes, streams, and rivers feeding the Kolyma were inoculated into filtered river water either individually or as a combination in order to study whether different populations consume a different fraction of the dissolved organic carbon (DOC) pool and whether local populations have a selective advantage over non-native populations. Metabolism was measured through biological oxygen demand, defined as the dissolved oxygen change over a five day period, and change in DOC over the same period.

The results of both independent methods suggest that bacteria in the Kolyma River and its environs do not consume different fractions of the DOC pool. Non-native bacteria introduced into the Kolyma do not appear to suffer a disadvantage compared to the local population. Another interesting finding of the project suggests that the carbon bioavailability this summer was no greater than 2.5% although further work will be necessary before explanations can be offered.

We would like to thank the National Science Foundation for financial support.

Poster 50

Protein Splicing: C-terminal Cleavage of an Intein

Stacy Chin and Kenneth Mills

Department of Chemistry, College of the Holy Cross

Protein splicing is a post-translational, self-catalyzed process in which an intervening polypeptide, known as the intein, is self-excised from the flanking polypeptide or exteins. Our goal is to successfully induce C-terminal cleavage of a protein to facilitate purification from a solid affinity resin. To achieve this goal, the plasmid, pHMIGlnSelwC1A, must be transformed into competent *Escherichia coli* BL21(DE3), overexpressed by inducing with IPTG, purified from a bacterial pellet, and bounded to a solid affinity resin. To observe C-terminal cleavage of the protein, a protein assay is performed by SDS-PAGE after heating the protein in solution at 55° C for 16 hours.

The C-terminal cleavage fragment was difficult to observe on the gel due to its low molecular weight. We replaced the N-terminal His-tag with a Strep-tag by cassette mutagenesis so we can then perform the reaction on the Strep-tag affinity resin under more rigorous conditions than with the His-link resin. We will attempt to directly cleave the C-extein off the resin by heating the protein-bound resin in the presence of TCEP and EDTA. The C-extein will then be collected and purified via a MonoS column using Fast Protein Liquid Chromatography.

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

Poster 51

The Effect of PARP Inhibition on Muscle Regeneration In Vitro

J. Trubiano, H. Albadawi, and M T. Watkins

Vascular Research Laboratory, Massachusetts General Hospital

Patients with vascular disease undergo surgical interventions aimed at reestablishing blood supply after a blockade of a major artery in their lower limbs. The inadequate blood supply, called ischemia, damages muscle fibers by necrosis. An initial inflammatory response clears some dead fibers, followed by a regeneration process. Muscle regeneration is dependent on the activation of the local stem cells (satellite cells), which are usually quiescent and reside beneath the basal lamina of the muscle fiber. Several signaling molecules initiate satellite cell proliferation into myoblasts, followed by fusion of multiple myoblasts into new myotubes. Despite successful surgical intervention, patients with underlying disease, such as diabetes, tend to have a delayed healing process in muscles and other affected tissues.

PJ34, a water soluble inhibitor of the nuclear enzyme Poly ADP ribose polymerase (PARP), is a candidate drug thought to enhance muscle regeneration following ischemia. PJ34 has proven to be effective in salvaging the tissue following injury in different experimental models including the heart, kidney and brain. The aim of my project was to test the effect of PJ34 on murine myoblasts cell line (C2C12) proliferation and differentiation in a dose- response manner under normal conditions. We utilized fluorescence microscopy and western blotting techniques to detect myoblasts fusion and measure the relative expression of specific markers of myoblasts differentiation. In addition, a WST-1 assay was performed to examine the metabolic effects of PJ34 on proliferating C2C12 myoblasts. PJ34 treatment had no impact on the expression of markers of regeneration or C2C12 metabolic activity. Future studies will be carried out to test the effect of this drug on these cells under pathologic conditions.

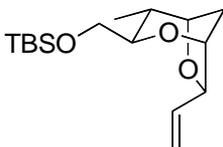
We sincerely thank the National Institutes of Health for financial support.

Poster 52

Efforts Toward the Synthesis of the Sorangicin A Bicyclic Ether Subunit

Nikolas Savage and Kevin J. Quinn

Department of Chemistry, College of the Holy Cross



Sorangicin A is natural product with potent antibiotic activity against both gram-positive and gram-negative bacteria. It possesses a unique bicyclic ether substructure embedded within a large macrocyclic lactone. We will discuss our efforts toward an asymmetric synthesis of the bicyclic ether subunit shown above. Key to our approach is the use of a C₂-symmetric diene diol starting material and application of a size-selective ring-closing metathesis reaction/conjugate addition sequence. If successful, our route would provide the bicycle in just four steps and would encourage further studies on a total synthesis of sorangicin A.

Financial support from the National Science Foundation is gratefully acknowledged.

Poster 53

“(Re)Texting Josephus: The Destruction of Jerusalem's Temple in an Emergent Edition.”

M. Caulfield and Professor Thomas Martin

Department of Classics, College of the Holy Cross

The Josephus Emergent Edition Project has made accessible, for the first time, three Latin texts of the most pivotal chapter in Flavius Josephus' Jewish War, based on printed editions from the 15th and 16th centuries, a time at which Josephus' works were second in popularity only to the Bible. These works hold especial interest for textual critics in that they were originally written in Aramaic, later in ancient Greek, and then translated into Latin under the Roman Empire.

Working from scanned images and high-quality photographs, we transcribed the texts and digitally tagged special components in Extensible Markup Language (XML) for content-specific display. With this data we were able to compare editions and isolate differences for use in tracing back to the “truest” representation of the Latin Josephus.

JEEP takes its name from the new editorial technique devised during and for the project, a full-disclosure comparative approach in the spirit of the open source humanities movement. This "emergent edition" technique eliminates redundant revision, fosters efficient collaboration, and allows for unlimited expansion of the scope of sources.

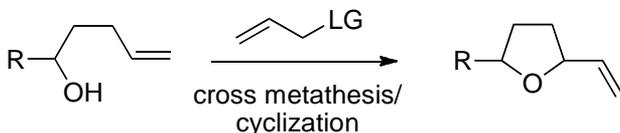
We would like to thank The Andrew W. Mellon Foundation for their generous financial support.

Poster 54

A Tandem Cross Metathesis/ S_N2' Approach for the Synthesis of Tetrahydrofurans

Christopher Jacques and Kevin J. Quinn

Department of Chemistry, College of the Holy Cross



Tetrahydrofuran rings are common substructures in biologically relevant natural products, including polyether antibiotics and Annonaceous acetogenins. We are studying an approach to the synthesis of tetrahydrofurans from homoallylic alcohols via olefin cross metathesis with an allyl halide or allyl acetate followed by intramolecular S_N2' displacement. The use of such a tandem approach offers significant advantages over more commonly employed sequential routes. We will report on our preliminary studies of this approach, including the stereochemical outcome of the cyclization.

Financial support from the Sherman Fairchild Foundation Summer Research Scholarship is gratefully acknowledged.

Poster 55

Targeted Mutagenesis of FtsZ to identify specific residues involved in MreB ring formation

J. Trautwein, P. Vats, and L. Rothfield

*Department of Molecular, Microbial, and Structural Biology,
University of Connecticut Health Center*

MreB, a prokaryotic actin homologue, is organized as a double stranded helical structure that extends from pole-to-pole along the longitudinal axis. It also gets redistributed in the form of ring structures, either single or in pairs that encircle the cell cylinder. This redistribution from helix to ring is dependent on an essential cell division protein--FtsZ. However, it is unknown whether FtsZ is solely responsible for this reorganization event of MreB or if some other proteins are promoting this process. Since FtsZ is now known to affect the MreB transition from helix to ring structures, specific FtsZ residues that may be interacting with MreB directly were screened. 90 surface amino acids on FtsZ were selected and mutagenized to alanine (*e.g.*, E3A) by PCR amplification. The PCR fragments were cloned into a medium copy vector for sequence confirmation. Once the mutations were confirmed, the fragments were cloned into a low copy plasmid for use in experiments. Preliminary experiments showed that a single mutation at the extreme N-terminus of FtsZ protein like E3→A destabilizes the protein. Phase contrast microscopy results showed that cells fail to divide and form long filaments. Immunofluorescence microscopy showed that these E3A filaments do not contain any FtsZ and MreB rings. Experiments are on-going to determine the mutant that abolishes MreB redistribution event from helix to ring without affecting FtsZ ring formation.

Sponsored by the UConn Health Center Graduate Programs
Committee Undergraduate Summer Fellowship Program

Poster 56

Embodied Social Coordination in Autism

R. Diorio, P. Fitzpatrick, C. Ward, and R. C. Schmidt
Department of Psychology, College of the Holy Cross

Although we often think that social connectedness arises from our ability to relate to others mentally, the coordination of our bodies also plays a critical role in our ability to connect with others. Previous research studies suggest that children with autism may be impaired in their ability to achieve bodily connectedness. We examined the nature of their impairment by studying their performance on a variety of simple imitation and synchrony tasks. Furthermore, using theory of mind, helping, and cooperation tasks, we examined their ability to achieve mental connectedness with others. Finally, we evaluated whether measures of bodily connectedness were significantly correlated with measures of mental connectedness in both children with autism and typically developing children.

