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# TWENTY-SECOND ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

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# **BIOLOGY**

1.

## **SCANNING EM OF THE PLACENTAL MEMBRANES IN THE VIVIPAROUS LIZARD *SCELOPORUS JARROVI***

Kristie E. Anderson '10

Faculty Sponsors: Daniel Blackburn, Kent Dunlap, Ann Lehman

In viviparous lizards, placentas sustain the developing embryos inside the pregnant female through gas exchange and provision of nutrients. We used scanning EM to reveal the nature of the fetal - maternal interface during the last trimester of gestation. Two distinct placentas are formed and persist until parturition. The allantoplacenta consists of the chorioallantois in direct apposition to the uterine epithelium. SEM reveals that fetal and maternal epithelia at the placental interface are highly attenuated, but not eroded, and lack evident surface specializations. In the yolk sac placenta, an avascular omphalopleure (with its isolated yolk mass) lies apposed to the uterus. The omphalopleure forms elaborate folds, consisting of epithelium overlying yolk droplets. These folds protrude into a mass of material in the uterine lumen, formed from shell membrane, cellular debris, and yolk. Scanning EM suggests that this debris is sequestered into a restricted, elongated region at the ventral pole, perhaps to free up adjacent regions for maternal secretion and fetal absorption. The presence of elaborate placental specializations in a "generalized" viviparous lizard is unexpected, and underscores the need for continued explorations of placental diversity in squamates.

2.

## **EFFECT OF LIGHT INTENSITY ON THE GROWTH OF TWO SNOW ALGAE**

Elisabeth Cianciola '10, Elizabeth Edmunds '09

Faculty Sponsor: Craig Schneider

Light intensity is one of the most important physical factors governing the distribution of algae. The amount of light available in a given environment determines the potential photosynthesis an alga can perform and thus how much it can grow. Light intensity is of particular importance to snow algae, because they are adapted to living at high altitudes where damaging ultraviolet radiation can be intense during warm periods when protective snow cover is reduced and light in the visible spectrum can be limited during cold periods when the insulating snow cover is thick. The reduction of snow algae productivity due to polar and alpine warming created by the anthropogenically enhanced greenhouse effect could act as a positive feedback leaving more carbon dioxide in the atmospheric reservoir to trap heat. Reduced snow cover could also change snow algal community composition by changing species' relative competitive abilities. In this study, we compare the growth of the two green algae *Chloromonas nivalis* (Chodat) Hoham & Mullet from Mount Lemmon, Arizona and *Cylindrocystis brebissonii* (Meneghini ex Ralfs) De Bary from Mount Baker, Washington in six different light environments ranging from full light exposure to complete darkness. We expect to find that *C. brebissonii*, will exhibit greater growth under high light conditions than *C. nivalis*, because the reported optimum temperature for *C. brebissonii* is higher than the range reported for those *Chloromonas* species which have been studied. Thus *C. brebissonii* is probably better adapted to environmental conditions associated with warmer temperatures: longer periods of light with higher UV concentration. The results of our experiment will be presented.

### 3.

#### **AN ANALYSIS OF UPPER RESPIRATORY TRACT BACTERIA USING PCR-RFLP TECHNIQUE**

Michael Ryan Farrell '09

Faculty Sponsor: Lisa-Anne Foster

The human upper respiratory tract (URT) contains a profoundly complex bacterial microenvironment consisting of both pathogenic and commensal organisms. This study utilized species-specific polymorphisms within the 16s ribosomal ribonucleic acid (rRNA) gene to identify the presence of several known URT pathogenic and normal flora bacterial species in samples of known composition and orthopharyngeal swabs of college students. Universal PCR targeting a segment of the 16s rRNA gene was used to detect the presence of bacteria in all samples. The resulting amplified product was approximately 996 bp. Restriction enzyme digestion of universal PCR products with *HaeIII* produced unique restriction fragment patterns for *Neisseria lactamica*, *Haemophilus parainfluenzae*, *Haemophilus influenzae*, *Staphylococcus epidermidis*, and *Staphylococcus aureus*. Digestion of the same universal PCR products with the restriction enzyme *AluI* generated distinct patterns for each species of bacteria. Patterns generated by *AluI* were different than patterns produced by *HaeIII* for all analyzed bacterial species. Relative abundance could be determined as samples containing greater concentrations of bacteria yielded amplified products of greater intensity compared to diluted samples of the same bacterial content. Restriction enzyme digestion of universal PCR products from orthopharyngeal swabs yielded different patterns when digested separately by *HaeIII* and *AluI*. These results suggest that universal PCR followed by restriction enzyme digestion is a feasible means for comparing and distinguishing the bacterial composition of samples with known bacterial content and orthopharyngeal swabs.

### 4.

#### **EFFECTS OF CAFFEINE ON UNIALGAL CULTURES OF *SCENEDESMUS QUADRICAUDA* AND *STAUSTRUM PINGUE* (CHAROPHYTA, DESMIDIACEAE)**

Gina Filloramo '10, Lincoln McMahon '10

Faculty Sponsor: Craig Schneider

Unmetabolized caffeine from human drug and food consumption is not effectively treated by municipal water treatment plants. As a result, unmetabolized caffeine has been detected in fresh and marine waters, especially when human population density is high and treated wastewater is returned to rivers and streams. Prior studies have demonstrated a deleterious effect of caffeine on coral algal endosymbionts, blue-greens and green algal flagellates. This study focuses on the effects of different levels of caffeine (3 ng/L, 7.5 ng/L, 15 ng/L, 30 ng/L, and 60 ng/L) on the growth of two desmids, the oligotrophic *Scenedesmus quadricauda* and the eutrophic *Staurastrum pingue*. To assess growth levels *in vivo*, fluorometric readings were taken every twelve hours for 7 days. Results are expected to demonstrate a significantly greater effect of caffeine on the growth rate of the oligotrophic species, *Scenedesmus quadricauda* than the eutrophic species, *Staurastrum pingue*.

## 5.

### **ECOLOGY OF AN URBAN RED-TAILED HAWK (*BUTEO JAMAICENSIS*) POPULATION**

Isabel Gottlieb '09

Faculty Sponsor: Joan Morrison

The red-tailed hawk (*Buteo jamaicensis*) is a common and well-studied bird in North America, but has been little-studied in an urban environment despite its prevalence in cities. We undertook this study to assess home ranges and habitat use of red-tailed hawks in Hartford, CT. Between November 2006 and December 2007, we trapped and radio-tagged seven adult red-tailed hawks within the Hartford metropolitan area. Home ranges were calculated from perch locations recorded approximately twice a week and plotted on aerial photographs using kernel density estimation. Home ranges were calculated for the breeding season, non breeding season, and entire year for each bird. Housing density and percent green space in home ranges were calculated from aerial photographs. Home range sizes ranged from 101-241 hectares. Home range size was compared between seasons using a paired two-tailed student t-test. We used correlation analysis to test to see if there is an association between percent green space and home range size to test the hypothesis that home ranges with a higher percent green space will be smaller. The home range sizes did not change significantly between seasons. Home ranges with a higher percent green space were smaller. Hawks with high quality territories may be able to fulfill their needs with a smaller home range whose size may be constrained by a minimum distance a nesting pair will tolerate a neighbor. Hawks with large, low quality territories may be limited by the amount of space a pair can defend.

## 6.

### **THE NEUROPROTECTIVE PROPERTIES OF PPAR $\delta$ and PPAR $\gamma$ ; WHEN ACTIVATED IN IMMORTALIZED NEURAL CELL LINES SUBJECTED TO OXYGEN-GLUCOSE DEPRIVATION**

Stacy Hathcox '09

Faculty Sponsor: Hebe Guardiola-Diaz

Peroxisome-proliferator activated receptors (PPARs) are found throughout the body, and have been linked to many physiological responses, including neuroprotection. This research targets the neuroprotective properties of PPAR $\delta$  and PPAR $\gamma$ ; when activated in immortalized neural cell lines subjected to oxygen-glucose deprivation (OGD). OGD research is of interest, for the brain rapidly consumes oxygen and glucose, and the slightest malfunction of the electron transport chain can lead to the generation of reactive oxygen species (ROS). Ischemia/reperfusion is also another source of ROS production. While ROS may be beneficial by serving as a signal for injured tissues, ROS damage many cellular components including DNA and proteins, negatively influencing the functions of the cell. Another aspect of this research included the neuroprotective effects of preconditioning. Preconditioning encompasses subjecting cells to a stimulus at an almost threshold level, in order to prevent those cells from a future stress. The underlying thought is that preconditioning will lead to an activation of genes that will protect the cells from future injury. Neuroprotective properties observed in SH-SY5Y, SK-N-MC, and PC-12 were measured by Alamar Blue Assays, LDH Assays, and a quantification of intracellular mRNA changes for specific genes. Activation of PPAR $\delta$  and PPAR $\gamma$ ; did not significantly protect the cells from OGD. Preconditioning PC-12 with an OGD stimulus prior to long term OGD significantly attenuated cell death.

7.

**A TEST OF DOGMA: DOES ADDITION OF ANIMAL-BASED KITCHEN SCRAPS REALLY ATTRACT MORE SCAVENGERS TO COMPOST PILES?**

Jackie Knapp '10, Steve Sullivan '09

Faculty Sponsor: Scott Smedley

Composting is becoming an increasingly popular practice for discarding household food scraps in an environmentally friendly manner. Composting decreases the amount of garbage entering municipal waste streams and produces useful material for home gardens. It has long been dogmatically stated that composting animal-based kitchen scraps (e.g., bones, eggshells, fat trimmings, cheese, etc.) increases visitation by scavenging wildlife, yet there have been no experimental studies to examine this claim. Consequently, we conducted an experiment in a rural/residential setting, Andover, Connecticut, which involved three temporal replicates in 2008 (mid-February to mid-April, late May to mid-August, and mid-September to mid-December) utilizing three types of compost piles (vegetable only, animal-vegetable mix, control). Visitors to the piles were recorded by motion/heat sensitive cameras. Sixteen species (11 mammals, 5 birds) were detected during the three replicates. All three replicates showed significantly more encounters at the compost pile with the animal-vegetable mix, and the primary encountered species differed with each replicate. For the first replicate, the majority of the encounters occurred during the day, while for the second and third replicates the majority was nocturnal. These results support the composting dogma that the addition of animal scraps to a pile does indeed increase the number of visitations by scavengers. With 2009 three replicates corresponding seasonally to those in 2008, we hope to establish the robustness of these findings.

8.

**DETERMINATION OF THE IDENTITY, FUNCTION, AND ORIGIN OF COMPOUNDS SECRETED BY DEFENSIVE GLANDULAR HAIRS IN LARVAE AND PUPAE OF THE LADYBIRD BEETLE *DELPHASTUS CATALINAE***

Patrick McCarthy '09

Faculty Sponsor: Scott Smedley

This study investigated compounds found in the defensive secretions of two life stages of the ladybird beetle *Delphastus catalinae* (Coleoptera: Coccinellidae). The larval and pupal forms are covered in hollow setae that secrete a liquid shown to deter certain predatory insects. In this study, larvae and pupae were sampled to determine the chemical composition of these secretions. Chemical analysis showed them to contain novel polypropanoids and germacrene sesquiterpenes. I performed a bioassay using the predatory ant *Crematogaster lineolata* to determine whether the polypropanoids serve a defensive role. I first applied isolated polypropanoids to dead fruit flies (*Drosophila*), which I then presented to foraging colonies of *C. lineolata*. I observed the colonies for one hour and then analyzed their behavior towards the flies to determine whether the polypropanoids had a deterrent effect. The ants' removal rate of polypropanoid-coated flies was significantly lower than compared to controls, suggesting that the polypropanoids have defensive activity. A previous bioassay suggested that the sesquiterpenes function in a similar manner. I also used *D. catalinae* larvae to ascertain whether the polypropanoids and germacrene sesquiterpenes in the pupal secretion are sequestered from the diet or synthesized *de novo* by the beetles. Larvae, which prey upon eggs and juveniles of the whitefly *Bemisia tabaci*, were fed eggs coated with labeled sodium acetate, a potential precursor to both compounds, and raised until pupation. Analysis of their pupal secretions showed significant incorporation of the label in the polypropanoids and sesquiterpenes. This suggests that the compounds are produced *de novo*.

9.

**DETERMINING SENSITIVITY OF DETECTION OF THE NORMAL FLORA OF THE UPPER RESPIRATORY TRACT**

Elizabeth Molano '09

Faculty Sponsor: Lisa-Anne Foster

The normal flora of the upper respiratory tract differs from one individual to the next. We sought to determine the variance in flora among individuals by examining the type and relative amount of bacteria present in a throat sample. The bacteria were identified by study of the 16s rRNA gene, which is highly conserved among all bacterial species but whose slight differences can be exploited for identification purposes. Serial dilutions were made of the bacterial samples. Then, universal primers were used to amplify the 16s rRNA region via polymerase chain reaction (PCR). To determine the limits of detection of bacteria in a sample, 100 µl of each dilution were plated onto a nutrient agar plate. These plates were incubated for 24 hours at 36.9° C, after which time the number of colonies present on each plate were counted. These data indicated the number of bacterial colonies present in a particular dilution, as well as in the amplified samples.

10.