Preliminary analyses of the participants' movement suggest that children with autism exhibited slightly less bodily coordination in imitation tasks. In addition, in spite of the fact autistic children demonstrated understanding of intentionality of others and the ability to initiate joint attention, they were less likely to attempt to re-engage the experimenter during an interruption period in a cooperation task. Finally, several analyses suggest that there is a relationship between bodily and mental connectedness. We will continue the research study over the course of the next year to further examine this relationship.

We thank the National Science Foundation (BCS-0750187) and Agence Nationale de la Recherche (ANR-09-BLAN-0405-03) for financial support.

Poster 57

Development of Corona Discharge Ion Mobility Spectrometer

J. DeLisio and J. Kelley

Department of Chemistry, College of the Holy Cross

Ion mobility spectrometry (IMS) is a fast and efficient way of detecting trace amounts of explosives and narcotics. IMS differentiates molecules by the time it takes ions to travel down a drift tube with an electric field gradient to a detector. A shutter is used to trap the ionized molecules mid flight, compress the ion packet, and release it into the drift tube in order to produce sharp peaks at the detector. This technique is very effective in detecting and differentiating large organic molecules based on how long it takes them to travel down the drift tube.

IMS technology is used commercially with radioactive ionization sources. In this work, a Corona Discharge IMS (CD-IMS) was designed and fabricated to create a non-radioactive ionization region by using electricity to create a plasma. Incorporating this type of ionization source will result in a more environmentally friendly device due to the removal of the radioactive source. This technique may also allow for ionization of molecules that may not be ionizable with a radioactive source.

A rack-mounted setup was constructed to house the control electronics for the instrument. Machining, chemical etching, and computer programming were used to assemble and troubleshoot the CD-IMS instrument.

We would like to thank the Alumni / Parent Summer Research Scholarship, Domenic J. '75 and Catherine E. Dinardo for their support of our research.

Poster 58

A Detection System for Ion-Atom Collisions

Matthew Davis '12 and Prof. Paul Oxley

Department of Physics, College of the Holy Cross

The ultimate goal of our research is to investigate collisions between highly excited atoms, known as Rydberg atoms, and ions. These experiments will improve our understanding of the role that Rydberg atoms play in determining the physical properties of plasmas, in which such collisions occur.

This summer we worked on two related projects. The first was to design an ion detection system that would extract ions after an ion-atom collision. Using *SIMION*, a sophisticated computer software program, we were able to complete designs of an apparatus which uses an arrangement of electric fields to guide ions from the collision site to an ion detector called a Channel Electron Multiplier (CEM). We completed two separate designs: one to detect “slow” ions (moving with speeds ~ 1000 m/s) and one to detect “fast” ions (moving at $\sim 100,000$ m/s). The apparatus we designed will be built in the future.

For the second project we constructed a vacuum system to operate the CEM and assembled electronics to read out the CEM signals. The vacuum system was built to house the CEM and a Polonium-210 radioactive source which emits helium ions. The readout electronics included a charge sensitive preamplifier, a voltage amplifier, a discriminator, and either a counter or a multi-channel analyzer. We successfully tested the CEM and were able to detect and count the number of helium ions emitted by the radioactive source.

We are very grateful to the Alumni/Parents Summer Research Scholarship, Gerard P. Richer, '80 for financial support, to Dick Miller for machining expertise, Prof. Narita for the preamplifier, and to Prof. Kelley for use of *SIMION*.

Poster 59

An Ion Source for Plasma Physics Collision Studies.

Pat Collins '12 and Prof. Paul Oxley

Department of Physics, College of the Holy Cross

Our research this summer encompassed two main projects. The first project consisted of the refurbishing of a Colutron Research Corporation ion gun system and the rewiring of the control electronics that power the system. The ion gun assembly includes an ion source, a focusing and accelerating system, and a velocity filter; all of which were disassembled, refurbished (where necessary) and reassembled. The control electronics consists of seven voltage and current supplies and a series of interlocks to ensure the safe running of the ion gun. Additional equipment, such as a gas handling system to supply the ion source with atoms to ionize and a cooling system used to cool the ion gun, were also assembled.

The second project consisted of refurbishing and testing a vacuum system used to create a region of very low pressure surrounding the ion gun. This is required since too high a pressure would result in unwanted collisions between ions and background gas molecules. The vacuum system includes two vacuum pumps: a high vacuum diffusion pump and low vacuum rotary vane pump, along with a series of vacuum valves and gauges. The vacuum system has achieved pressures as low as 3.6×10^{-6} Torr, or a factor of 200 million times lower than atmospheric pressure. The ion gun with its associated electronics, cooling system, gas handling hardware, and vacuum system have all been tested separately and perform as required.

This ion gun system will provide an ion beam suitable for future charge transfer collision experiments between atoms and ions. Understanding the physical processes which occur in these collisions is essential for determining the physical properties of astrophysical plasmas, and high quality experimental data produced using this ion source will contribute to continuing progress in this field.

We are very grateful to the Alumni/Parents Summer Research Scholarship and Sean J. O'Scannlain '86 for their financial support, and to Dick Miller for machining expertise.

Poster 60

Investigation of hydrogen bonding in β -sheets

Benjamin D. Brink and Brian R. Linton

Department of Chemistry, College of the Holy Cross

Protein misfolding can cause various ailments including Alzheimer's, Huntington's, and Parkinson's disease. In order to better understand how protein folding works we are studying hydrogen bonding in β -sheets. However, β -sheets tend to be fairly large and contain many hydrogen bonds so in order to closely study a specific hydrogen bonding interaction we are synthesizing small cystine peptides which mimic a small β -sheet but with only two hydrogen bonds present.

While working on building various cystine peptides we used the coupling reagent 1-hydroxybenzotriazole, abbreviated as HOBt. To our surprise, HOBt reacted in a way that produced two acyl-OBt products instead of the expected single product. Depending on various conditions we were able to manipulate the ratio's of acyl-OBt products.

We thank the Sherman Fairchild Foundation Summer Research Scholarship for financial support.

Poster 61

Obtaining Information from the Pitchf/x System

SJ Anderson and MB Koss

Department of Physics, College of the Holy Cross

The Pitchf/x system is used in every Major League Baseball park to track the trajectory of each and every pitch thrown in all games and extract parameters to describe those pitches. These parameters are then available via the internet to anyone who wishes to view it hours after the game ends.

What we were able to accomplish was to take nine parameters for every pitch and create a spreadsheet that calculated more useful quantities. The nine parameters were the three initial position components, the three initial velocity components, and the three acceleration components (assumed constant by Pitchf/x). We were first able to take the velocity components in Cartesian coordinates and transform them into more useful spherical coordinate quantities (a magnitude and two angles, the polar angle, θ , and the azimuthal angle, ϕ).

Next, we calculated the drag and lift forces with the goal of obtaining a time dependent spin rate for each pitch thrown. We then were able to find spin rates for the entire flight of the pitch. The spin rate that we calculated was generally too large and also increased with time. The former of these two discoveries can perhaps be attributed to the error in the Pitchf/x values, while the latter we feel is a direct consequence of the system assuming the ball's acceleration to be constant from start to finish.

We thank the Massachusetts Space Grant Consortium Summer Fellowship Fund for financial support.

Poster 62

The Burden of Autism: Improving our Understanding of the Economic Impact of Autism in the Context of Early Detection among the Global Autism Community

*Alison Komorowski, College of the Holy Cross
In affiliation with the Summer Internship Program and Autism Speaks*



The cost of autism spectrum disorders (ASD) is a measure of all possible burdens resulting from the disorder, including direct and indirect costs as well as its detrimental effect on quality of life of the individual and their family. Although the cost of autism spectrum disorders to individuals, their families and society is profound, concrete estimates are scarce because of difficulties in assessment. Specifically, little is known about the effect of early detection and intervention on burden of ASD. Furthermore, the few studies that are available were conducted in the Western World meaning limited information, if any, exists on burden of ASD in low and middle income countries. The purpose of this project is to consider ASD in the context of burden of disease (BoD) to discern what information is available and what information is still needed in order to conduct a comprehensive study of the burden of ASD. Recommendations for future assessments, in both developing and developed countries, are made based on the methods and resources employed in BoD studies on other developmental disorders. Learning from these models, we can take steps toward improving our understanding of the burden of autism, which can serve as an instrument for the advocacy of individuals living with and affected by ASD.