**CELL GROWTH AND CAROTENOID PRODUCTION OF TWO GREEN ALGAL SPECIES *HAEMTOCOCCUS CARPENSIS* AND *HORMIDIUM SP.* WHEN EXPOSED TO MEDIA WITH VARYING NITROGEN CONCENTRATIONS**

Frances Thomas '10, Connie Hernandez '10

Faculty Sponsor: Craig Schneider

Two chlorophytes species from the genera *Haematococcus* and *Hormidium* were exposed to various nitrate environments for a period of 8 da. While under stress *Haematococcus* is known to accumulate carotenoids, but less is known of the performance of *Hormidium*. Changes in chlorophyll a and carotenoid abundance under various levels of nitrate deficiency were studied. Algal species were exposed to Bold's Basal medium (control, 0.12M NaNO<sub>3</sub>) and Bold's Basal medium with decreased levels of nitrate (experimental, 0.00M, 0.03M, 0.06M, 0.09 M NaNO<sub>3</sub>). Chlorophyll a absorption levels of the cultures were expected to correlate to decreasing concentrations of nitrate. A spectrophotometer was used to measure peak absorbance of chlorophyll a and the carotenoid astaxanthin, 420 and 475 nm respectively. The relative amount of cells/culture was correlated from chlorophyll and carotenoid spectrophotometry data as a measure of cell growth. This study was conducted to reflect expected cell growth performance and carotenoid production of *Haematococcus carpensis* and *Hormidium sp.*, exposed to media with varying nitrogen concentrations.

## 11.

### **VAUCHERIA LITOREA RESISTANCE TO DIGESTION**

Santiago Varela '09

Faculty Sponsor: Kathleen Archer

The sea slug *Elysia chlorotica* evolved an endosymbiotic relationship with the chloroplasts of the xanthophyte alga, *Vaucheria litorea*. When the slug feeds on *V. litorea*, it retains live, functional chloroplasts within specialized cells of its digestive epithelium. *E. chlorotica* benefits from the plastids because they undergo photosynthesis and release photosynthate to their host. It is known that *V. litorea* plastids are not digested, but the exact reason is unclear. Past studies such as those by Trench have questioned whether it is their physical qualities that initially keep the chloroplasts alive after they have been ingested. The objective of this experiment was to see if symbiotic chloroplasts are resistant to digestion in a non-symbiont animal model. For this research, digestion rate experiments were performed in the dinoflagellate *Noctiluca scintillans*. This protist was presented with the symbiotic *V. litorea* chloroplasts, non-symbiotic spinach chloroplasts and *N. scintillans*'s natural food source, *Dunaliella tertiolecta*. The digestion rates for the three food sources in *N. scintillans* were compared using the time known as  $t_{1/2}$ . This is the time at which 50% of the *N. scintillans* cells in a sample population had been cleared of any food particles. The  $t_{1/2}$  times were 7.68 hours for *V. litorea* chloroplasts, 6.99 hours for spinach chloroplasts, and 6.18 hours for *D. tertiolecta*. These preliminary results suggest that in a non-symbiont animal model, symbiotic chloroplasts such as those of *V. litorea* chloroplasts may be able to resist digestion longer than natural food sources and non-symbiotic chloroplasts.

## 12.

### **SQUIRREL DENSITIES IN RELATION TO URBAN RED-TAILED HAWK (*Buteo jamaicensis*) HOME RANGES**

Connor Wells '09

Faculty Sponsor: Joan Morrison

The red-tailed hawk (*Buteo jamaicensis*) is a common raptor in the northeastern United States, including in Hartford's urban environment. As a bird of prey, red-tailed hawks feed on rabbits, other small rodents, and birds. Field observations indicate that squirrels are a primary prey item for Hartford's red-tailed hawks. I wanted to analyze how gray squirrel (*Sciurus carolinensis*) densities affected red-tailed hawk home ranges. I hypothesized that squirrel densities would be negatively associated with hawk home range size and positively associated with percent green space within hawk home ranges. In this study I examined squirrel densities in nine areas within Hartford where radio tagged hawks were known to be present. I determined squirrel densities using line transect sampling, where I counted squirrels along transects, each 100 m in length and 100 m wide, in nine hawk territories. These transects covered as much of a hawk's home range as possible, and we quantified urban green space, hawk home range areas, and percent green space within each hawk home range using Arc GIS mapping program. I found that there was a negative trend between squirrel densities and hawk home range size for all seasons analyzed. There was no relationship found between squirrel densities and percent green space within each hawk home range. I also found seasonal differences in squirrel counts. For fall data there was a positive association between squirrel numbers and temperature at time of sampling. Possible explanations for the lack of association seen between squirrel densities and percent green space within hawk home ranges include potential relationships with other prey items, the size of useable urban green space, and lack of availability of squirrels as prey items.

# CHEMISTRY

13.

## **METHOD OPTIMIZATION FOR THE SUPERCRITICAL FLUID EXTRACTION AND LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSIS OF ROTENONE IN HUMAN HAIR**

Jonathan Ashby '09

Faculty Sponsor: Janet Morrison

Rotenone, a naturally occurring compound extracted from the roots of Cubé and other leguminous plants, is a common ingredient in pesticide formulations used in gardens and agriculture. Recent animal studies have shown a correlation between chronic rotenone exposure and development of symptoms associated with Parkinson's disease. Prior studies in our laboratory have demonstrated rotenone's solubility in pure supercritical carbon dioxide, suggesting supercritical fluid extraction (SFE) as a possible alternative to acid digestion and liquid solvent based methods for the extraction of compounds from a hair matrix. The aim of this study is to optimize the method of analyte extraction via SFE and analyte identification and quantitation via high-pressure liquid chromatography (HPLC) and liquid chromatography-mass spectrometry (LC-MS). Results of method optimization experiments to maximize recoveries and compensate for various matrix effects – such as matrix binding during extraction and matrix interferences during analysis– in rotenone-fortified human hair samples will be presented. The goal of this research is to successfully develop a method capable of assessing chronic rotenone exposure in employees with high occupational risk of rotenone contamination.

14.

## **ANALYTICAL DETERMINATION OF PHARMACEUTICALS IN LOCAL WATER SAMPLES**

Jonathan Ashby '09, Christine Gerdin '09, Michael Lee '10, John Love '10

Faculty Sponsor: David Henderson

Over the past decade, national consumption of pharmaceutical compounds have increased dramatically. Due to the small quantities metabolized and used by the body, the majority of pharmaceutical compounds taken end up in wastewater. As the effects of these pharmaceuticals on local ecosystems is unknown, quantitatively determining the presence of these drugs is paramount. Solid phase extraction and liquid chromatography-mass spectrometry methods were developed to simultaneously test for three compounds found in many common pharmaceutical drugs. This method was then applied to natural samples taken from the Quinnipiac, Farmington, and Connecticut Rivers. Results from this study will aid in future assessment of the environmental safety of these three rivers.

**15.**  
**SYNTHESIS AND ANALYSIS OF NEW BIDENTATE ORGANOPHOSPHORUS MOLYBDENUM COMPOUNDS**

Stephen Bloom '09

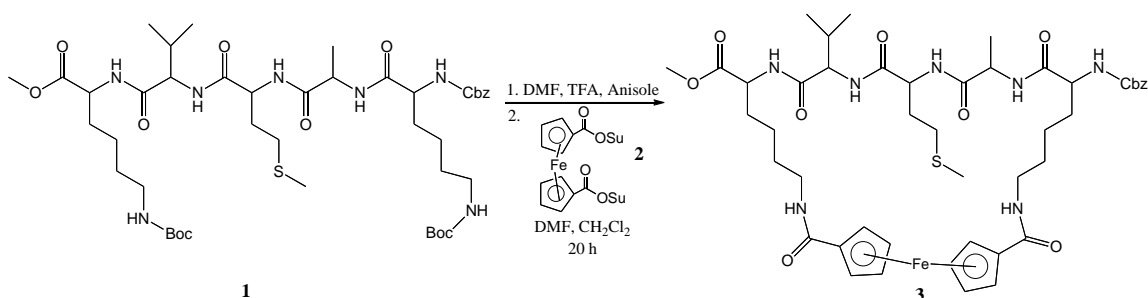
Faculty Sponsor: Maria Parr

Organometallic compounds are significant in the field of catalytic reactions. Specifically, organophosphorus ligands have been widely used as supporting ligands to carry out these types of reactions. Several new molybdenum compounds with the formula  $[\text{Mo}(\text{CO})_4\text{L}_2]$  were synthesized using bidentate organophosphorus ligands [ $\text{L}_2 = \text{xantphos}$ ,  $\text{DPEphos}$  and  $\text{dppe-F20}$ ] with  $[\text{Mo}(\text{CO})_4(\text{pip})_2]$  as the precursor. The structural elucidation of the products was determined through FTIR, multinuclear NMR, elemental analysis, and X-ray diffraction.

**16.**  
**LINKAGE OF LYSINE SIDE-CHAINS IN THE I AND I+5 POSITIONS WITH 1,1'-FERROCENE DI-OSU TO INDUCE SECONDARY STRUCTURE FORMATION WITHIN A METALLACYCLICPENTAPEPTIDE**

Neena T. Chakrabarti '09

Faculty Sponsor: Timothy Curran



Previous work in the Curran research group has shown that the linkage of the lysine side chains in the  $i$  and  $i+4$  positions with 1,1'-ferrocene diacid chloride will result a  $3_{10}$ -helix. From these results, it was predicted that the side chain linkage of lysines in the  $i$  and  $i+5$  positions with ferrocene will result in an  $\alpha$ -helix. To date, the pentapeptide Boc-Lys-Ala-Met-Val-Lys-OMe **1** was synthesized via solid phase peptide synthesis (SPPS). Peptide **1** has lysines located in the  $i$  and  $i+5$  positions and so the next step in the metallacyclicpentapeptide synthesis will involve the linkage of the lysine side chains amines with a 1,1'-ferrocene di-OSu **2**. The metallacyclicpentapeptide **3** is expected to conform to a stable  $\alpha$ -helical secondary structure.

**17.**  
**PROGRESS TOWARDS THE SYNTHESIS OF A TUNGSTEN CROSSLINKED DIPEPTIDE**

Zephyr Dworsky '10

Faculty Sponsor: Timothy Curran

Previous research in Dr. Curran's laboratory has shown that an alkyne can be attached to the side chain amine of a lysine by reaction with propargylchloroformate, and that these alkynes will coordinate to a tungsten complex. The ability of bis-alkyne complexes of this type to form metalocyclicpeptides has been investigated, and it has been found that these species do not



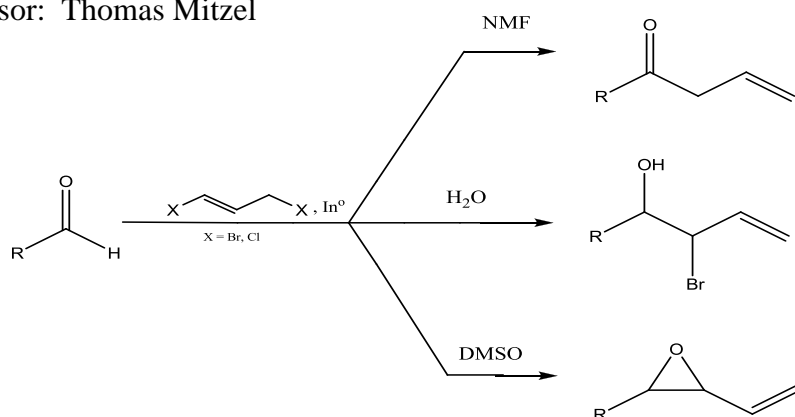
adopt rigid, defined conformations. It is hypothesized that the alkyne groups attached to the lysine side chains are too far from the peptide backbone to provide a conformational constraint. Thus, the goal of the current study is to synthesize a cysteine derivative with an attached alkyne, and to use this alkynylamino acid to form a tungsten crosslinked dipeptide. In the cysteine derivative, the alkyne is located much closer to the peptide backbone than in the previously studied lysine derivatives. The first step towards this goal was to synthesize a propargyl cysteine by reacting L-cysteine hydrochloride hydrate with propargyl bromide. This intermediate was then reacted with Boc<sub>2</sub>O and triethylamine to produce the desired propargyl cysteine. The intermediate and product were characterized using <sup>1</sup>H NMR. Future work will synthesize the dipeptide and finally crosslink it with tungsten.

## 18.

### INDIUM PROMOTED COUPLING IN SOLVENT CONTROLLED EPOXIDE SYNTHESIS

Alden Gordon '10

Faculty Sponsor: Thomas Mitzel



The Mitzel lab has worked on the synthesis of various functional groups from aldehyde starting materials using 1,3 dihalogenated propenes and indium metal. The purpose of this project is to be able to alter the functional group synthesized solely through variation of the solvent used, as shown above. The focus of this project has been the synthesis of the epoxide product using DMSO as a solvent, starting with two different starting aldehydes. It is believed that final product has been formed, though there have been a number of problems in the characterization of this product.