I thank the Holy Cross Leadership Council of New York for providing the funding for this project.

Poster 63

Creating a database of carotid endarterectomies (CEA) and carotid angioplasty and stenting (CAS)

*Virendra Patel, M.D., Mark Conrad, M.D, and Emily Atkinson
Department of Vascular Surgery, Massachusetts General Hospital*

Ever since carotid angioplasty and stenting (CAS) was introduced in 1994, it has been hailed as a miraculous innovation. Without a doubt, the procedure possesses benefits over endarterectomy (CEA), the conventional carotid surgery. Given that it is an endovascular procedure, CAS is especially advantageous for patients at high-risk for open surgery. In addition, recovery time is quicker, and there is a decreased chance of wound infection. However, how CAS compares to CEA in frequency of other morbidities such as stroke, transient ischemic attack (TIA), and myocardial infarction (MI) is less obvious. Depending on the criteria and methods used, various studies have found both that CAS is equivalent to CEA and that it is inferior. Consequently, the purpose of this project is to obtain a more definitive conclusion about the effectiveness of CAS vs. CEA.

Using a large-scale retrospective cohort study, the researchers analyzed a plethora of variables in order to thoroughly compare CAS and CEA. **[Based on the preliminary results, CAS resulted in a greater frequency of TIAs and strokes, whereas CEA was more often associated with MIs and death.]** (this can be eliminated if you want me to just discuss similar studies, since I don't have complete results or statistical significance testing)

Financial support was provided by the Department of Vascular Surgery at the Massachusetts General Hospital.

Poster 64

Female Veterans of the Persian Gulf War

Cristin Johnson

Department of History, College of the Holy Cross

“No army can withstand the strength of an idea whose time has come” –Victor Hugo

Who are the female veterans of the Persian Gulf, and why is the role that they played so important? The Persian Gulf War saw the largest deployment of female soldiers in United States history, a fact that is all but forgotten by the American public, the military, and historians alike. This project focuses on the history of U.S. women in war, the roles and performances of women in the Persian Gulf War, the legislation affecting female soldiers before Desert Shield and Desert Storm, and the legislation established after the conflict. The transformation of female military participation can be attributed not only to a high demand for female enlistment due to the creation and continuation of the All Volunteer Force, but also due to the accomplishments made by servicewomen during the Persian Gulf War. With a heavy emphasis on independent study, this project largely consisted of archival research. Some interviews of female veterans were conducted in order to ascertain what the veterans themselves emphasized as influential—the lack of a “front line” in modern warfare, the impact that deployment had on their families, and psychological affects after the war. A website was created in order to exhibit the findings, the interviews and the trials and tribulations of undertaking such a research process. While much effort was put forth, much remains to be achieved, and proper tribute through historiography is still needed in order to compile a complete and accurate record of these events. The process of identifying veterans and performing the initial interviews was initiated, however much remains to be developed.

Special thanks to the Alumni / Parent Summer Research Scholarship, Stephen P. Skinner '77 and Nancy Savage Skinner '79 for their generous financial support.

Poster 65

Summer Legal Research-The Tax Exemption Status of Churches

Casandra Medeiros '12 and Scott Sandstrom

Department of Economics, College of the Holy Cross

Topic: At what point does a tax-exempt organization violate the Internal Revenue Code (IRC) when it engages in political speech? What is an appropriate remedy for churches that cross the line?

Background: 503(B) religious organizations remain tax-exempt, providing that IRS rules and regulations are met, and respected. Specifically, churches are not allowed to substantially partake in political activities, such as electioneering, which is promotion of a particular candidate/party. Tax exemption could be lost if requirements not followed.

Views of the Prohibition: Many oppose the prohibition of churches engaging in politics due to many believing that political and religious issues, such as abortion, euthanasia, gay-marriage, etc. are topics that should be discussed by both politicians and religious leaders.

Others who support the prohibition believe that the ban prevents members of a congregation from donating to a church that supports a candidate that the member himself/herself does not.

Conclusion: There is a hotly contested line between what is acceptable political behavior by religious leaders and what is free speech and general advocacy for ideas. Those who engage in pulpit activities where political candidates and political parties are endorsed risk losing the tax-exempt status of their religious group.

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

Poster 66

Evaluating the American Recovery and Reinvestment Act (ARRA)

R.Baumann, B.Engelhardt, A.Panetta

Department of Economics, College of the Holy Cross

On February 17, 2009 congress passed the largest countercyclical fiscal stimulus in history. The stimulus was enacted in the midst of what many call “the Great Recession”, with real GDP falling and unemployment rising rapidly. At a record, \$787 Billion the American Recovery and Reinvestment Act (ARRA) allocated billions in stimulus funds to states and individuals in the form of tax breaks, entitlements, contracts, grants, and loans. Under a provision of the ARRA recipients receiving over \$25k were required to report their expenditures, place of performance, and jobs created or saved. The main objective of the ARRA was job creation and stimulating the economy toward recovery.

The task was to take this recipient reported data and evaluate, in economic terms, the effect of stimulus funds on job creation. Our research looked at many different economic indicators alongside the stimulus data. The Bureau of Labor Statistics (BLS) and Bureau of Economic Analysis (BEA) provided various measures of employment and personal income.

Our preliminary results show no effect on employment. Based on the recipient reported data; each job came at a cost of \$160,000. The BLS employment data showed no significant change in employment due to the ARRA.

This research was supported by the May and Stanley Smith Charitable Trust

Poster 67

Do College Athletic Programs Satisfy Generally Accepted Accounting Principles

*Joseph Herberger, Victor Matheson, Debra O'Connor
Department of Economics, College of the Holy Cross*

This paper examines the profitability of Division I athletic programs at colleges and universities in the United States under a variety of accounting definitions of profit. The data identify several broad themes. First, a majority of athletic departments rely heavily on direct and indirect subsidization of their programs by the student body, the institution itself, and state governments in order to balance their books. Without such funding, less than a third of BCS athletic departments and no non-BCS departments are in the black. Second, athletic programs rely heavily on contributions to balance their books. Donations to athletic department may serve as a substitute for donations to the rest of the university, lowering giving to other programs. Third, football and men's basketball programs are generally highly profitable at BCS schools, but below this top tier, fewer than 10% of football programs and 15% of men's basketball programs make money.

We would like to thank The May and Stanley Smith Charitable Trust for their support.

Poster 68

Paleontological Fieldwork in Arizona, New Mexico and Utah

M. Gallant and Z. Lavender

Faculty Advisor: L. Claessens

Department of Biology, College of the Holy Cross

In June and July of 2010 we excavated vertebrate fossils from Early Permian through Late Cretaceous rock exposures in Petrified Forest National Park, Arizona; Ghost Ranch, New Mexico; and Grand Staircase-Escalante National Monument, Utah. Fieldwork was conducted in collaboration with the Yale Peabody Museum of Natural History (YPM) and the Utah Museum of Natural History (UMNH).

At Petrified Forest National Park, we helped the YPM field crew excavate disarticulated limb, skull, and dermal plate elements of aetosaurs and phytosaurs. Aetosaurs are herbivorous reptiles that have a pig snout and an armadillo-like body with armored dermal plates. Phytosaurs are carnivorous aquatic reptiles resembling modern day long-snouted piscivorous crocodiles. The fossils were recovered from fluvial deposits from the Upper Triassic Chinle Formation.

We worked with the UMNH field crew to excavate the Hayden Quarry at Ghost Ranch, a locality from the Upper Triassic Chinle Formation. The Hayden Quarry dates between 210 and 220 million years ago. At one of the four quarry sites, we recovered an unusually large amount of phytosaur skulls.

In Grand Staircase-Escalante National Monument, we uncovered a turtle shell and limb and skull elements of a taxon that may be basal to hadrosaurian dinosaurs. The fossils that were excavated were from the Upper Cretaceous Straight Cliffs Formation which dates between approximately 80.1 and 93.5 million years ago.

All of the fossil specimens that were collected this summer will help to enhance our understanding of the terrestrial vertebrate faunas of the Mesozoic era.

We would like to thank the YPM, UMNH, and the Alumni and Parents Summer Research Scholarship, Peter F. '86 and Linda C. '86 Jankowski, for this incredible opportunity and financial support.