## 19.

### BINDING OF OSTEOCALCIN N-TERMINAL PEPTIDES TO BOVINE TYPE-1 COLLAGEN

Andrew Janiga '11, Joseph Lim '12

Faculty Sponsor: Richard Prigodich

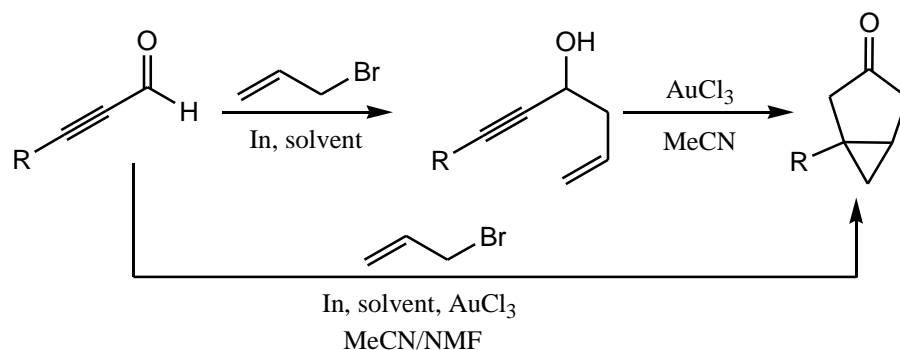
Osteocalcin and collagen are two of the main proteins that play a role in bone structure. It is known that these two proteins bind together. Prior research showed that a peptide derived from the first 14 amino acids of the amino-terminus of osteocalcin will bind to collagen. Preliminary tests with a 10-mer osteocalcin solution seemed to yield similar results. This study will complete a quantitative analysis of amino terminal peptides of 10, 12, 14 and 16 amino acids in length to determine what portion of the osteocalcin molecule is binding to collagen.

## 20.

### GOLD CATALYZED CYCLIZATION

Jo-Ann Jee '10

Faculty Sponsor: Thomas Mitzel



Gold catalysis has attracted much attention in recent years due to the role it plays in cycloisomerization reactions involving alkynes, alkenes and allynes (Hong, 2008). Previous research in our lab has shown that the cyclization of an alcohol product from a phenol propargyl aldehyde and allyl halide system is possible with gold catalysis. The goal is to obtain cyclization with various R-groups under similar conditions. This research focuses on using tetramethylsilane (TMS) as the R-group. The first step of the reaction involving the formation of TMS-propargyl aldehyde followed by the coupling reaction with allyl bromide and indium metal as a catalyst in N,N-dimethylformamide will be discussed.

## 21.

### IMAGING THE OSTEOCALCIN BINDING SITE ON TYPE I TROPICOLLAGEN

Piper Klemm '09

Faculty Sponsor: Richard Prigodich

Type I collagen is a fibrillar collagen that is an important component of skin, bone, tendon and ligament. Osteocalcin is a major component of bone tissue and has a role in bone formation and remodeling. Osteocalcin binds hydroxyapatite and collagen. The osteocalcin binding site on collagen is unknown. To identify this site, type I tropocollagen was imaged using rotary shadowing and transmission electron microscopy. Tropocollagen at a concentration of 3  $\mu\text{g/mL}$  was sprayed onto freshly cleaved mica. The mica was vacuum evaporated, and at a rotary angle of six degrees, was coated with carbon and platinum. Decorin, which binds 25 nm from the tropocollagen carboxy-terminus, was used as a marker on the tropocollagen molecules to determine directionality on the tropocollagen molecule.

**22.**

**DOES CONFORMATION PROTECT A PEPTIDE FROM PROTEASE CLEAVAGES?**

Michael Lee '10

Faculty Sponsor: Timothy Curran

Amino acids are the building blocks for proteins, and these amino acids can be strung together in long chains, and these chains can take on specific three-dimensional conformations that give a protein its secondary, tertiary, and quaternary structures. Within the protein, one of the secondary structures adopted is the helix. Protease enzymes are molecules that are known to cleave peptides and protein chains, usually at specific amino acids.

The goal of this study is determine whether a constrained tetrapeptide having a helical conformation undergoes hydrolysis by the protease chymotrypsin. Previous research by Emma Handy accomplished the synthesis of a tetrapeptide crosslinked by a tether that joins two lysines and a 1, 1'-disubstituted ferrocene, and she demonstrated its helical conformation using NMR methods. Current research is focused on the solution-phase synthesis of the tetrapeptide Lys-Phe-Ala-Lys. Once synthesized, the tetrapeptide will be split into two; one half of the peptide product will be left as an extended peptide chain, while the other half will be crosslinked with the 1, 1'-disubstituted ferrocene which will enforce a helical conformation. Both the constrained and unconstrained tetrapeptides will be tested to see if they undergo cleavage by chymotrypsin, which is known to cleave the Phe-Ala peptide bond.

**23.**

**FOOTPRINTING DNA BINDING SITES USING MALDI-TOF MS**

Madelyn Light '09

Faculty Sponsor: Richard Prigodich

Hydroxyl radical footprinting is technique commonly used to identify protein bonding sites on oligonucleotides. Hydroxyl radicals react with the 4'-hydrogen of the ribose ring of DNA, ultimately achieving strand cleavage after reaction with piperidine. Interference from proteins bound to DNA diminishes the rate of this reaction, and analysis of the resulting cleavage pattern provides a "footprint" of the protein binding sites. In the past, experiments have been carried out using gel electrophoresis to analyze these cleaved DNA strands. Development of matrix-assisted laser desorption (MALDI) time-of-flight (TOF) mass spectrometry (MS) provides faster, higher resolution and sensitivity analysis, as well as small sample consumption, making it an advantageous tool for studying DNA fragments. The aim of this study is to identify protein binding sites by utilizing the hydroxyl radical footprinting technique and analyzing the MALDI-TOF spectra of the resulting oligonucleotide fragments.

24.

### ORGANOMETALLIC 3-D CAGE FORMATION

John Love '10

Faculty Sponsor: Thomas Mitzel

The discovery of fullerene molecules in 1985 generated a tremendous amount of interest and has given way to many new discoveries. Studies of the unique electronic properties of fullerenes have rejuvenated interest in 3-dimensional electron flow and aromaticity. Hydrocarbon cages containing acetylene functional groups are excellent candidates for the study of electron flow and aromaticity in 3-dimensions and, have thus, become very intriguing synthetic targets. The incorporation of metals into the skeletal structure lead to very unique steric and electronic properties. This poster will discuss the formation of the platinum cage shown below as well as the electronic properties of the molecule.



25.

### SYNTHESIS OF A TRIPEPTIDE FOR CYCLIZATION WITH A FERROCENE DERIVATIVE

Megan McNamara '09

Faculty Sponsor: Timothy Curran

Metal ions are known to be important in both the stabilization of the structure of peptides as well as their biological function. The ends of peptides may be coupled using ferrocene derivatives, forming metallacyclicpeptides. Because the structure of peptides are controlled by hydrogen bonding, it is of interest to determine these interactions and elucidate the structure. This work is interested in looking at structure adapted when the tripeptide Boc-Lys-Ala-Lys-NHCH<sub>3</sub> is cyclized with 1,1'-ferrocenedicarboxylic acid chloride. The tripeptide has been synthesized and characterized using <sup>1</sup>HNMR spectroscopy.

26.

### **NUCLEATION OF $\beta$ -SHEETS USING BIS(DIALKYNYLPEPTIDE) TUNGSTEN COMPLEXES AS CONFORMATIONAL CONSTRAINTS**

Thomas McTeague '12, Adam Boynton '12

Faculty Sponsor: Timothy Curran

Protein misfolding within the body often occurs due to  $\beta$ -sheet aggregation. The  $\beta$ -sheet conformation, a secondary structure of proteins, is formed by hydrogen bonding between parallel or anti-parallel polypeptide strands within a protein. In order to synthesize a molecule which would adopt a  $\beta$ -sheet conformation, two techniques utilizing coordination chemistry were investigated. First, an amino acid was reacted with propargyl chloroformate in a 1:1 solution of H<sub>2</sub>O and THF with NaHCO<sub>3</sub> (5 equiv.) to yield an alkynylpeptide with the propargyl chloroformate bonded to the N-terminus of the amino acid. The tungsten complex [W(CO)<sub>5</sub>I][Et<sub>4</sub>N] was then synthesized and reacted with iodine sodium dimethyldithiocarbamate hydrate in degassed methanol and vacuum filtered after an addition of toluene and hexanes to produce [W(dmtc)<sub>2</sub>(CO)<sub>3</sub>]. The previously synthesized alkynylpeptide was then reacted with [W(dmtc)<sub>2</sub>(CO)<sub>3</sub>] in a refluxing solution of methanol under nitrogen atmosphere until the solution became yellow, and the desired tungsten alkynylpeptide complex was formed. <sup>1</sup>H NMR indicated that the oil formed was not the desired product. An alternative method utilizing an alkynylpeptide with a t-butyl ester protecting group, rather than a carboxyl group, was then attempted, the results of which are in progress. With a more accessible procedure for synthesizing peptides which take on the  $\beta$ -sheet conformation, more knowledge of the relationship between protein structure and activity may be gained. Such information has vast implications in the biomedical world, such as aiding the prevention/cure of protein aggregate related diseases.

27.

### **ANALYSIS OF MERCURY IN COMMERCIAL TUNA AND HUMAN HAIR DUE TO DIET**

Katherine M. Nichols '09

Faculty Sponsor: David Henderson

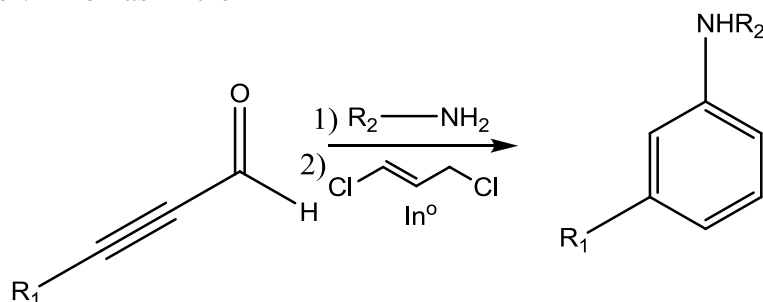
Environmental mercury levels are of increasing interest due to their implications on human health. Seafood in diet is a primary source of exposure, particularly large, predatory fish like Tuna. Average mercury levels in commercial canned tuna fish were determined, allowing for comparison of various brands and tissue types (solid white, chunk white, and chunk light). The body burden of mercury was also tracked using beard hairs as an individual's fish consumption changed. All mercury analysis was performed with a DMA-80 mercury analyzer. Chunk solid albacore tuna had the highest mercury levels with an average value of 471.69  $\mu$ g/kg (n=2 cans), followed by white solid albacore at 370.90  $\mu$ g/kg (n=11), and chunk light tuna at 62.89  $\mu$ g/kg (n=5). Mercury level data in beard hair was an accurate reflection of fish consumption. Separation of extractable mercury fraction in samples into inorganic and organic mercury fractions was investigated following EPA guidelines.

28.

### CYCLIZATION OF AN IMINE USING INDIUM METAL

Katie Pearson '10

Faculty Sponsor: Thomas Mitzel



A main focus of the world today is improving the environment. The use of more environmentally friendly reaction conditions to carry out chemical transformations would aid a great deal in this area. Many reactions currently utilized to form molecules that are popular templates in organic synthesis require the use of “harsh” organic conditions. Indium metal has been shown to promote C-C bond formations under environmentally benign conditions, including the use of water as an “organic” solvent, with good regio- and stereocontrol. Previous research in the Mitzel laboratory has shown that the use of indium metal has led to not only an oxy-cope rearrangement but also a cyclization of an alcohol product. This research focuses on the attempt to repeat this experiment using an imine functional group in place of the aldehyde as the beginning electrophile.

29.

### INDIUM-PROMOTED BARBIER AND CASCADE REACTIONS UNDER BENIGN CONDITIONS

Merry Smith '09

Faculty Sponsor: Thomas Mitzel

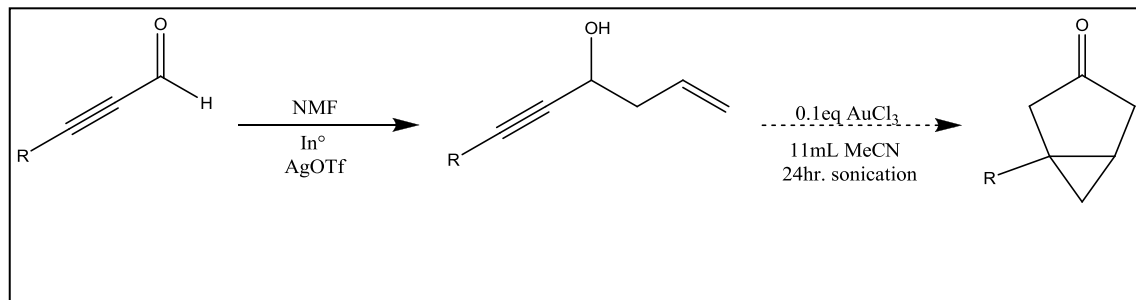
The drawbacks of existing methods of cascade and Barbier reactions arise from the use of organic solvents and inert conditions, causing a movement toward benign conditions. When applied under benign conditions, these one-pot reactions can lead to more efficient and environmentally friendly chemical processes, with less organic waste. In these projects, Barbier and cascade reactions under benign conditions were proposed. The first project is an indium-promoted Barbier coupling, followed the second project, a gold (III) promoted cascade reaction producing a cyclic product. The results demonstrate that Barbier coupling and cascade reactions can be run efficiently and with promising results under benign conditions.

30.

### ACCELERATING EFFECTS OF LEWIS ACID CATALYSTS IN THE FORMATION OF A CYCLIZED PRODUCT

Linda Tam '10

Faculty Sponsor: Thomas Mitzel



Cyclic products are well known in nature and many have biological activity. As such the synthesis of these compounds has become of great interest to organic synthetic chemists. The formation of a polycyclic organic molecules has been achieved repeatedly, however, most syntheses require multiple steps, lowering the overall yield of product isolation. Interest in our lab focuses on establishing the appropriate reaction conditions to synthesize a polycyclic product from acyclic precursors in a one-pot synthesis. Different Lewis acid catalysts and different solvents were used in hopes of inducing re-arrangement and cyclization. These will be discussed within the poster.

31.

### USING NMR TO DETERMINE THE CONFORMATION OF CAPSAICIN IN ENVIRONMENTS OF VARYING POLARITY: RELEVANCE TO CAPSAICIN BINDING TO TRPV1 RECEPTORS

Brice Vallieres '09

Faculty Sponsor: Richard Prigodich

Capsaicin is a biological agent found in chili peppers. It has been used in industry as a means to treat minor aches and pains. Capsaicin functions in this role by binding to the TRPV1 ion-channel receptor. Capsaicin conformation at the receptor binding site will be relevant to its function. The purpose of this research was to determine whether capsaicin adopts different conformations in hydrophobic (receptor binding site) and hydrophilic (aqueous solution) environments by measuring the inter-proton distances of capsaicin in solvents of varying polarity. The extent of the folding was mapped using 1D nOe and rOe, ROESY and NOESY data sets. A conventional proton NMR was also obtained and a spectrum assigned using COSY data. The solvent list includes, deuterated chloroform, deuterated benzene and deuterated methanol.

# COMPUTER SCIENCE

32.

## **A STUDY ON SUPPORT VECTOR MACHINES - THE IMPACT OF VARIOUS TRAINING SIZES ON THE ACCURACY OF THE GENERATED MODELS**

Nicolae Dragu '12

Faculty Sponsors: Ralph Morelli, Takunari Miyazaki

A Support Vector Machine (SVM) is a supervised learning technique used for classification and regression problems. In order to examine how the accuracy of the model generated by SVM is influenced by the different number of training instances, LibSVM (a software library for SVM) was used in conjunction with the Tic-Tac-Toe data set from the University of California, Irvine Repository. The experiment consisted of splitting the data set into training sets of various sizes and six different testing sets used for the purpose of testing the accuracy of the models. The results indicate a gradual increase of the accuracy of the generated models as the training sets get larger. Another observation is that the accuracy of the models is satisfactory when a training set with 25%-30% of the original data set is used. Results from similar studies on Tic-Tac-Toe will be contrasted with the results of this study. Having this experiment as a background, we hope to apply this technique to problems in bioinformatics (such as microarray analysis) and public health (detecting spread of infectious diseases).

33.

## **PARALLEL IMPLEMENTATION OF A RAY TRACING ALGORITHM WITH ADVANCED LIGHTING EFFECTS**

Kalin Gochev '09

Faculty Sponsor: Peter Yoon

Ray tracing is an algorithm for realistic rendering of 3-dimensional environments. The algorithm is based on the physical properties of light; it is very computationally expensive algorithm and until recently was considered not feasible for practical purposes.

The benefits of the ray tracing algorithm compared to the conventional 3D rendering, is that it allows us to generate an image with exceptionally high level of detail and realism. It supports the implementation of advanced graphical effects such as anti-aliasing, realistic reflections and refractions, geometrically correct shadows, global illumination and caustics (complex shadows cast by transparent objects).

Our parallel implementation of the algorithm is designed to operate in a multi-processor environment using the MPI and POSIX libraries. This allows us to fully utilize the CPU cycles on multi-core systems as well as multi-CPU systems. We also have implemented an acceleration structure, known as a kd-Tree, which reduces the complexity of the algorithm from  $O(n)$  to  $O(\log n)$ . Moreover, we have optimized all computations to achieve the shortest possible run-time.



**34.**

### **ALGORITHMS RELATED TO ODD PERFECT NUMBERS**

Justin Sweeney '09

Faculty Sponsors: Takunari Miyazaki

A perfect number is defined as a number,  $n$ , whose divisors, including both 1 and itself, sum to  $2n$ . An odd perfect number is any odd number which satisfies this condition. To this day, despite the great deal of work done on the topic of odd perfect numbers, no odd perfect numbers have yet been found, but their non-existence has not been proven. This leaves the problem of odd perfect numbers as one of the most significant unsolved problems in number theory. As technology has advanced, new and more effective ways to study odd perfect numbers have been developed, which use new technology. Algorithms are being written to solve various problems related to the study of odd perfect numbers. The purpose of this project was to research and study the algorithms used in the study of odd perfect numbers. Examples of algorithms were studied to gain an understanding of the methods and tools necessary to solve problems related to odd perfect numbers. In particular two algorithms related to the prime factors of an odd perfect number were studied extensively. After studying examples, new algorithms were implemented which improved upon the algorithms studied.

## **ENGINEERING**

**35.**

### **DESIGN AND IMPLEMENTATION OF A RAT EYELID MOVEMENT SENSOR**

Sagar Bhandari '09

Faculty Sponsor: David Ahlgren

Facial nerve injury and recovery often result in a condition called synkinesis. Synkinesis is the occurrence of inappropriate movement of innervated facial muscles in humans. Studies of facial nerve function could be performed by simultaneous monitoring of eyelid and whisker movements in rats. The currently used opto-electronic-sensor-based method does not easily differentiate between two different eyelid movements: 1) active eyelid movement resulting from contraction of the orbicularis oculi versus 2) passive eyelid movement resulting from eye retraction into the orbit. The goal of the current project is to design a stand alone device that will differentiate between the active eyelid and passive eyelid movement.

The stand alone device provides analog output proportional to the amount of active eyelid movement only. A single line scan camera is used as an image acquisition device. A custom circuit board for the CMOS linear sensor is tested and mounted in the security camera. Circuit has also been designed and implemented to display the video output of the camera chip on a VGA monitor. An analog comparator is used to compare the analog pixel value with a set threshold. The output from this comparator is either low or high depending on the brightness of the pixel. A high speed pixel counter (200 KHz) is built that computes the number of pixels lower than the threshold value. It then transmits that information for every frame (at 200Hz) to a microcontroller. The microcontroller computes the fraction of the eye opening using this information and outputs an analog signal. As of now, this system is implemented in a prototyping board.

**36.**

### **QUANTITATIVE COMPARISON OF INDIRECT AND DIRECT LUNG FUNCTION MEASUREMENTS**

Brittany Bristow '09

Faculty Sponsors: Joseph Palladino, Roger Thrall PhD, Department of Immunology, University of Connecticut Health Center

7.3% of adults (16.2 million) and 9.1% of children (6.7 million) in the United States have asthma. There is research on new drugs that might be able to treat asthmatic symptoms, which include bromelain that has been reported to reduce inflammation of the airway. In an effort to contribute to this research it is necessary to observe how the lungs react during a respiratory attack. The ovalbumine induced mice, allergic airway diseased mice, have shown similar outcomes to those found in humans, including increased white blood cells and airway hyperreactivity, which makes them useful in studying pulmonary functions. The severity of the symptoms can be measured in relation to the airway resistance of the mouse or its penh (unit-less index of airway hyperreactivity). The airway resistance measurement is recorded during an invasive procedure. This procedure consists of a tracheotomy surgery for the mouse; it is then ventilated and recordings of airway resistance are measured at various concentrations of methacholine (allergen). The penh can be measured in a conscious mouse during its natural state of breathing. Results show that the penh and resistance will increase as concentration increases from 3 to 300mg/ml. Therefore, it is possible to observe the pulmonary functions of an allergen by measuring it's penh as suppose to the airway resistance procedure that causes euthanation of the mouse.

**37.**

### **DETERMINATION OF NEONATAL URINARY OUTPUT**

Joshua Caplan '09, Joao DeOliveira '09, Evan Daley '09

Faculty Sponsors: Harry Blaise, Joseph Bronzino, Leonard Eisenfeld MD, Neonatology, Connecticut Children's Medical Center

The current methods used to measure bladder volume and urinary output in neonates is inaccurate. The weighing of diapers and catheterization are the two practices used for taking measurements, each of which present problems. Catheterization is invasive and weighing diapers is inaccurate. The goal of this project is to develop a new process that uses ultrasound to measure fluid volume in a neonatal bladder. Ultrasound is beneficial because it is non-invasive and provides accurate image measurements. A physiological prototype of a neonatal bladder was built in order to test the accuracy of the ultrasound. The percent error of the ultrasound measurements has so far ranged from 5% to 15%. Using software implemented calipers, the volume of fluid in the bladder is calculated from the ultrasound image. A Labview computer program is being developed that will process ultrasound measurements and determine changes in bladder volume and calculate urinary output for each voiding event. Ideally, Labview will be fully incorporated into the hospital computer network. These calculations can then be read on any computer within the network. With these calculations readily available through the Neonatal Intensive Care Unit (NICU) nurses will be alerted when patients' bladder issues arise.

**38.**

**DESIGN OF SYSTEM TO IMPLEMENT SEIZURE BEHAVIOR IN A PATIENT SIMULATOR MANNEQUIN**

Mary Ebraheem '09, Marissa Powers '09

Faculty Sponsors: Joseph Palladino, Jay McIssac, MD, Hartford Hospital

Medical simulation mannequins have become an important method of training in many hospitals as a result of their ability to accurately simulate real time emergency scenarios. This project focuses on further enhancing the versatility of the patient mannequin in order to improve the realism of simulation training. While a large number of high level simulation mannequins are currently available, the majority cannot demonstrate seizure behavior. The objective of this project is to design and implement a fully functional external seizure-inducing mechanism for the Laerdal SimMan mannequins.

**39.**

**UNIQUE ARTIFACT IDENTIFICATION THROUGH RFID AND GPS TECHNOLOGIES**

Alex Greenough '09

Faculty Sponsor: David Ahlgren

Archaeologists spend much of their time in the field marking artifacts and taking down their GPS coordinates. Once they are done working in the field for the day they must upload all of this information by hand to a computer. An additional problem in archaeology is the presence of fake artifacts, which decrease the value of real ones found at a dig site.

The proposed solution to this problem is to create a device that uses RFID technology to uniquely identify each artifact while simultaneously taking down the GPS coordinates of where the artifact was found. It should then be possible to upload this data to a computer for further analysis.

**40.**

**SLOW COMPRESSION MACHINE REDESIGN FOR IGNITION STUDIES**

Scott Mussmann '09

Faculty Sponsor: John Mertens

Recent studies have shown experimental syngas ignition times for high pressure low temperature conditions to be faster than the current theoretical model by up to 3 orders of magnitude. A slow compression machine (SCM) was designed to determine whether the early ignition times seen were due to surface induced chemical reactions or due to gas phase reactions. Initial testing using the SCM revealed some mechanical design flaws, and significant thermal design flaws for tests over 600K. A mechanical redesign of the piston/cylinder has been completed, and additional thermal redesign is in progress. The design goals include maintaining a high temperature for the gas (up to 800K), preventing the O-rings from failing, and attempting to minimize the temperature gradient within the gas. Design tools include finite element heat transfer analysis and experimental testing of various heating conditions. The SCM was recently used for an ignition test with conditions of 30.4 atm and  $500K < T < 585K$  and resulted in no ignition. More tests at temperatures below 600K with higher pressures and higher fuel to air ratios will be run soon.

**41.**

**DESIGN AND FABRICATION OF AN ON-CHIP LED PANEL LIGHT CONTROLLER**

Kumud Nepal '09

Faculty Sponsor: David Ahlgren

Studies have shown that Light Emitting Diode (LED) Panels consume up to 90% lesser energy than normal light bulbs. This project aims at making LED Panels more energy friendly by designing a system-on-chip that controls the amount of LED light output depending on the ambient lighting condition. The main objective is to design, layout, simulate and fabricate an on-chip light intensity controller that will take in light signal through a wide-area lens and control LED current for brighter or dimmer lighting output. Towards that goal, a P-N junction photodiode will be combined with a source follower amplifier, a sample and hold circuit, an 8 bit flash Analog to Digital Converter and an 8 to 3 encoder. This will consequently provide three levels of possible lighting output. All the components will be designed at a low transistor level and the timing operations will be operated by a simple finite state machine counter written in Verilog. The design will be simulated and manually laid out for fabrication using Mentor Graphics software package. The final product, which will be a single chip, will be sent out to the MOSIS Service for fabrication on June 22nd.

**42.**

**FIRE FIGHTING ROBOT FOR TRINITY'S ROBOTICS COMPETITION**

Adam Norton '12

Faculty Sponsor: David Ahlgren

The Trinity College Fire Fighting Robot Competition challenges a robot to navigate a small course, to draw water from a pool, and use this water to put out a fire in one of three structures in the course. With this in mind, a robot was built using an irobot as a base, which was equipped with sharp sensors, flame sensors, a frequency sensor, a pump, and a spraying mechanism. These all had to work as a seamless unit, activating at the correct times and in the right places based on the program that was written and installed onto the irobot. The robot was intended to follow the wall of the course until it found the pool, where it was then to pump up water for a specified period of time until it would back away from the pool and find the flames with its sharp and flame sensors, where the spraying mechanism would come into effect and put out the fire. However, this project brought to light the fact that in engineering, things rarely work on the first try, or even the second for that matter. Therefore, the majority of the time was spent debugging the equipment. With the deadline fast approaching, time ran out on the debugging process, and on the day of the competition, one of the sharp sensors refused to work correctly, the flame sensors did not work at all, and a relay switch used to activate the pump and the spraying mechanism was unable to draw enough current from the batteries. Therefore, although the project served as an excellent learning experience, the robot failed to complete the task, and did not win the competition.