Poster 69

Implicit Learning in Cotton Top Tamarins

Laura Dillon, Dr. Locurto

Department of Psychology, College of the Holy Cross

Implicit learning is the learning of sequence information through exposure without instructions to learn that information. Learning to ride a bicycle or walking down the street are examples of implicit learning. These tasks are may be learned without awareness. We used Cotton-top Tamarins to study implicit learning in a non-human primate. Subjects were presented with a sequence of visual images on a six-quadrant touch screen. There were no correct responses but the subjects had to touch the image to advance the sequence to the next image. Subjects were rewarded randomly with a probability of .17/element. A sequence of four elements was arranged in a pattern dictated by an artificial grammar. The grammar consisted of four elements, each of which had two possible correct transitions determined by a specific location on the touch screen. These grammatical transitions were put into chains or trials that consisted of a series of the different transitions on the touch screen. The subjects were exposed to a series of these grammatical transitions in discrete trials during acquisition. The subjects then underwent pair-wise testing to determine if they had gained knowledge of the grammar or were choosing an element randomly. This pair-wise testing was done by having two images appear on the touch screen at the same time. One of the images was grammatical while the other image was a non-grammatical transition. It was expected that the Tamarins would choose the grammatical transition over the non-grammatical transition, thereby indicating they had learned the grammar. We also conducted a random test which is a blunt assessment to see if the subjects learned the grammar by examining the latency of the response by the subject.

We thank the Alumni / Parent Summer Research Scholarship Herman R.'56 and Mary Charbonneau P97 for their financial support and the New England Primate Research Center for allowing us to use their facility.

Poster 70

A novel HINT-like protein

Kristina Xega, Julie N. Reitter and Kenneth V. Mills
Department of Chemistry, College of the Holy Cross

A "hedgehog protein" is a transmembrane protein involved in segment polarity and cell-cell signaling during embryogenesis and metamorphosis in the fruit fly *Drosophila melanogaster*, and in other insects and vertebrates. The Hh protein is synthesized as a precursor composed of two domains, the N-terminal signaling domain and the C-terminal autoprocessing domain. A substantial part of the autoprocessing domain shares sequence similarity with self-splicing inteins and therefore this domain has been named Hint. C-terminal to the Hint domain is a sterol recognition region (SRR). A cholesterol moiety to the N-terminal signaling domain is required for the proper function of the N-terminal ligand. Splicing can be induced in vitro, allowing for time-resolved studies of the mechanism of the hedgehog protein. I am currently studying the properties of an intein-like protein found in Japanese wild rice. During the summer I was trying to make two expression contexts: S-V-H-His and His-M-V-H-GST. I was mostly concentrated on cloning the cDNA either with Vwait domain or without into an E.coli expression vector called the RIR1 gst vector by ligating it with the Rice insert which was successfully done. This year, I plan to express my proteins, see if they can promote N-terminal cleavage, and make mutations to conserved Hh residues.

This material is based upon work supported by the National Science Foundation under Grant No. 0320824 and CAREER grant No. 0447647

Poster 71

Using the CHANDRA X-Ray Observatory to Model the Accretion Structure of Black Holes: A Comparative Study

R. Nazarian and T. Narita

Department of Physics, College of the Holy Cross

Using the Chandra X-Ray Observatory, we conduct a comparative study of 4U1630-472, Cygnus X-1, GX 339, and H1821+643 to understand the accretion structure and statistical modeling techniques of black holes. Subsequently, we seek to probe and modify the standard data processing pipeline in NASA's CIAO data processing software for this individualized method of analysis. Specifically, we pay special attention to the "Gaussian" model which indicates the presence of highly ionized emission lines from the black hole's gaseous accretion disk, and absorption lines from the accretion disk corona. Similarly, photon emission dips will provide evidence for possible warping within the black holes' accretion disk. This theory of gaseous warping will be proven by quantitative traces of stronger and weaker emission lines as a function of time, which varies from time-independent functions seen in non-warping accretion disks.

We studied the photon emission from 4U1630-472 during a 50180 second observation, Cygnus X-1 during a 15000 second observation, GX 339 during a 75600 second observation, and H1821+643 during a 101260 second observation. A spectral analysis of the data suggests these sources to be modeled by various components including absorption from interstellar gases, blackbody radiation from a hot gaseous disk surrounding the source, and atomic absorption from iron. The width of this absorption line and the suspected accretion disk warping have not yet been confirmed.

We thank the Sherman Fairchild Foundation for their financial support.

Poster 72

Frequency Tuning of a Semiconductor Laser with and without Feedback from an External Cavity

*Michael DeFeo '12 and Prof. Timothy Roach
Department of Physics, College of the Holy Cross*

We studied the frequency tuning behavior of a GaAlAs diode laser with and without an external cavity. Without the cavity, we measured the effect of input current and casing temperature on the output laser light frequency, which changed in a continuous manner over most of the explored range. To add an external cavity, we constructed a mount for a diffraction grating with a parallel mirror to reflect the beam in a consistent direction. Behind the grating we placed three piezoelectric transducers (PZT) to add full control of the position of the grating, including the angle between the grating face and the incident beam. After the external cavity was completed, the laser light frequency dependence on input current and casing temperature was again tested, with several different external cavity configurations. The laser light frequency in this case showed only short regions of continuous tuning, separated by discontinuous jumps (“mode hops”). The character of the mode hops depended on the length of the external cavity, in a manner consistent with results of our numerical model for the laser system.

Additionally, we investigated how the laser frequency (via the diffraction grating) reacted to driven oscillations in the PZT. Using a lock-in amplifier to compare the modulation input of the PZT and the output of a photodiode measuring the laser light after passing through a Rb absorption cell, we were able to identify several resonant frequencies in the PZT-grating setup. Understanding the response of the laser on different time scales will be useful when we need to control the laser using the PZT.

We thank the Sherman Fairchild Foundation for their support.

Computer Modeling of a Laser & Properties of a CCD Camera

A. Novicki, M. DeFeo and T. Roach

Department of Physics, College of the Holy Cross

We developed a numerical model of a GaAlAs semiconductor laser with external cavity grating feedback to understand and predict the behavior of the laser frequency with changes to variables such as the laser current and the external cavity length. The model accounted for the gain and loss in the semiconductor diode, and included the external cavity using a complex reflection coefficient. Using a computer to investigate the model, we were able to explain some strange behavior that we saw in the actual laser, such as the pattern of discontinuous frequency jumps when current is changed. The model was also applied to the behavior in situations without an external cavity. In this case, the model, along with experimental data, helped us to determine some physical properties of the laser such as the length of the diode and the reflectivity of the laser facet.

We also ran tests on a camera we use to take images of laser light scattered by atoms in our experiments, to determine the electronic noise on the CCD chip and the quantum efficiency of the camera. We found that "binning" (combining adjacent pixels) improves the signal-to-noise ratio. Hardware binning results in lower noise than software binning, though not as low as expected from a simple "read-noise" model.

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

Poster 74

The Use of LIBS to Detect Heavy Metal Pollution in Blackstone River Sediments

K. Tracy and J. Kelley

Department of Chemistry, College of the Holy Cross

Laser induced breakdown spectroscopy (LIBS) is a technique that uses a highly focused, pulsed laser beam to strike a sample and create a superheated plasma. This plasma emits light characteristic of the elements within the sample. The resulting spectrum is analyzed to determine what elements are present (qualitative information) as well as the amount of each element present (quantitative information). We use LIBS as a fast and inexpensive way of quantifying heavy metal pollution in river sediment. Sample preparation is minimal as LIBS works directly on untreated soil. LIBS, however, has the disadvantage of shot to shot fluctuations in spectrum intensity, which leads to a higher degree of error compared to other analytical techniques.

We examined our samples using the more accepted method of Atomic Absorption (AA) Spectroscopy and compared the AA results to our LIBS results. AA requires significantly more sample preparation, which is costly and does not allow for as many samples to be examined. AA requires that the soil sample be fully in solution, a process that uses large quantities of strong nitric acid to dissolve the soil.

Over the course of our research we were able to modify the LIBS instrument to make it more efficient, and worked on creating a straightforward way of processing the resulting data. We are working on developing better experimental techniques for acquiring LIBS spectra so the technique can become a reliable method of surveying for heavy metal contamination on the Blackstone River.

We thank the Sherman Fairchild Foundation for financial support of this work.

Poster 75

The Impact of Voter Initiatives on a State's Economic Characteristics

Justin Svec and Sovita Hean

Department of Economics, College of the Holy Cross

This research explores the impact of voter initiative laws on a state's macroeconomy. The voter initiative laws, held by twenty-four US states, permit a voter to directly submit legislation for a public vote, assuming that the voter has obtained the required number of signatures. Specifically, we sought to analyze whether the presence of these laws influenced the average growth rate or the level of inequality within a state. Preliminary results are obtained using simple linear regressions by having voter initiatives as an independent variable, inequality (1977-2008), change in inequality (1977-2008), and real growth (1977-1997) as dependent variables, and other relevant factors as control variables (using 1977 data). The results show that the presence of laws that allow voter initiatives decreases a state's growth rate in output and its growth rate in inequality. Thus, it seems that voter initiatives present a trade off between growth and change in inequality for policymakers.

We thank the Smith Charitable Trust for their financial support.

Poster 76

The Value of a Private School: Differential Returns and Selection on Observables

Anil Nathan and Sovita Hean

Department of Economics, College of the Holy Cross

The value of attending a private school versus a public school is explored in this paper. Many prior studies have explored this topic, with results that are mixed in either direction. This study attempts to see whether there are differential returns to attending a private school based on ability level. This study also intends to non-parametrically control for the selection on observables of the decision to attend private school. Two methods of matching are used to correct for selection: propensity score matching and nearest-neighbor covariate matching. Using 8th graders from the National Educational Longitudinal Study of 1988, we find that there is a positive effect on standardized math test scores using OLS. Based on quantile regression results, average students (the middle percentile) benefit most from private schools. Low-achieving students (the low percentile) and high-achieving students (the high percentile) do not benefit as much. The particularly low return to private school for high achievers suggests most of them would succeed at any school. The nearest neighbor matching results suggest that after controlling for selection, that returns to private school are higher than before. This result suggests that perhaps low and average achieving students are selecting into private schools in order to seek improvement. However, propensity score matching results suggest that controlling for selection lowers the returns to private school. This result suggests that high-achieving students are selecting into private schools, and they could do just as well in a public school. Therefore, selection effects are ambiguous.

We thank the Smith Charitable Trust for their financial support.

Poster 77

Non-Invasive Measurement of Chemotherapy Drugs in Tissue

K. Rosenthal, I. Bigio, and A. Ergin

Department of Biomedical Engineering, Boston University

The need for non-invasive measurements of chemotherapy drugs is integral for monitoring the optimum dosage of the drug. The effects of chemotherapy drugs are time-concentration dependent. With the knowledge of the concentration in the system, the better the drug can be catered to fight the tumor. We have collected data on the optical properties of various dyes in tissue phantoms using the method of Optical pharmacokinetics (OP) spectroscopy. Each experiment is set up with a tubing bundle placed between two layers of the agar gel tissue phantom; mimicking a blood vessel and skin. The use of OP spectroscopy allows us to see the level of absorption inside the phantom and the bundle by observing the optical properties of the various dyes.

This study has been brought to the next level of testing at Columbia University. The OP spectroscopy technique was used to determine if the blood-brain barriers of rabbits were successfully disrupted by the dye (Evan's Blue dye). In the future this technique will allow oncologists to determine whether they are distributing the correct dosage of drugs to the effected area.

We thank the Boston University Biomedical Engineering Department for its support.

Poster 78

Synthesis of new thiophine-phenol hybrid ligands for electropolymerization

Tom Morell, J. Farrell, R. Anderson

Department of Chemistry, College of the Holy Cross

The Farrell research group has focused on preparing several different polyelectrochromic materials, which change color when an applied voltage is varied. For several years, the Farrell group has worked to perfect the use of the Mannich condensation reaction for such syntheses, and so my synthesis has followed the same general guideline. Overall, it is a 5-step synthesis in which the starting phenol first undergoes a protective step. Then undergoes a thiophene coupling, followed by the deprotection of the phenol. Finally, the Mannich condensation reaction is run and the metal is introduced into the compound as the final step of the reaction.

For the summer, our apparent dilemma was determining how best to resolve the solubility problems that final ligand displayed. So, in the second step of the reaction we coupled the protected phenol with 3,4-ethylenedioxythiophene (EDOT) in an attempt to make it more soluble. However after coupling, we were never able to deprotect the phenol. Therefore, we went back to the original synthesis and tried the Mannich condensation reaction under different conditions until we were able to synthesize the desired ligand in sufficient yields. Next, we will study the electrochemical properties of the ligand and begin to determine possible applications for it.

We thank the Alumni / Parents Summer Research Scholarship, Rhonda L. Larsen and Robert A. Harrington M.D. '82 for financial support.

Poster 79

Characterization of the Mutagenic Activity of APOBEC3G, An Antiviral Protein

Sarah Meng and Ann M. Sheehy

Department of Biology, College of the Holy Cross

Acquired Immunodeficiency Syndrome, AIDS, is a devastating disease that currently affects 33.4 million people worldwide. It is caused by the retrovirus HIV which targets and destroys the host's T cells, the primary cells of the immune system. As a result, the immune system weakens, leaving the host unable to fight off infections. HIV is particularly difficult to target therapeutically; however, human cells express an endogenous antiviral protein, APOBEC3G (A3G), which provides a potent defense against HIV. A3G is a cytidine deaminase, an enzyme that is able to mutate the viral genome. Interestingly, it is not clear whether this enzymatic ability is absolutely essential to the antiviral function of this protein. However, it is clear that A3G fatally interfere with viral infectivity. An investigation of the relationship between the catalytic and antiviral functions of A3G will be crucial to fully understand its antiviral mechanism.

In this work, we have identified A3G mutants that exhibit a complete loss of catalytic function yet still exert a strong antiviral effect. Our work supports previous observations that reported an uncoupling of these two functions. The exertion of an antiviral effect independent of mutagenic capacity not only supports the possibility of alternative antiviral mechanisms, but also will be important to future design of novel therapeutic interventions.

We are grateful to Asha and Mahesh Navani P12 for their generous support of the Alumni/Parent Summer Research scholarship that provided the resources for this work.

Poster 80

Role of α_1 GABA_A receptors in the acute dependence of squirrel monkeys following zolpidem administration

J. Jankowski, B. Fischer, and J. Rowlett

*Harvard Medical School, New England Primate Research Center,
Southborough, MA*

The present study utilized operant behavior as a means of assessing the involvement of the α_1 GABA_A receptor subtype in acute dependence of the benzodiazepine zolpidem. Three squirrel monkeys were trained to respond for sucrose pellets under a fixed-ratio 10 (FR10) schedule of reinforcement before being administered zolpidem (an α_1 -selective GABA_A receptor agonist), flumazenil (a nonselective GABA_A receptor antagonist), and/or 3-PBC (an α_1 -selective GABA_A receptor antagonist).

Zolpidem (0.032-1.0 mg/kg, i.v.) alone produced dose-dependent decreases in response rate, an effect that was also found to be time-dependent (rates returned to baseline 100 minutes after the injection). Flumazenil (0.1-3.2 mg/kg, i.v.) alone and 3-PBC (0.32-10.0 mg/kg, i.v.) alone produced no rate-decrease, but if administered following a 100 minute pretreatment of zolpidem, flumazenil and 3-PBC were seen to produce dose-dependent decreases in response rates (~50% and ~25% of control levels respectively). The results suggest that both flumazenil and 3-PBC can precipitate a disruption of schedule-controlled behavior, that a single injection of zolpidem is sufficient to produce a physical dependence, and that the α_1 GABA_A receptor is likely involved in this effect. Additional studies are necessary to determine the role of α_2 , α_3 , and α_5 GABA_A receptors in this effect.

This work was funded in part by U.S. Public Health Service grants DA11792 and RR00168.

Poster 81

Enhancing Linear Representations in Preschoolers: There's an App for That

C. Francois and D. Bukatko

Department of Psychology, College of the Holy Cross

Research has shown that preschoolers' numerical ability can predict their later academic success. Siegler and Ramani (2009) showed that linear board games improved children's numerical skills by enhancing their number line understanding. The present study sought to explore the effect of a related mathematical intervention on the numerical performance of children at risk for underachievement.

Thirty children from a local childcare center servicing low income children were pretested on five numerical skills: counting, numerical magnitude, number identification, arithmetic and number line estimation. They were randomly assigned to a vertical, horizontal or control condition where the children in horizontal and vertical groups were asked to measure vertical or horizontal pairs of pictures in four sessions of 15 minutes. The children then took a posttest, which assessed the same numerical skills as the pretest. It was hypothesized that the children in the horizontal condition would show greater improvement in math skills because the activity would allow them to form a mental representation of the linear number line. Results showed no significant changes in performance from pretest to posttest although there was a trend for accuracy in numerical magnitude comparison to increase in all conditions. Reasons for failure to obtain significant effects are explored.

This research was made possible with funds provided by the Richard B. Fisher Summer Research Scholarship.

Poster 82

Bipolar Disorder and Creativity

Benjamin Fask, Robert Cording, and Mark Freeman

Department of English and Psychology, College of the Holy Cross

The goal of my research was to investigate the relationship between bipolar disorder and creativity. Through extensive readings under the guidance of faculty advisor Mark Freeman, I was able to learn about both philosophical and psychological aspects of the relationship at hand.

The list of readings we explored ranged from classical readings in ascetics by such writers as Freud, Jung and Tolstoy to more contemporary works including *Finding Your Bipolar Muse* by Lana R. Castle, *The Courage to Create* by Rollo May, *The Dynamics of Creation* by Anthony Storr, and *Touched with Fire: Manic Depressive Illness and the Artistic Temperament* by Kay R. Jamison.