**43.**

**ROBOWAITER**

Binay Poudel '12

Faculty Sponsor: David Ahlgren

Trinity Robot team was founded in 1992 with the aim of promoting robotics in the society. International Fire-fighting robotics competition has been conducted by robot team since 1993 as a part of its various activities on the field of robotics. The robowaiter competition was introduced in the competition in 2009 in collaboration with Connecticut Council on Developmental Disabilities. Mindstorm NXT programmed with Labview was used to prepare a robowaiter. Bluetooth communication between two NXT and NXT cameras for the navigation were used. The robowaiter was programmed to search for the LED lights followed by the navigation with the aid of ultrasonic sensor and the NXT camera. The arm height was made adjustable to account for the uncertainty of the table's height. During the contest, the robowaiter did not operate successfully because of its inability to differentiate the chair from the LED lights. The reason behind this was later found to be the difference between ambient light in the contest arena compared to the lab where camera was calibrated. Taking the reason into account further modification in the robot is being done. If the robowaiter can be calibrated to work under more general conditions, it was seen that robowaiter could be a good solution to the problems of disabled and elderly people who cannot frequently walk.

**44.**

**CONVERSION OF MECHANICAL ENERGY USING A ROWING MACHINE**

Adam Re '09, Eli Roxby '09

Faculty Sponsors: Joseph Palladino, Jay Whelan, The Green Revolution

While many alternative sources are currently being utilized or developed, one untapped resource lies in mechanical energy expended through exercise. In cooperation with The Green Revolution, a company currently developing energy producing spinning bikes, the goal of this project was to explore the possibility of generating electricity using a rowing machine. In order to achieve this, energy expended by the person rowing is converted to electrical power via a permanent magnet alternator (PMA). A belt drive transmission system, consisting of two pulleys and a single belt, is responsible for connecting the flywheel and the alternator. The DC voltage and current generated by the PMA are then sent into two 12 V batteries in series, which are in turn connected to a grid tied inverter. Excess voltage supplied to the batteries is transferred into the inverter, which takes in 24 V DC and outputs 120 V AC. Thus far this system successfully converts the kinetic energy of rowing into useable AC power. At this point, the amount of power is much lower than expected calculations, which predicted an output of approximately 150 W. Experiments suggest that the low power output is due to excessive mechanical heat damage to the alternator. The damaged permanent magnet alternator is in the process of being replaced and testing will continue.

#### **45.**

### **THE DESIGN OF AN AUTONOMOUS UNDERWATER VEHICLE (AUV)**

Bryce Snarski-Pierce '09

Faculty Sponsor: David Ahlgren

An autonomous underwater vehicle (robotic submersible) was designed by Trinity Engineering students Patrick O'Brien and Ridgely Dodge in 2005, and was moderately successful in achieving its goal of precise movement in the Trinity College swimming pool. Through the re-design of the AUV and the incorporation of new components, these goals are rectified in this design project. This new AUV includes environmental sensors (i.e. temperature) and is built with consideration of possible future use as a data-collecting platform. The 28-inch long vehicle has a 4-inch diameter PVC Hull, is powered by a pair of 7.2V 3000mah NiCad Batteries, and is propelled by a 63W circulator pump, which allows the 6.88 kg AUV to achieve a theoretical maximum velocity of 0.24 m/s. The vehicle is driven by a Handy Board and programmed in the Interactive-C variation of the C language designed for easy debugging. The AUV is naturally buoyant and actively controls its pitch via a feedback system consisting of a depth sensor (sensing water pressure), a pitch sensor (a capacitive fluid inclinometer), and an internal balance weight (8% of the AUV's total mass) suspended on an internal translation stage, allowing the vehicle to adjust its center of mass in relation to its fixed center of buoyancy, pitching the AUV forward and back to ascend and descend via subsequent forward propulsion. Steering is maintained by a second feedback system that senses external obstacles with an array of 60-cm range IR sensors and steers via a reversible pump feeding to laterally directed nozzles. The system is designed to be easily maintained and modified; all internal components are attached to an extractable internal skeleton of two threaded rods and four aluminum bulkheads, which in turn are connected to a detachable rear end cap, where all hull breaches for sensors, inlets, and outlets are located.

#### **46.**

### **BIOMETRICS AND SECURITY: SEQUENTIAL PASSWORD BASED ON FINGERPRINTS**

O'Rayan Velarde '09, Naoto Hamashima '09

Faculty Sponsor: Taikang Ning

Security systems have improved as technology has developed. Common authorization mechanisms include: computer systems and alpha-numeric passwords and cardkeys for securely accessing a dormitory room or a similar restricted area. In recent years, the Department of Homeland Security and other governmental organizations have decided to implement biometric systems (i.e. fingerprint recognition) for their security measurements. Even though such fingerprint recognition systems are much more secure than previous implementations, these systems are still prone to a possible database breach and thus the fingerprint information would be compromised.

Our mission statement is to design and construct a security system that is more secure and less expensive than the current fingerprint reading standards. An Altera DE2 FPGA board is used as the hardware for the real-time signal processing. A 5 Mega pixel CMOS sensor is used for capturing a live image of a fingerprint, which is processed and displayed on a VGA screen, while a 4.3" touch screen with a resolution of 800 x 480 pixels is used for displaying an image from the database. The two displayed images, the live image data and the database image data, are

processed and compared pixel by pixel in our hardware. At this point, the achieved tasks include: process and display of both the live image and database image on the VGA and the touch screen, respectively. Current work is focused on an authorization (matching) algorithm which would compare the two images and utilize the LEDs on the Altera DE2 board to display the results of this process.

## **ENVIRONMENTAL SCIENCE**

**47.**

### **A COMPARISON OF THE MERCURY CONCENTRATIONS ACROSS THE SOUTH BRANCH OF THE PARK RIVER, THE CONNECTICUT RIVER, AND THE MOUNT HOPE RIVER**

Victoria Done '11, David Burszan '12  
Faculty Sponsor: Jonathan Gourley

The Park River is an urban river that flows through the city of Hartford. It has an extensive and very diverse watershed that encompasses many levels of development and different types of environments. The north branch is much less developed than the south while the south branch has many industries operating on its banks. Due to the impact of these industries (more specifically the metal finishing industries), there may be significant concentrations of heavy metals present in the sediment. This study will be specifically focused on the concentrations of mercury. Sediment samples were obtained from several brooks of the south branch of the Park River (Piper Brook and Trout Brook), Connecticut River, and Mount Hope River. They were then dried and analyzed with a Direct Mercury Analyzer (DMA-80). It is expected that there should be a greater concentration of mercury closest to the industries hence these concentrations would be greater in the more developed south branch of the river. Our results range from 5.1 ppb to 1218.0 ppb with the highest concentration present in the Mount Hope River. A map of the sampling sites and any possible pollutants located near them will be constructed. This may give an explanation as to why there are certain concentrations of mercury present in the sediment. Connecticut does not have official sediment quality regulations so this research may aid in the development of this type of legislature in the near future.

**48.**

### **AVIAN COMMUNITY COMPOSITION AT CONNECTICUT MAPS SITES**

Amy Duggan '12  
Faculty Sponsor: Joan Morrison

Bird community composition data were collected over the last 7-8 years during the breeding season at two Monitoring Avian Productivity and Survivorship Program sites in Connecticut. The sites were the Trinity College Field Station (TCFS) in Ashford, and Connecticut Audubon Society at Pomfret (CASP) in Pomfret. Much of the CASP site is characterized by large shrubs and open areas whereas the TCFS site is covered in forests with little undergrowth. Few wetland birds were caught overall because there is little wetland habitat in either of the study areas. More shrub species were caught at the CASP site because there is more shrub habitat there than at TCFS. Ten species were unique to the TCFS site and eleven species were unique to the CAPS

site which reflects the difference in habitat between the two sites. Six of the eleven birds unique to CASP were shrub foragers whereas four out of the ten species unique to TCFS were canopy birds. At both sites, the majority of bird species were migratory and migrant birds made up a majority of the population. More of the species were Neotropical migrants, but non Neotropical migrants made up a larger percentage of the overall population at both sites. CASP had more Neotropical migrant species but Neotropical migrants made up a larger percentage of all individuals captured at TCFS. Fewer cavity nesters and canopy foragers were caught because these species inhabit the upper strata of the forest and the mist nests used in the MAPS program are only 3m tall. Information about links between the types of habitats available and bird populations that inhabit them can be used to aid conservation efforts at both sites.

#### **49.**

### **CHANGES IN CLIMATE HISTORY IDENTIFIED USING SMEAR SLIDE ANALYSIS OF MUDGE POND, SHARON, CONNECTICUT**

Geoffrey Heppenheimer '10, Susan Juggernaut '09

Faculty Sponsor: Jonathan Gourley

Climate change has been fluctuating throughout Earth's history prior to human presence. Our study aimed to identify large changes in biological and environmental components in the early Holocene using smear slide analysis of lake sediments in western Connecticut. We took one sediment core from Mudge Pond on February 7, 2009 and analyzed four major sediment components: 1) organics, 2) organisms, 3) clastics, and 4) carbonates using a polarizing light microscope. Our results show a decrease in organisms, organics and carbonates towards the bottom of the core and an increase in clastics. We compare this data with loss on ignition studies of the same core and conclude that these changes may be due to a lower lake level that occurred in a dryer period in the past. We note this period between 12 and 13 meters deep but need more information about the type of carbonates (biogenic or inorganic) to determine whether or not it is indeed a dryer period that is correlating with the supposed lower lake level.

#### **50.**

### **INORGANIC CARBON IN LAKEBED SEDIMENT CORES AS AN INDICATOR OF PAST CLIMATIC CHANGES USING LOSS ON IGNITION**

Alex Hoxsie '10, Isabel Gottlieb '09, Corey Stein '10

Faculty Sponsors: Jonathan Gourley, Christoph Geiss

Loss on ignition is a scientific technique that can be used to make inferences about past climatic conditions. Deep lakebed sediments keep a continuous history of the environment that created them, and loss on ignition keeps a record of organic carbon, inorganic carbon, and a detrital component within those sediments. Focusing on inorganic carbon, we can begin to make conclusions about water level, lake productivity, and soil cover/erosion at the water's edge. Low percentages of inorganic carbon in sediment indicate a possible wet period and high water levels going back 1600-5300 years. Deeper within the core there were high percentages of organic and inorganic carbon. Although there are multiple possibilities for the climatic conditions that caused this, the disappearance of external input into the lake and the increase of inorganic carbon show a distinct change in the climate of the region. Loss on ignition is extremely useful for its efficiency, but like any scientific discipline needs to be corroborated by different sources. Using data collected from a smear slide analysis of the same lakebed sediment core, our loss on ignition findings for inorganic carbon were supported and the supposed trends validated.



**51.**

**MERCURY IN SEDIMENT PRIOR TO ANTHROPOGENIC INFLUENCES AT MUDGE POND, SHARON, CT**

Isabel Iwachiw '10, Colby Tucker '09

Faculty Sponsor: Jonathan Gourley

We measured the mercury concentrations of sediments taken from a core collected from Mudge Pond, in Sharon, CT in February 2009. Our investigation consisted of an exploratory study which measured mercury concentrations about every meter (15 samples) using a Direct Mercury Analyzer—80. The results confirmed that mercury exists in paleosediments in measureable and variable levels. The investigation also consisted of a high resolution study (100 samples) of mercury concentration comparing two cores from Mudge Pond, dating from 2009 and 2003, to determine if mercury concentrations can be correlated between two different points. Results show that mercury concentrations appear similar between two locations and can be used to correlate cores taken from the same lake. This similarity may be attributed to atmospheric deposition which reduces the potential factors for influences of mercury concentrations in lake beds, such as erosion contributions. The influxes of mercury concentration may be attributed to volcanic eruptions, however, assigning mercury spikes to specific volcanic events proves problematic.

**52.**

**MERCURY CONCENTRATIONS IN HARTFORD URBAN WILDLIFE**

Casey Jung '12

Faculty Sponsor: Joan Morrison

Mercury is an abundant pollutant that is easily transported atmospherically and has many documented adverse effects on the bodily systems of various bird species. Because of their high trophic positions, birds are strong bioindicators of pollutant levels within a particular environment. In an effort to obtain baseline data for mercury levels in urban birds, feathers were collected from the breast and body of Red-tailed Hawks (*Buteo jamaicensis*) living in Hartford, Connecticut. Given that squirrels are a main source of food for urban Red-tailed Hawks, squirrel hair samples were also collected and analyzed for mercury. Feathers from 20 different hawks (18 wild and 2 captive) were washed first in a solution of 0.25 M NaOH and then in three separate beakers containing de-ionized water for one minute each. . After drying for three to five hours at 65°C, feather samples were weighed and placed in nickel boats to be analyzed in a Direct Mercury Analyzer-80 (DMA-80) according to a previously determined protocol. On average, three feather samples per bird were tested with each sample weighing between 5-10 mg. Hair samples from 4 different squirrels were also tested; each weighed between 5-10 mg. Mercury concentrations differed between wild Red-tailed hawk feathers (18.0 - 1750.0 µg/kg) and captive hawks (18.0-42.0 µg/kg,  $t=-4.26$ ,  $p=0.00$ ). Mercury concentrations in squirrel hair samples ranged from 8.00- 55.0 µg/kg; thus we hypothesize that high mercury levels in hawk feathers are unlikely to be attributed to their squirrel prey. Results contribute to baseline data needed to gain a stronger understanding of heavy metal levels in birds living in urban environments.