The second objective of my summer research was to write my own poetry. Under the guidance of Professor Cording, I read selected poems by contemporary poets Carl Dennis, Billy Collins, Mark Halliday, Dean Young, and Tony Hoagland. Reading their work was incredibly helpful to my own writing. Also under Professor Cording's guidance I was able to create my own "chapbook," a small collection of my own poetry, titled *Puddle-wonderful*.

A final aspect of my project was establishing a poetry group at the Worcester Recovery Learning Center (RLC), a state-funded outreach program dedicated to individuals coping with mental illness. I will be continuing my work with the RLC through independent study during the fall 2010 semester.

My experience has been nothing short of spectacular! Through it I have been able to dig deeper into my own soul and reach out to others in a meaningful and significant way. Ultimately, I have grown both as a poet and as a human being.

This work was made possible by a grant from the Andrew W. Mellon Foundation.

Poster 83

Visualizing the physics of baseball

N. A Drane and M. B. Koss

Department of Physics, College of the Holy Cross

Physicists are engaged in dialogue with other physicists discussing the flight of a pitched baseball, and their exchanges are recorded in professional journals. We are resolved to expand this conversation to include players and coaches. We distilled the physicists' models into a computer program that permits a player to interact directly with the pitch, without understanding its mathematical underpinnings. The program accepts a set of input parameters extracted from the Major League's Pitchf/x system in standard units, performs a series of calculations, and then plots the pitch's trajectory onto an axis whose orientation a player or coach can manipulate. The final product reveals how a small change in pitcher's release speed or direction can turn a wild pitch into a well-placed strike and how one pitcher's fastball, curveball, and changeup differ.

We thank the Massachusetts Space Grant Consortium Summer Fellowship Fund for financial support.

Poster 84

The Kinetics of Protein Splicing

Colleen Donahue and Kenneth Mills

Department of Chemistry, College of the Holy Cross

In the molecular process known as protein splicing, an intervening polypeptide, an intein, is able to facilitate its own excision from its two flanking sequences, the exteins. Since this reaction does not require a supplementary enzyme for activation, the intein acts as its own pseudo-enzyme. Due to its enzyme-like behavior we know that its rates of reaction are dependent on certain factors such as pH and temperature. Observing the third step in the protein splicing reaction of a mutant intein fusion protein of *Pyrococcus abyssi*, we ran pH curves to determine the optimal pH for this reaction. Buffers with pH's at intervals of 0.5 were created using sodium phosphate with sodium chloride and bicine with sodium chloride, and tested in an oven at a temperature of 60°C. After densitometry analysis of the data, the pH that had the fastest rate of reaction was 6.5.

Once the optimal pH was determined, we used it to test the rate of reaction at different temperatures. The temperatures that were used during the experiment ranged from 45°C to 70°C at intervals of five. Thermocyclers were used to ensure more accurate results at each temperature over one-hour time intervals. From the data analysis, the optimal temperature with a pH of 6.5 is 70°C. The kinetics of this protein splicing will be tested further using other mutant inteins, as well as wild type intein, and observing the first step of the mechanism.

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

A numerical approach to the n-body problem

*Chelsea Dalphond and Prof. Gareth Roberts,
Dept. of Mathematics/CS – College of the Holy Cross*

The n-body problem is a difficult problem in celestial mechanics. It deals with predicting the motion of arbitrarily many celestial bodies in any arrangement in space and their subsequent interactions according to Newton's laws of gravitation. Past this, various methods are used to investigate the problem such as locating central configurations. With the correct initial velocities, these configurations lead to circular or elliptical periodic solutions. Released from rest, the masses are attracted toward the center of mass until they collide.

One is able to numerically approximate solutions to the n-body problem using pre-programmed differential equation solvers. However, there will always be some level of numerical error. This can be seen easily when mapping a periodic solution over a long period of time.

Symplectic integration tries to minimize this error by approximating the flow with a symplectic map, thereby preserving the Hamiltonian structure of the system. In this way, energy is nearly preserved. In order to better understand the pre-programmed ODE solvers, we wrote and implemented code for a symplectic integrator for the three-body problem. This gave us a handle on the level of numerical error obtained in each method and can be used in the future to design better n-body simulators.

A special thanks to the National Science Foundation for funding our research.

Poster 86

Poster Presented at the 9th International Congress of Vertebrate Morphology, Punta del Este, Uruguay, July 2010

Aves 3D: A new online resource for the three-dimensional skeletal anatomy of extant and extinct birds

Blumhagen, E.¹, Cooper, M.¹, Dmytriw, M.¹, Eckardt, M.¹, Ehlers, H.¹, John, S.¹, Lavender, Z.¹, Martinez, R.¹, Drake, A.¹, Edwards, S.² & L. Claessens¹

¹ *College of the Holy Cross. United States*

² *Harvard University. United States*

Aves 3D is a new National Science Foundation funded online database for the skeletal anatomy of extant and extinct birds. The Aves 3D website, <http://aves3d.org>, offers detailed three-dimensional digital models of common, rare, fragile and unique avian bones and skeletons. At the time of writing this abstract, the database covers 128 species 400 individual models, including two holotypes. New models are added to the database on a weekly basis. Digital three-dimensional surface models are produced through non-contact laser surface scanning of skeletal material from, amongst others, the Harvard Museum of Comparative Zoology and the Yale Peabody Museum of Natural History. Digital models for the database are produced predominantly through undergraduate research, in collaboration with affiliated and external researchers and students, on a variety of ecomorphological, functional, developmental, and phylogenetic studies. Current projects include the analysis of hypotarsal structure and function, and the shape and function of the avian sternum. The online database also serves as a digital archive for the collections of contributing museums and allows for rapid global dissemination of 3D data on common as well as rare and potentially fragile specimens. Data is produced in a format ready for a wide range of computational analyses, including finite element analysis and 3D morphometrics, as well as 3D animation. We encourage use of the database of research and educational purposes, and opportunities exist for initiating new (student-based) projects that will contribute to database growth.

**A GEOMETRIC MORPHOMETRIC ANALYSIS OF
STERNAL ECOMORPHOLOGY IN BIRDS**

Stephanie John, Maggie Johnson, Ariana Masi, Tiffany Medwid
and Abby Drake

Faculty Advisor: L. Claessens

Department of Biology, College of the Holy Cross

Birds are one of the most diverse groups of the tetrapod vertebrates and participate in a wide variety of flight behaviors, including flapping flight, soaring flight, and underwater swimming. Some birds have even lost the ability to fly (e.g. ostriches and emus). The pectoral and supracoracoidal muscles account for a large portion of total body mass, and help power the avian flight stroke. The breastbone provides an attachment surface for many of the muscles associated with the flight stroke, and differences in sternal shape may reflect differences in flight behavior. We have investigated sternal shape differences using three-dimensional geometric morphometrics in order to gain a better understanding of flight biomechanics in birds. Our analysis included 239 bird specimens from five different taxonomic orders (Procellariiformes, Ciconiiformes, Casuariiformes, Anseriformes, and Sphenisciformes), which represent the orders with the largest sample size from our dataset. Principal Components Analysis (PCA) was used to obtain an approximation for the total shape variation. The first principal component of our analysis captured the variation in length and width of the body of the sterna, separating the petrels, tube-nosed seabirds with a square-shaped sterna, from all other birds that have a more elongated sterna. The second principle component captured the variation in the shape of the rib facet row and the keel of the sternum. Penguins have a relatively short and anteriorly positioned lateral costal margin when compared with ratites, but in the latter group the sternum is not as elongated posteriorly as in penguins. The penguin keel is positioned more anterior, whereas in ratites, the keel is completely reduced. This summer research project was made possible thanks to financial support from the National Science Foundation, Division of Biological Infrastructure, to LC.

Poster 88

Modeling the Immunological Response of HIV-1 after HAART

Maria S. Cavicchi and David B. Damiano

Department of Mathematics, College of the Holy Cross

Patients in the chronic phase of HIV infection typically show heightened activation and lowered counts of CD4+ (helper) T cells (the primary target of HIV) and heightened activation and heightened counts of CD8+ (killer) T cells. For many patients, upon initiation of highly active anti-retroviral therapy (HAART), these activation levels and counts return to normal.

As part of an ongoing retrospective study of data from the HIV clinic at the University of Massachusetts Medical School, we have found that for a large cohort of patients, the return to normal is accompanied by a linear rise in CD4:CD8 ratios (ratio responders). This is regardless of whether the patients are virological responders (HIV counts drop to undetectable levels) immunological responders (CD4+ levels increase to near normal levels), or both. This is of potential clinical significance because it is counter to current clinical guidelines, which suggest that tracking CD4:CD8 ratios is not relevant.

We have also examined immune recovery of patient with viral interruptions and thus, two or more immune responses. The linear increases of these responses do not appear to vary from each other, which is also counterintuitive to the belief that treatment interruptions are detrimental to viral suppression.

Though still in a preliminary stage, we hope to develop a mathematical model that explains the linear rise in the CD4:CD8 ratio.

This is a joint endeavor with Dr. Richard Ellison, Dr. Jennifer Daly, Dr. Thomas Greenough, and Regan Savas from UMass Medical Center. The first author would like to the the Alumni / Parent Summer Research Scholarship, Paul S. Stuka '77, for financial support.

Poster 89

Characterizing APOBEC3G (A3G) Mutants in a Wild-type HIV Infection

Emily Cartwright, Patrick Cheney, Ann M. Sheehy
Department of Biology, College of the Holy Cross

HIV is a retrovirus that attacks and kills the cells of the human immune system, leaving the host vulnerable to decimating opportunistic infections. Without drug intervention, HIV infection results in death. However, there are natural defenses against HIV, one such defense is the intracellular protein APOBEC3G (A3G). While this protein is subject to viral regulation, via the Vif (Viral infectivity factor) protein of HIV, preliminary clinical data suggests this viral suppression may be overcome. Characterizing the Vif:A3G interaction provides an important resource for understanding the full breadth of such an anti-viral capability.

A library of 135 mutants was previously created and a subsequent follow-up screen to examine a relevant subset of these mutants for their ability to resist a wild-type HIV infection has been established. Delineation of an ability to restrict an HIV challenge would suggest a resistance to Vif inhibition and a disruption of the critical interaction between A3G and Vif. Such mutants would expand the current understanding of the relationship between A3G and Vif. By further characterizing the critical domains involved in the regulation of A3G via Vif, a novel therapeutic strategy liberating A3G and enhancing the host's natural defenses may be revealed.

We would like to thank Mr. Kirby '79 and Mrs. Anne Bray for their generous contribution to the Alumni/Parents Summer Research Fund that provided the resources for this project.

Poster 90

A Fieldwork Study: Cultural Heritage Identity and Education among Young Vietnamese Americans and Vietnamese American Adoptees

Thu H. Tran and Prof. Ann Marie Leshkowich

Department of Sociology and Anthropology, College of the Holy Cross

This summer, Professor Leshkowich and student Thu Tran investigated how educational and recreational programs for Vietnamese American youth promote different concepts of ethnic identity and cultural heritage through language, food, rituals, folklore, and the performing arts. We were particularly interested in comparing ideas about Vietnamese American identity between two groups of Vietnamese American children and teens: those whose parents are from Vietnam and those who have been adopted by non-Vietnamese American parents. Extensive participant observation fieldwork was conducted in two locations: the Southeast Asian Coalition (SEAC) in Worcester, MA, which provides programming for non-adopted youth ages thirteen to nineteen, and the Catalyst Foundation's Vietnam Culture Camp in Minnesota and Connecticut for families with adopted children from pre-school to eighth grade.

This research contributes to a growing body of scholarship on Vietnamese American and Asian American ethnic and cultural identities by considering inter-generational interaction between parents' and children's perceptions of identity, and the role of non-family programming in promoting these self-ascriptions.

Tran found that the majority of non-adopted children identify themselves as Vietnamese American, while they see their parents as Vietnamese. Among adoptive families, parents tend to identify the entire family as Vietnamese American, while their Vietnamese-born children often view themselves as Asian American and their parents as white. At the same time, a focus on the role of language suggests dramatic differences in how adopted and non-adopted families define and experience ethnicity.

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

Poster 91

Multidentate aminophenol ligands synthesized using Mannich condensations

T. Huhta and J.R. Farrell

Department of Chemistry, College of the Holy Cross

The Mannich condensation is multicomponent, enolate reaction that combines an amine, formaldehyde, and a phenol resulting in the formation of a new carbon-carbon and carbon-nitrogen bond. The goal of the project is to create a library of new aminoalcohol compounds for use in the formation of new catalysts, for nuclear remediation, to bind transition metals and serve as nano-particle precursors and to bind biologically relevant metals and mimic the structure and function of enzyme active-sites. The amines 1,5-diaminopentane, N-methylethylenediamine, and butylamine were combined with formaldehyde and various phenols such as 2,4-di-*t*-butyl-, 2,4-dichloro-, and 2,4-dimethylphenol in order to adjust the steric and electronic properties of the resulting compounds. All reactions were run in pressure flasks and the temperature, solvent, and lengths of reaction were systematically varied to maximize yield. The synthesis and characterization of several novel compounds will be presented along with current strategies for increasing the yield and utility of these species.

We thank the Research Corporation for Scientific Advancement for their financial support.

Poster 92

Using Tethered Fullerene Adducts to Improve the Efficiency of Organic Solar Cells

Ryan K. Quinn, Krastina Petrova and Yves Rubin

Department of Chemistry & Biochemistry, UCLA

As a result of rising energy costs and increased concern for the environment, there is a large focus on the development of cheap and renewable energy sources. In terms of solar energy, bulk heterojunction (BHJ) organic photovoltaic cells fit these criteria well. The goal of this project is to create fullerene derivatives that are better electron acceptor materials within the cell. Recently, fullerene bisadducts, like bisPCBM, have been shown to improve the efficiency of BHJ solar cells, but suffer from problems with regioregularity. The purpose of our project is to develop a synthetic route that maximizes the regioregularity of bisadducts, and to examine the effect that this resulting regioregularity has on the efficiency of BHJ photovoltaic cells. The method that was employed to increase the regioselectivity of fullerene bisadducts is through the use of tethered diols. An alkyl chain can be used to bond the two adducts together, the tethered molecule can then be reacted with the fullerene molecule adding both groups simultaneously. This is accomplished by synthesizing an alkyl chain with two ester functionalities, converting the ester to a bishydrazone and then reacting the following product with C60. Other members of the solar cell group will be providing the electrochemical data relating to the compounds performance in a solar cell.

We thank the Department of Chemistry & Biochemistry, UCLA for its support.

Poster 93

Provisional Title: 'The Woodenfish: A Short Film'

B. Medeiros and T. Lewis

Department of Religious Studies, College of the Holy Cross

The Woodenfish Program is a month-long program for students and young adults at Fo Guang Shan Monastery held annually in Taiwan. Participants live as monastics while taking academic classes on Buddhism and participating in traditional practices. Participants come from all countries, faiths and academic fields – and starting with 2007, Holy Cross students have been regular participants in the program.

Part of a larger scale video project on Asian Buddhism in practice, this short-film is an autobiographical reflection of one student's experience in Taiwan. It aims to bridge the gap between the academic teachings of Buddhism in the classroom and the real-world monastic practice.

This almost completed version of the film will be also be used in Professor Todd Lewis' Fall 2010 "Introduction to Buddhism" class as an instructional aid, providing an overview of Buddhist philosophy and teachings in practice.

We thank the Andrew W. Mellon Foundation for financial support and the Buddha's Light International Association for sponsoring the Woodenfish Program

Poster 94

Testing Active Ingredients on Skin Cells

C. Kane

Skin Cell Biology Laboratory, Chanel, Inc.

The human skin serves not only as the integument barrier between the internal and external environments, but also serves as to respond to internal and external stimuli. The skin is composed of three layers and various appendages such as sweat glands and hair follicles. The upper layer, the epidermis, is mainly composed of keratinocytes and melanocytes, which are found near the dermal-epidermal junction. The dermis largely consists of a matrix containing collagen and elastin, among many other proteins, and fibroblasts. The third, and lowest, layer is the hypodermis which contains adipocytes.

Through extensive research, genes were identified that are responsible for skin functions such as protection of the body from the environment, mainly through pigment production, regulation of temperature, and protection from microbial invasion. A consequence of dysregulation or aging may be the appearance of wrinkles and loss of firmness, or a dehydrated appearance. These visible changes in skin appearance are also reflected as changes in protein and gene expression. Therefore, identification of active ingredients that restore gene/protein expression levels to those of younger/non-exposed skin may translate into changes in skin appearance.

Cell culture of human keratinocytes, melanocytes, and fibroblasts, as well as the use of a three dimensional skin model, provide the scientist models to study skin and its regulation *in vitro*. To determine the toxicity of active ingredients on cells, cytotoxicity tests are run prior to experimentation. Skin pigmentation is studied through analysis of melanin production by melanocytes. In order to analyze target gene expression, RNA isolation, quantitation, and PCR are performed. Protein analysis is performed using Western Blot and immunohistochemistry. Basic histological methods are used to explore cellular and extracellular matrix staining in the epidermal or dermal layer of a skin model. Techniques used are fixation of tissue, dehydration of samples, and lastly immunohistochemistry of cytoplasmic and nuclear antigens. In addition, the effect of active ingredients on free radical and oxidant formation may be evaluated.

Through the use of these various techniques, the biology of skin can be further elucidated, and active ingredients may be identified which may be interesting for cosmetic skin products.