**53.**

**RECONSTRUCTING CLIMATIC HISTORY AND THE POSSIBLE EFFECTS OF SETTLEMENT ON MUDGE POND, SHARON, CT, USING SMEAR SLIDE ANALYSIS FROM LAKE SEDIMENTS**

Caroline Lewis '09, Daniel Echavarria '11

Faculty Sponsor: Jonathan Gourley

In this study smear slide analysis was used to interpret the effects human settlement had on Mudge Pond in Sharon, CT. Smear slides can be used to quantify the percent abundance of clastic material, diatoms, carbonates, and organic matter in a lake. Two cores were taken from Mudge Pond on 2/7/09. Samples were prepared for smear slide analysis every 20cm throughout the core 09-A. We found that human settlement did have an impact on Mudge Pond. When humans settled in 1740, the amount of clastic material increased because of runoff, resulting from deforestation. We expected that organic material would also increase from this increased runoff, as it should bring nutrients into the lake, stimulating primary production. This effect was not significant. The construction of a dam on Mudge Pond in 1825 also changed the composition of the lake at our core location. Clastic material decreased as the lake level rose and the location of core 09-A became farther from shore. Carbonates also decreased at this time because of decreases in organic material content, which acidifies the lake and prevents carbonates from precipitating. Organic matter showed a positive correlation with temperature, and decreased as temperatures decreased throughout the Holocene. Diatoms were not used to indicate climatic history or human impact because we did not identify their taxonomy.

**54.**

**MAGNETIC ANALYSIS OF SEDIMENT CORES, MUDGE POND, SHARON CT: IMPLICATIONS FOR HOLOCENE CLIMATE CHANGE**

Rachel Lynch '11, Chris Binnie '11

Faculty Sponsors: Christoph Geiss, Jonathan Gourley

Magnetic mineral contributions to lake sediments fluctuate with changes in the environment. Our study analyzes the magnetic mineral compositions of two sediment cores taken from Mudge Pond in Sharon, CT. By examining magnetic susceptibility, ARM, IRM, SIRM and backfield IRM, we were able to identify the concentration, grain size, and basic mineralogy of the magnetic sediments. By comparing this data with loss on ignition data we were able to construct a basic local history of Holocene climate changes in the pond. Our data suggests that Mudge Pond formed as the result of glacial activity, and the glacier left the watershed approximately 9,000 years ago. After its formation the lake went through a period of shallow water before reaching the depths it is today. These results were supported by a decrease in the percentage of inorganic carbonates, and a change in the mineral composition from hematite to magnetite.

**55.**

**ANALYSIS OF MAGNETIC COERCIVITY DISTRIBUTIONS OF PALEOSOLS TO RECONSTRUCT PAST CLIMATES**

Emily Quinton '11

Faculty Sponsor: Christoph Geiss

We analyzed magnetic coercivity distributions for paleosols developed during the early Holocene at four sites located in the Midwestern United States to reconstruct past climatic conditions. Coercivity distributions were measured by stepwise alternating field demagnetization of an isothermal remanence applied in a pulsed magnetic field of 1 T. We estimated the abundance of pedogenic magnetite for the magnetically enhanced region of the paleosol by fitting the demagnetization spectrum to a series of cumulative log-Gaussian distributions (CLG). Our earlier analysis showed a good correlation between the amount of pedogenic magnetite in modern soils with mean annual precipitation. Our analysis of three paleosol profiles (North Cove, Bignell Hill and North Lutheran Cemetery) suggests that these soils developed under a wetter climate than present. The other site we analyzed, Beisel-Steinle, suggests that the soil there developed during a dryer climate. Comparing our data with the other measurements of magnetic enhancement including magnetic susceptibility and ARM/IRM ratios reveals that our method produces similar results.

**56.**

**RECONSTRUCTING PAST CLIMATES USING LOSS ON IGNITION TO DETERMINE ORGANIC MATTER ABUNDANCE IN MUDGE POND, SHARON, CONNECTICUT**

Emily Quinton '11, Giuliani Lopez '11

Faculty Sponsor: Christoph Geiss

Lake sediments are studied in various ways in order to make connections between the relative depth of the sediment in the core, the time of accumulation and past climate. Using loss-on-ignition (LOI) we determined the abundance of organic matter for two lake sediment cores taken from Mudge Pond in Sharon, Connecticut. We analyzed our data to determine the climate history of Mudge Pond based on the relationships understood between organic matter accumulation and climate. LOI is used to determine the abundance of water, organic matter and inorganic carbonates in soil by heating samples to various temperatures to burn off these components respectively. Our data show a general increase in organic matter between four and 11 meters in Mud09A. This suggests that during the time this sediment was deposited, the climate was relatively wetter than today or that the lake level was relatively lower than it is now. Because data collected on inorganic carbonate abundance implies a lower lake level, the combination of our results supports a lower lake level in the past.

**57.**

## **ANALYSIS OF PRECIPITATION SAMPLES FROM TRINITY COLLEGE IN HARTFORD, CT**

Lucille Schiffman '10

Faculty Sponsor: Jonathan Gourley

Acid deposition has become a widespread environmental issue in recent times due to anthropogenic factors, such as the industrial revolution of the late 18th and early 19th centuries, which caused large amounts of precursor pollutants to acid precipitation to be released into the atmosphere. These precursor pollutants are sulfur dioxide (SO<sub>2</sub>), various oxides of nitrogen (NO<sub>x</sub>), as well as reduced nitrogen (NH<sub>3</sub>) which react with water to oxidize and form sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), nitric acid (HNO<sub>3</sub>), and ammonium (NH<sub>4</sub><sup>+</sup>), respectively. These pollutants are released into the atmosphere as a result of the combustion, of oil, coal, and natural gas. Acid compounds from these fuel combustions accumulate in clouds and are released through either wet or dry deposition.

Acid deposition remains an issue in this area because storms that track over the Northeast often form over the many fossil fuel burning plants of the Midwest, or track over the urban sprawl that runs up the East coast, or even form on the densely populated West coast, accumulate precursor pollutants, and release their acid deposition in the Northwest. The Northwest itself is also a source of the precursor pollutants due to its large population. Despite the ongoing issue of acid deposition, policy changes have helped to alleviate much acid deposition in the Northeast.

Acid rain research was done at Trinity College from September 2007 -April 2009. Samples were collected from the roof of the Clement chemistry building and tested for pH, total free acid (H<sub>3</sub>O), total acid strength, and nitrate and sulfate concentrations. Storm track was also recorded in an Arc GIS map. It was found that pH and concentrations of sulfates, nitrates, and chloride are correlated to storm origin and track. There is a correlation between storm size, pH, and anion concentrations. Further research could help continue to strengthen confidence in conclusions made from the cumulative storm data.

**58.**

## **THE IMPACT OF SNOW MELTING ON PARK RIVER SALINITY LEVELS**

Brenna Spingler '10

Faculty Sponsor: Jonathan Gourley

High levels of salt accumulate in rivers after snowmelt events occur. Throughout the winter, snow is piled into banks along roadsides, parking lots, and dead end roads. This study focuses on the effects of snow melting and how it contributes to the salinity of the Park River. To quantify snow melting events, data was collected from the National Oceanic and Atmospheric Administration (NOAA) website. Snow melt tracking devices located in the Hartford area measure snow depth and snow melt rates in inches per hour. When a large storm event occurred in Connecticut, it was usually about a day and a half before snow melting began, and 3 to 4 days before significant changes could be seen. After these events, water was collected from the Beachland Park location along the Park River. The water quality was determined by testing temperature, pH, conductivity, total dissolved solids, and salinity. Atmospheric temperatures were also collected. The water samples were diluted and tested for major anions using an Ion Chromatography (IC) machine. The IC machine was able to give a very accurate reading of

water sulfate levels and these values were used to determine trends throughout the winter season. Evidence suggests that as salt becomes more abundant in the environment, the salinity levels of the surrounding watersheds also increase. The sulfate levels of snow banks rose to nearly 141.91ppm and the Park River sulfate levels rose from 18.96 ppm before winter to 26.43ppm in the peak months of snow melt.

**59.**

### **A TEST OF REFLECTANCE SPECTROSCOPY AS A PROXY FOR HEMATITE CONCENTRATIONS IN SYNTHETIC AND NATURAL SAMPLES**

William Tucker '09

Faculty Sponsor: Christoph Geiss

Sediment color is often used to quantify the abundance of weakly magnetic iron minerals, such as hematite or goethite in sediments and soils. Most studies, however, use mixtures of synthetic hematite and an iron-free matrix to calibrate the results of spectroscopic analyses. Such calibrations may be problematic as the color of hematite depends critically on crystallite size. We produced synthetic hematite using two methods outlined by (Schwertmann and Cornell, 1991) and produced standards with hematite concentrations ranging between 1 and 50 wt % and analyzed ten natural soil and sediment samples from New England, Iceland and Minnesota. Color analyses succeed in reconstructing hematite abundances in synthetic samples but yield semi-quantitative results at best for our natural sample set, allowing for the detection of relative changes in hematite abundance but making truly quantitative analyses problematic.

**60.**

### **INVESTIGATING HUMAN ENVIRONMENTAL IMPACT THROUGH MAGNETIC ANALYSIS OF SEDIMENT CORES FROM MUDGE POND, SHARON, CT**

Sean Zimmer '11, Conor Garvie '11

Faculty Sponsors: Christoph Geiss, Jonathan Gourley

It is possible to link high levels of magnetic minerals in lake sediments to human activities that alter the landscape. Agriculture, forest clearing, and other activities increase erosion rates. This results in an influx of sediments into watersheds, including magnetic minerals. For this project, we extracted two sediment cores from Mudge Pond in Sharon, CT (MUD-09-A and MUD-09-B). We created a basic model, in which we predicted that as Euro-Americans settled in Sharon, they increased erosion rates. We performed susceptibility, ARM, IRM, ARM/IRM, and backfield/SIRM magnetic measurements on samples from the cores. Susceptibility exposed the samples to a weak magnetic field of 1mT, which measured the magnetization per unit volume in a sample. With ARM, samples were exposed to a field of 100mT, which magnetized small grains. IRM and SIRM were used to align strongly magnetic particles in one direction, so that we might obtain S-Ratios. S-Ratios show the proportions of strongly magnetized grains against weakly magnetized grains. We also obtained SEM images of a sample from MUD-09-B to search for particles of fly ash, an anthropogenic magnetic mineral that would indicate coal-burning activity. Our results show that the arrival of Euro-American settlers did have a noticeable effect in the magnetic record of Mudge Pond. This evidence is especially apparent beginning at a depth of 100cm, and continuing to the top of both cores. We correlated our results with previous magnetic data taken from Mudge Pond in 2003, and found that this increase in magnetic material is uniform throughout the lake bottom. The SEM images obtained revealed only one potential fly ash particle. However, we plan to refine our sample preparation methods to continue this search.

# **HEALTH FELLOWS**

**61.**

## **BODY SURFACE AREA MEASUREMENTS IN PATIENTS WITH ADRENAL INSUFFICIENCY: A PHYSICIAN QUALITY IMPROVEMENT STUDY**

Nicole Albino '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Karen Rubin MD, Department of Endocrinology, Connecticut Children's Medical Center

Adrenal insufficiency occurs when a person is unable to produce adequate amounts of cortisol, and if untreated leads to adrenal crisis through hypovolemia and hypoglycemia. Glucocorticoid replacement treats adrenal insufficiency by mimicking natural physiological cortisol. Body surface area (BSA) is used to calculate dosages of glucocorticoids. My study aimed to improve physician adherence to making BSA measurements and therefore decrease rates of adrenal crisis. I hypothesized that physician adherence to calculating body surface area measurements could be improved by 25 percent. I further hypothesized that physicians who do not measure body surface area are two times more likely to prescribe their patients dosages outside of the recommended range. This study was conducted as a retrospective review of four physicians' record of calculating body surface area. First a database was created containing all baseline BSA data. Then a journal club was held to act as an educational intervention on the dangers of underdosing adrenal insufficiency and tell physicians their performance in calculating BSA was lacking. New face sheets with a place for calculated milligrams per meter squared and BSA were added to every adrenal insufficiency patient's chart. The journal club and the new face sheets combined as an educational intervention and real-time reminder system. Pre and post results were obtained on 12 patients thus far. Each physician improved their number of patients with measured BSA. The data on the practice as a whole was also analyzed. 66.6 percent adherence pre-intervention was compared to 100 percent adherence post-intervention. This held with my primary hypothesis that adherence could be improved by 25 percent. The data for my secondary hypothesis showed no difference in accurate dosages comparing doctors that measured BSA and doctors that did not. The experiment is still in progress and data collection continues.

**62.**

## **EVALUATION OF PERCUTANEOUS HAMSTRING OUTCOMES IN CHILDREN WITH CEREBRAL PALSY**

Kristie Anderson '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Kristan Pierz MD, Department of Orthopaedics, Connecticut Children's Medical Center

Cerebral Palsy (CP) is a disorder of motion and posture resulting from a nonprogressive brain injury sustained during early development. Although the disease is nonprogressive, the resulting abnormal muscle tone and musculoskeletal imbalances lead to increased abnormalities of motion, gait, and function that can worsen over time. In particular, during gait, children with CP often walk with flexed knees in stance and limited knee extension at initial contact, thus impeding foot clearance and limiting step length. This crouch gait may result from excessively tight, spastic hamstrings. Children who exhibit such crouched gait often undergo surgical lengthening of the hamstrings in order to address sagittal plane dysfunction. Currently, two

techniques are being used interchangeably: percutaneous hamstring lengthening, and intramuscular hamstring lengthening. Compared to intramuscular lengthening, percutaneous hamstring lengthening is a minimally invasive, relatively new procedure. It involves lengthening of the tendons through either tiny “stab” incisions, or via dissection with a stout needle. Using techniques of gait analysis, this retrospective study evaluated the surgical outcomes of percutaneous medial hamstring lengthening in 24 children (43 knees) with ambulatory forms of CP. Clinical assessment and comprehensive gait analysis were performed both preoperatively and postoperatively; sagittal plane kinematic and kinetic data were collected during barefoot ambulation. Patients demonstrated statistically significant improvement in popliteal angle ( $p < 0.005$ ) and straight leg raise ( $p < 0.005$ ), as well as kinematic parameters including knee angle at initial contact ( $p < 0.005$ ) and mean knee angle in stance ( $p < 0.005$ ). Although the mean knee extensor moment in stance decreased, this was not statistically significant ( $p = 0.215$ ). Hip extensor and knee flexion strength were not significantly decreased ( $p = 0.330$ ,  $p = 0.600$ , respectively). Initial results suggest that percutaneous medial hamstring lengthening is effective in addressing sagittal plane knee dysfunction in patients with ambulatory forms of CP. Percutaneous outcomes appear to be similar to those of the more invasive, intramuscular hamstring lengthening.

### **63.**

#### **OSTEOPROTEGERIN AS A MARKER OF THE VASO-OCCLUSIVE CRISIS IN SICKLE CELL DISEASE**

Laura Anderson '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Francisco Sylvester MD, Department of Gastroenterology, Connecticut Children's Medical Center

Osteoprotegerin (OPG), a member of the tumor necrosis factor (TNF) superfamily is a regulator of bone resorption. OPG may be involved in the progression of atherosclerosis and coronary artery disease and may be a marker of the severity of these diseases. Sickle cell disease is characterized by an abnormal type of hemoglobin that causes red blood cells to become sickle shaped and rigid, making it difficult for them to pass through capillary blood vessels. This results in a loss of blood flow and onset of inflammation in affected tissues, or a vaso-occlusive (pain) crisis. Since pain caused by vaso-occlusion is a subjective experience, an objective marker of vascular obstruction is needed in sickle cell disease. Atherosclerosis, coronary artery disease, and sickle cell disease all have vascular occlusion and inflammation in common. Consequently, we propose that OPG plays an important role in the development of the vascular lesion in sickle cell disease and may be a marker of vascular inflammation and occlusion. We hypothesize that serum OPG is increased in children with sickle cell disease suffering from acute vaso-occlusive crisis. As part of a prospective pilot study, the levels of serum OPG were detected in outpatients and inpatients with sickle cell disease at Connecticut Children's Medical Center using an ELISA kit. Serum OPG was stratified depending on the subject's pain status: acute, chronic, or no pain. Average OPG values for control, no pain, acute, and chronic were found to be 3.16, 3.20, 3.34, 2.28 pmol/l respectively. When comparing the sickle cell disease groups with the control, no significant difference was found, however within the diseased study groups there was significance difference between chronic and acute ( $P = 0.044$ ). This fact warrants further analysis of the presence and functional importance of OPG in humans.

**64.**

**NEURAL NETWORK ABNORMALITIES IN AD/HD: A STUDY USING DYNAMIC CAUSAL MODELING**

Ritika Chandra '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Michael Stevens PhD, Institute for Living,

Attention Deficit Hyperactivity Disorder (AD/HD), characterized by impulsiveness, hyperactivity and inattentiveness, is one of the most common childhood mental disorders. Previous fMRI studies have indicated that AD/HD likely arises from dysfunction in fronto-striatal neural systems that directly affect executive functioning. One important domain of impaired executive function is response inhibition, as is commonly measured by laboratory Go/No-Go tasks. In a previous study, three separate functionally integrated circuits responsible for response inhibition were identified, including a fronto-striatal-thalamic circuit. This neural network might be abnormally engaged in persons with AD/HD, but to date, no study has examined interactions among the neural regions that are involved in this circuit. The objectives of this study are (1) to study 'effective connectivity' of the fronto-striatal-thalamic circuit using dynamic causal modeling of fMRI time series data collected during performance of the Go/No task, and (2) to test for abnormal network interactions among the nodes of this network in adolescents diagnosed with AD/HD. The results displayed that both AD/HD and healthy control participants have comparable overall network structure when performing the Go/No-Go task. Although the AD/HD group and healthy controls had similar intrinsic connections among network nodes, AD/HD participants were found to have generally weaker connectivity between key brain regions during response inhibition compared to healthy controls. These results empirically identify key aspects of network dysfunction in AD/HD that support models of frontostriatal hypofunction.

**65.**

**THE EFFECT OF SURGICAL SUBSPECIALTY TRAINING ON PDA LIGATION OUTCOMES**

Michael Chung '11

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Brendan T. Campbell MD, MPH, Department of Surgery, Connecticut Children's Medical Center

Patent ductus arteriosus (PDA) is a condition in which the blood vessel that connects the pulmonary artery to the aorta does not close spontaneously after birth. The first line of treatment is administration of indomethacin. The second line of treatment is surgical ligation of the PDA.

PDA ligations are performed either by pediatric cardiothoracic or pediatric general surgeons. Our study objective was to determine which surgeon type performed PDA ligations better. Measurement outcomes were total hospital charges, patient length of stay and mortality. Data were extracted from the Pediatric Health Information System (PHIS), an administrative database that collects patient chart information from 44 U.S. children's hospitals. Extracted data included sex, date of birth, gestational age, birthweight, ethnicity, length of stay, total hospital charges, procedures and diagnoses. All subjects were born between 1 Jan. 2006 and 1 Jan. 2008. Subjects with other congenital heart conditions were excluded. Pediatric surgeons at each of the PHIS hospitals were asked who performs PDA ligations via email.



Following these criteria, 163 pediatric general surgeon cases and 962 pediatric cardiothoracic cases were isolated from 21 hospitals. PDA ligations performed by pediatric cardiothoracic surgeons had significantly higher mortality (9.5%) as compared to pediatric general surgeons (3.1%,  $p < 0.001$ ). No significant differences in age at ligation, birthweight and gestational age, vocal cord paralysis incidence, total hospital charges or length of stay were found. Our study suggests that pediatric general surgeons may perform PDA ligations at less risk of death to the patient than pediatric cardiothoracic surgeons.

**66.**

### **CONDITIONED PLACE PREFERENCE IN A VIRTUAL ENVIRONMENT**

Shana Conroy '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Robert Astur PhD, Olin Neuropsychiatry Research Center, Institute of Living

The conditioned place preference (CPP) paradigm is an established method used in order to study the effect of the context on drug abuse and relapse. The conditioned place (CPP) paradigm pairs a positive reinforcer, such as nicotine, with a specific environment in order to test whether or not the subject shows a preference for the specific environment in the absence of the drug. In an effort to examine whether or not the conditioned place paradigm can be established in human participants, a virtual reality analogue of the CPP paradigm was created with three rooms resembling a virtual reality apartment – a bedroom, a living room, and a hallway. One of the rooms in the apartment was paired with a nicotine cigarette and the other room was paired with the placebo cigarette. On the last day of the experiment, during the “testing” session, the participants were given access to both of the rooms in the absence of the drug and the time spent in both of the rooms was monitored. There was found to be no direct correlation between how the participants rated the cigarette of their choice over the placebo cigarette and how much time he or she spent in the nicotine-paired room during the “testing” session. However, there was a direct correlation between how “good” the participant rated themselves while in the nicotine room and the rating that the participant gave the nicotine-paired room at the end of the experiment. Future work will be directed towards using these results in order to develop and use pharmaceutical techniques and different forms of therapy in order to block or minimize these cravings.

**67.**

### **PREGNANCY AND NEONATAL OUTCOMES ASSOCIATED WITH INDUCTION OF LABOR FOR COMPLICATIONS OF PREGNANCY**

Gina Filloramo '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Natalie Cushman MD, Obstetrics and Gynecology, Hartford Hospital

Presently, induction of labor has become a standard means of managing complicated pregnancies in an effort to prevent related risk factors and improve maternal and fetal outcome. Based on recent studies, it is difficult to determine if indications for induction are correlated to specific pregnancy outcomes (method of delivery). Furthermore, it is unknown if there are associations between pregnancy outcome and the overall health of the neonate. Knowledge of the influence of labor induction on method of delivery and neonatal outcome may provide patients with the option of a primary elective cesarean section in avoidance of failed inductions and unnecessary

maternal and fetal stress. Assessment and evaluation of the impact of maternal demographic factors will also provide physicians with a greater understanding as to how age, parity, race, and practice type are related to induction for all indications of induction in complicated pregnancies. An IRB approved retrospective cohort study of 7,302 induced births occurring at Hartford Hospital from January 2004-December 2008 was designed to assess pregnancy and neonatal outcomes associated with isolated cases of indications for labor: chronic hypertension defined by the presence of hypertension before pregnancy or prior to 20 weeks gestation and a current blood pressure greater than 140/90 mm HG; diabetes mellitus defined by a Glucola test level < 35; intrauterine growth restriction defined by an estimated fetal weight < 10th percentile; macrosomia defined by fetal weight > than 4500g; oligohydramnios defined by an amniotic fluid index (AFI) < 5cm; polyhydramnios defined by an AFI > 25cm; post term defined as > 40 weeks+0 days; and pre-clampsia defined by a blood pressure > 140/90 mm HG and proteinuria. Only singleton, vertex positioned pregnancies of women who have not had a prior cesarean section were analyzed with maternal demographics of age, race, parity and healthcare provider as non exclusive criteria. Pregnancy outcome after induction was evaluated as spontaneous vaginal delivery (SVD) or cesarean section (C/S). Obtained from the Connecticut Children's Medical Center database, neonatal outcomes were measured by Apgar scores (normal >7) NICU admission and NICU duration of stay. Data collection and analysis is ongoing; however, preliminary results indicate isolated post term cases as the most common indication for induction and a greater rate of cesarean section among nulliparous patients vs. multiparous patients

## **68.**

### **IMPACT OF SCHIZOPHRENIA REHABILITATION PROGRAM ON VOCATIONAL OUTCOMES**

Kristen Homiski '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Silvia Corbera PhD, Institute of Living

Research indicates that several factors may negatively impact the vocational productivity of individuals with schizophrenia, such as positive and negative symptoms, cognitive deficits, and job satisfaction. The Schizophrenia Rehabilitation Program (SRP) is a long-term outpatient program that provides comprehensive treatment including neurocognitive rehabilitation and vocational services. SRP follows a modified Individual Placement and Support vocational approach which is the most empirically supported one in this field. This study aimed to identify the variables that predict successful vocational outcomes after outpatient rehabilitation in the SRP. Data was collected from 30 individuals with schizophrenia including demographics, clinical measures, measures of depression and quality of life, and cognitive performance of processing speed, attention, working memory, and problem solving. In addition, vocational measures were also obtained, including total weeks worked per month, total hours worked per month, and a measure of job satisfaction. Preliminary results showed negative correlations between negative symptoms and weeks worked per month, and positive symptoms and job satisfaction, which suggested that elevated levels of negative symptoms hindered vocational productivity, and high rates of positive symptoms predicted low job satisfaction. Moreover, positive correlations were found between overall treatment length and hours of cognitive rehabilitation with the weeks worked per month, which implied that treatment length and cognitive rehabilitation were associated with improved vocational outcomes. A correlation was found between measures of attention and weeks worked per month, as well as hours worked per month, although this relationship is unclear. Lastly, one-way ANOVA exhibited a significant difference between the productive and non-productive group (patients involved in a vocational

activity vs. non-involved) regarding the length of treatment, the hours of cognitive rehabilitation, and one measure of attention. We expect to explicate the role of job satisfaction and other variables at predicting job tenure in the upcoming months.