I thank the researchers from the Skin Cell Laboratory at Chanel: Christelle Lasserre, Sandra D'Arcangelis, Elena Fedorova, Pinaki Bhatt, Jin Namkoong, and Alicia Leo.

Poster 95

Alcohol May Mean More to You than You Think

K. Gettens, J. Daffron, E. Sophis, N. Patel, S. Gillespie and G. J. DiGirolamo

Department of Psychology, College of the Holy Cross

Alcohol use in college populations is prevalent, and previous research on this campus has shown a strong negative relationship between amount of alcohol drunk per week and academic performance (Singleton, 2007). In this project, we investigated the mere presentation of a previous alcohol-related image on subsequent task performance.

It is well-known that the content of an image can affect subjects' abilities to perform a subsequent task. Previous research (Blaukopf & DiGirolamo, 2006; 2007) has shown that when subjects find a stimulus important, it produces an arousal effect that can speed their reaction times. The present study investigated the impact that the content of irrelevant pictures (specifically alcohol related) had on the correct completion of a subsequent task. 16 Holy Cross students were presented briefly with either a neutral picture or one pertaining to alcohol or nicotine. The picture was then replaced by a simple target discrimination (“&” or “%”) and we measured how quickly and accurately subjects responded based on the previous images identity. Reactions times following alcohol related pictures were significantly faster than those associated with either neutral or nicotine pictures. These results indicate that the identity of an irrelevant pictures has a significant effect on a subject's attention bias, consequently effecting the ability of a subject to focus and complete subsequent tasks. These findings may be a result of the increased alcohol consumption seen in college students. For the average college student, alcohol-related stimuli are arousing independent of their own consumption.

Poster 96

Improving Control Over Behavior in Opiate Addiction with a Novel Treatment Therapy

S. Gillespie, N. Patel, E. Sophis, J. Daffron, K. Gettens and G. J. DiGirolamo

Department of Psychology, College of the Holy Cross

The 2009 National Survey on Drug Use & Health indicated growing drug use in 18-25 year olds, with 2.1 million initiates beginning with the abuse of opioid pain relievers (a larger number than initiates of marijuana). Yet, the prevalent current addiction treatment for this young population is opioid replacement therapy (often a lifetime of medication). In short, the current treatment option is keeping patients opioid-intoxicated at low levels daily.

This study investigated a new treatment therapy (memantine) that would limit the duration of opioid replacement therapy to 12 week in young adults. Memantine may work to allow patients to control their behavior toward opioids in the absence of replacement therapy. The drug memantine, currently in use for dementia populations, has been shown to increase performance of control-related tasks in animals. The current study investigated the effect of the drug Memantine on voluntary and involuntary eye movements in an opiate-dependent population. This task directly measures the ability of subjects to control their own behavior in people addicted to opiates receiving this new treatment or placebo.

This double-blinded study is still ongoing. We hypothesize that those patients who have been treated with Memantine will show fewer prosaccadic errors, and thus more antisaccades (an exertion of control over their own behavior), than patients receiving placebo. The study has immediate implications in opiate-dependence treatment.

We thank the Sherman-Fairchild Research Fellowship and the National Institute on Drug Abuse for financial support.

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Control Over Behavior in Nicotine Addiction: How much does that cigarette make you want it?

E. Sophis, N. Patel, S. Gillespie, J. Daffron, K. Gettens and G. J. DiGirolamo

Department of Psychology, College of the Holy Cross

Despite the declining overall rate of smoking (28.4%) in the United States, the rates remain significantly elevated among 18-25 year old adults, with young adults having the highest rate (41.4%) of current use among all ages (SAMHSA, 2009). Given the potential long-term health and financial costs of smoking-related illnesses, improving quit rates in this young adult population is critical.

Previous research has shown that when presented with smoking stimuli (a cigarette) and neutral stimuli (a seashell), smokers will look toward the smoking pictures. This research suggests an attentional bias toward smoking related stimuli. However, in none of these studies were subjects asked to not look at the smoking related stimuli. The purpose of this study is to examine an objective measure of the ability of smokers to control their behavior toward nicotine related cues and how this control is modulate by varenicline (an anti-smoking drug).

The current, on-going study investigated the ability of subjects to look away from smoking, alcohol, and neutral images on voluntary and involuntary eye movements in a smoking-dependent population. We hypothesize that smokers will make more prosaccadic errors toward smoking and alcohol stimuli (a breakdown of control) than control subjects. We further suggest that varenicline will improve control without reducing cravings. This study could have important implications in treatment for smoking dependence.

We thank the Sherman-Fairchild Research Fellowship for financial support.

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**Indicators of Climate Change: Assessing Mountain Lake
Ecosystems of the Pacific Northwest**

J. Jones and S. Fradkin

*Natural Resource Management, Olympic National Park,
Port Angeles, Washington 98362*

The high mountain lakes of the Pacific Northwest are particularly good indicators of climate change due to their pristine condition, thermal regimes, and exposure to global and regional atmospheric processes. High mountain lakes are particularly susceptible to atmospheric deposition due to their high elevation and short period of productivity between times of ice-off and ice-on. The flora and fauna that can survive the harsh environment associated with high elevation serve as direct indicators for ecosystem health. Olympic National Park, located on the Olympic Peninsula of the Pacific Northwest, receives the majority of its atmospheric pollution from Asian sources across the Pacific Ocean and also from nearby shipping traffic. Studying a subset of nine sub-alpine Park lakes has allowed Park scientists to examine lake food web dynamics, thermal flux, and nutrient and water chemistry change that may be altered by climate change. Olympic National Park is one of three federally funded sites that conduct long-term mountain lake monitoring as part of the North Coast and Cascades Network (NCCN). Together, these sites produce annual baseline data that form an extensive long-term data set. While short timescale inferences are necessarily limited, data collected over many years will be essential to our understanding of climate change and its effects on pristine natural ecosystems.

Thank you to the National Park Service for Financial Support.

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Sex, Drugs, and Impulsivity: A Model of ADHD in Rats

H. MacGillivray and S. Andersen

*Department of Psychology, College of the Holy Cross
Department of Psychiatry, Harvard Medical School*

Attention deficit hyperactivity disorder (ADHD) is characterized behaviorally by increased impulsivity and drug seeking that is evident at a much earlier age than normal teens. These behaviors may result from decreased dopamine levels in the prefrontal cortex (PFC) typical of ADHD brains. To test the hypothesis that low dopamine levels increase risky behaviors, we used an animal model to simulate reduce dopamine in rats' brains. In one group we created bilateral 6-OHDA lesions in the PFC at 10/11 days of age to deplete dopamine levels in their developing brains. The other group was injected with saline to control for surgery without depleting dopamine levels. At 21/22 days the rats were assigned to behavioral tests—delay discounting task (DDT) or place conditioning with cocaine to examine impulsivity and drug seeking, respectively.

We found that juvenile female rats were more sensitive to the cocaine-related cues than juvenile male rats. 6-OHDA increased sensitivity to cues associated to 10mg/kg doses of cocaine relative to vehicle treated males, but not females (Condition X Sex interaction: $1,15=6.12$, $p<0.05$). In addition, tests of DDT show that 6-OHDA increases impulsivity male rats, but did not have an effect in female rats relative to saline-treated rats (Condition X Sex interaction: $1,18=5.04$, $p<0.05$). These results support the hypothesis that low dopamine in the PFC increases drug-seeking and impulsivity in male rats.

This work was supported by the NIDA.

Physics of Baseball: On the Nature of Spin Decay

R. Eslinger and D. Barrett, and M. Koss

Department of Physics, College of the Holy Cross

In the study of the Physics of baseball, we have delved into the nature of the ball's spin. We believe this spin affects the ball's motion in a meaningful way, creating a magnus force which alters the linear motion of the ball, depending on the axis of rotation. Studies of this nature have already been tested on golf balls and the results are promising for our endeavors. Spin has a greater effect the longer the ball is in motion. Therefore, in baseball, the spin most affects the ball's motion after a hit. We sought to find the spin decay rate of the baseball, as well as its nature, which can help us plot the true trajectory of the ball.

After experimentation with various methods, we have found that the best method of finding the spin decay rate of a baseball is via a wind tunnel or a simulated pitch. We thus have built a lab to accommodate both of these experiments. Our wind tunnel is currently in production and we have run tests with a simulated pitch. We have used both a mechanical pitcher that reaches velocities of 45 mph and an air powered gun that reaches 70 mph. We have situated hi-speed cameras that capture at 1,000 fps or 420 fps at the initial and final positions, in order to find the initial and final average omega. With this, we can extrapolate the spin decay rate with respect to environmental conditions. More tests must be run for concrete data but our preliminary results look promising.

We sincerely thank the Sherman Fairchild Foundation for sponsoring our research.