**69.**

**ANTIPLATELET EFFECT OF TORODOL AND OVERALL COAGULATION FUNCTION IN PEDIATRIC POST-OPERATIVE NEUROSURGERY PATIENTS AS ASSESSED BY THROMBOELASTOGRAPHY**

Lea Jancic '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Philip Spinella MD, Pediatric Intensive Care Unit, Connecticut Children's Medical Center

Torodol is a non-steroidal anti-inflammatory drug (NSAID) used to treat moderate to severe pain. Although opioids are usually the drug of choice when treating post-operative pain, their significant side effects make them undesirable in many cases, particularly neurosurgery. Torodol is an effective alternative, delivering significant pain relief without the side effects associated with opioids. However, there are concerns over the possible antiplatelet effects of Torodol and the risk of increased bleeding in patients. As of now there is no standard in the surgical community regarding the use of Torodol post-operatively. This study was conducted in order to examine at the antiplatelet effect of Torodol in pediatric post-operative neurosurgery patients by using thromboelastography (TEG). Thromboelastography is a laboratory technique which delivers a global assessment of coagulation function by analyzing a small sample of blood. It offers several advantages over standard tests by simultaneously analyzing several coagulation parameters. Pediatric patients undergoing an intradural neurosurgical procedure at Connecticut Children's Medical Center were enrolled and designated to a study group, receiving either Torodol or opioids for pain control. Blood samples were collected pre-operatively, and after the initiation of analgesic treatment. The blood samples were analyzed using thromboelastography platelet mapping and the patients categorized into hypo-coagulable, normo-coagulable, and hyper-coagulable states. The two groups were then compared. Data collection is ongoing and no clear results have been obtained at this time. The hope is that this study will eventually lead to a standard regarding the safety of Torodol use post-operatively and come to benefit future patients.

**70.**

**INTERPRETATION OF OXYGEN SATURATION VALUES RECORDED BY NEONATAL INTENSIVE CARE UNIT NURSES**

Tiffany Ruiz '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, James Hagadorn MD, Neonatal Intensive Care Unit, Connecticut Children's Medical Center

Pulse oximetry provides an indirect estimate of arterial oxygen saturation (SaO<sub>2</sub>) used to assess the concentration of oxygen in the infant's blood. This noninvasive, continuous monitoring device is the standard method for determining appropriate oxygen therapy of infants.

The objective of this study was to examine the relationship between oxygen saturation (SpO<sub>2</sub>) values as recorded hourly by bedside nurses and the infant's actual saturation as measure by oximetry. We hypothesized that SpO<sub>2</sub> values recorded by the bedside nurse will be significantly different from the oximeter data. Very low birth weight (VLBW) infants, having a birth weight less than 1500 grams, admitted to the Connecticut Children's Medical Center (CCMC) Neonatal

Intensive Care Unit (NICU) between January 1st, 2008 and June 30th, 2008 with continuous oximeter data from a 2008 Quality Improvement (QI) study were included. QI data was linked to SpO<sub>2</sub> values recorded by nurses. Oximeter data were separated into two groups. Group A consisted of patient care hours selected randomly from the QI Database. Group B consisted of patient care hours included in a previous study for which detailed individual nurse and respiratory support was available. Descriptive, univariate, and multivariate analyses was performed. Comparison in Group A between NICU nurses' hourly recorded SpO<sub>2</sub> values with simultaneous oximeter data showed close overall agreement between the two. However, correlation between oximeter mean, median and mode from the preceding hour versus nurses' SpO<sub>2</sub> values showed only moderate correlation. Further analysis is planned to determine the correlation and relationship between hourly recorded SpO<sub>2</sub> values by nurses' versus simultaneous oximetry data in Group B.

## 71.

### **EFFECTS OF THE KETOGENIC DIET ON BEHAVIOR AND TEMPERAMENT OF AUTISTIC AND NON-AUTISTIC CHILDREN**

Julia Svedova '11

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Francis J. DiMario MD, Department of Neurology, Connecticut Children's Medical Center

The ketogenic diet (KD) is a restrictive diet high in fats and low in carbohydrates and proteins commonly used for treatment of intractable epilepsy. It has been demonstrated that the KD significantly reduces frequency of seizures and may even eliminate seizures completely. There is some evidence that the KD may also have positive effects on some aspects of behavior, cognition, and autistic behavior. Phase 1 is a retrospective design to analyze children who have already initiated the KD since January 2004. The aim of Phase 1 is to determine whether there is a relationship between the duration of the KD and the effects it has on behavior and temperament. Phase 2 is a prospective design to determine the effects of the KD on behavior and temperament of children who have not yet started the KD. The subjects in Phase 2 will undergo pre-diet testing and will be retested after 6 months. Parents of subjects in both phases will obtain three parental surveys by mail to assess their child's behavior, temperament, and autistic behavior. The results of the surveys together with clinical and demographic data will be evaluated for any significant correlations. Currently, 4 out of 29 subjects' parents recruited for the retrospective phase completed the surveys. The results confirmed reliability of the surveys when compared to diagnostic information and parental evaluations. At the same time, they revealed certain weaknesses, in particular, with respect to children with severe mental disabilities. The data collection is currently in process and it is anticipated to be completed in two years.

72.

**THE EFFECTS OF AGE AND ETIOLOGY ON THE SUCCESS RATE OF A  
NEUROENDOSCOPIC TECHNIQUE USED IN THE TREATMENT OF  
HYDROCEPHALUS**

Deniz Vatansever '10

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Paul Kanev MD, Department of  
Neurosurgery, Connecticut Children's Medical Center

Hydrocephalus is a condition which is characterized as an abnormal accumulation of cerebrospinal fluid in the ventricles of the brain resulting in increased intracranial pressure. Affecting 1 out of every 500 children in the United States, hydrocephalus can lead to brain damage and other adverse neurological defects. The most widely utilized treatment towards relieving the hydrocephalus symptoms is the placement of a ventriculoperitoneal shunt which diverts the excess fluid from the brain to the abdominal cavity. Despite its clinical benefits, this invasive procedure is associated with a number of complications, requiring many revisions due to 66% failure rate in the second year of placement. Thus, a less invasive neuroendoscopic technique, called endoscopic third ventriculostomy, has been recently revitalized with the available medical technology which allows the physician to create a new CSF flow pathway by making a fenestration at the base of the third ventricle. Although there has not been a prospective randomized controlled trial of VP shunt and ETV, a number of studies showed that endoscopic third ventriculostomy in combination with choroid plexus (CSF producing bodies) cauterization may be as efficient, if not more, as ventriculoperitoneal shunt in the treatment of hydrocephalus. The aim of our retrospective study was to enhance the existing literature on the efficacy of this procedure, focusing particularly on the effects of age and etiology on the success rate. Medical records of 13 hydrocephalus patients were examined and grouped in accordance with age and cause of hydrocephalus. Due to the small sample size, no statistical analysis was attempted. However, a trend of higher success rate was seen in infancy, late adolescence and in children with myelomeningocele and macrocephaly. The cases were individually examined suggesting future studies that might be useful in deciphering the cause of hydrocephalus and proposing alternative treatments such as ETV.

## **MATHEMATICS**

73.

**MODELING AGE-DISTRIBUTION OF HEPATITIS A VIRUS INCIDENCE IN THE  
UNITED STATES WITH MARKOV CHAIN STOCHASTIC PROCESSES**

Corazón Irizarry '09

Faculty Sponsor: Philip Brown

Viral hepatitis, an inflammation of the liver, is caused by one of at least five viruses. Hepatitis A, one of these virus types, is a global public health problem. Although, according to the CDC, Hepatitis A rates have declined 89% in the United States since the vaccine first became available in 1995, it is still a serious public health concern. Seroprevalence information provides crucial data for predicting and controlling the hepatitis A epidemic. One useful focus of seroprevalence study is the age-distribution.

This project uses data from the "CDC: Morbidity and Mortality Report: Surveillance of Acute

Viral Hepatitis- United States, 2006” to emulate the methodology of the 1998 study, “Assessing hepatitis A virus epidemic stochastic process in eight cities in China in 1990.” We create and apply a stochastic model, two-state Markov chains to age-specific, sex-specific acute hepatitis A incidence rates, creating one model for each sex. From the multi-step transition probability matrices for our Markov chains, a long-term prediction can be obtained for acute hepatitis A prevalence among different age-groups.

**74.**

**APPLICATION OF MONTE CARLO THEOREM FOR NUMBER OF TABLES AT TRUMBULL KITCHEN**

Kristen McNamara '09, Ezel Poslu '09

Faculty Sponsor: Philip Brown

In order for a restaurant to be able to accommodate its potential clients on a given night, it is important that it have the correct number of tables. We apply the Monte Carlo Method in order to compute the number of tables the restaurant Trumbull Kitchen should have on a Friday night in order to accommodate its clients. To apply the method we have obtained some statistics from Trumbull Kitchen including the average number of people they seat on Friday nights, and the average number of tables they serve. We then compare Monte Carlo simulation results with the actual statistics as reported by Trumbull Kitchen.

## **NEUROSCIENCE**

**75.**

**MEASUREMENT OF REACTIVE OXYGEN SPECIES PRODUCED BY MITOCHONDRIA TREATED WITH ROTENONE**

Max Alderman '11, Derek Kim '12

Faculty Sponsor: William Church

Rotenone is a pesticide that causes Parkinson's disease-like symptoms following overexposure. It works by interfering with complex I in mitochondria, preventing NADH from being converted into ATP. A mitochondrial extract assay was developed to complement whole cell in vitro assays determining the production of reactive oxygen species (ROS) following rotenone exposure. SH-SY5Y cells were treated with 500 nM and 250 nM of rotenone and incubated for an 18 hour period. The cells were collected using a mitochondrial buffer solution to isolate the mitochondria. The mitochondrial isolate was resuspended in PBS. ROS generation was quantified fluorometrically using dichlorofluoroscein (DCF). The results indicated a dose-dependent increase in mitochondrial-isolate ROS. These results are in agreement with whole cell assay experiments from this lab. Future experiments will be conducted to determine whether treatment of cells with antioxidants will decrease mitochondrial generated ROS.

76.

**ELUCIDATING THE MANIFESTATION OF TIME CONSCIOUSNESS IN THE BRAIN USING fMRI TECHNOLOGY**

Brain Castelluccio '12

Faculty Sponsor: Dan Lloyd

Cognitive neuroscience has turned to functional magnetic resonance imaging (fMRI) to elucidate the neural basis of human conscious experience, and, as the questions become more complex, new methodologies may be necessary. The standard approach to fMRI analysis involves the assumption of stationarity, that the reaction of the brain to a given stimulus is the same no matter when the stimulus is presented and how many times the same stimulus has been previously presented. Thus, in standard analyses, brain activation images from distinct time points are averaged together to achieve greater statistical power in the data. In the present study, it was hypothesized that the effect of time in the brain invalidates the theory of stationarity. Time is a crucial element of human consciousness; past, present, future, and duration are all inherent in experience. It follows intuitively that time must have a significant manifestation in the brain. In this study, publicly archived raw fMRI data from a simple visual stimulus experiment was used to investigate the effects of time consciousness in the brain. Using Statistical Parametric Mapping 5 software, statistical contrasts were executed to compare brain activation images at distinct time points when the subject was presented with the same stimulus. Standard analytical methodology would expect no difference between these images, but the results from the contrasts show statistically significant results in some cases. It is hypothesized that these differences are the neural manifestation of time. This study suggests a rejection of the standard brain imaging methodology in favor of a new model that treats every moment in time as an opportunity for a distinct brain state.

77.

**EFFECTS OF THE KETOGENIC DIET ON SYNAPTIC PLASTICITY IN FREELY BEHAVING ADULT RATS**

Urey Chow '09, Kelly O'Brien '12

Faculty Sponsor: Harry Blaise

The long-lasting increase in synaptic efficacy known as long-term potentiation (LTP) has been successfully used to test the strength of synapses which connect neurons to one another. In the hippocampus, which is a limbic structure associated with learning and memory, measurement of synapse potentiation along the neuronal pathway from the medial perforant path (PP) to the dentate gyrus (DG) reflects both the level neuronal excitability, as well as the relative influence of inhibitory mechanisms that regulate such neuronal excitability. Moreover, the hippocampus has also been shown to be a site where epileptic seizures originate before spreading to other brain areas. A high-fat, low-protein, low-carbohydrate ketogenic diet has been clinically proven to treat seizure disorders since the 1920's. To evaluate whether inhibitory mechanisms are responsible for the anticonvulsant effects of the ketogenic diet in the mammalian brain, electrophysiological measures of LTP along the PP-DG pathway were recorded in freely behaving rats ranging in age between 70 and 120 days old. The study compared LTP measures in two groups of rats: a group fed a ketogenic diet for at least two weeks prior to commencement of experimentation, and a control group fed a basal diet composed of regular lab rodent chow (Purina 5001). Animals of both groups underwent stereotaxic surgery under anesthesia to chronically implant electrodes in the PP and DG. Following surgery, animals were allowed one week to recover prior to beginning stimulation protocols (100-pulse, 5-Hz theta-burst stimulation

[TBS]) which induced LTP in the PP-DG synaptic pathway. Levels of neuronal excitability and synaptic enhancement were measured and compared between rats fed the ketogenic diet and the basal diet. Preliminary results indicate that inhibitory mechanisms may primarily be responsible for the anticonvulsant effects of the ketogenic diet in epileptic patients. The preliminary findings of the present study may ultimately be used to develop future epilepsy treatments that are safer, more effective, and easier to administer.

## **78.**

### **QUANTIFICATION OF URIC ACID LEVELS IN SH-SY5Y CELL CULTURE**

Patricia Cipicchio '10, Annie Jenney '11

Faculty Sponsor: William Church

Uric acid is a critical antioxidant found in cells which appears to play a neuroprotective role by destroying harmful reactive oxygen species that normally induce apoptosis. Dopaminergic cell loss in the substantia nigra via ROS is of particular interest, given that in brain tissue, a correlation has been found between death in these cells and decreased uric acid levels. The overall focus of the research project is to define the reason for this relationship through manipulation of uric acid levels with allopurinol in cell culture. The method used to quantify uric acid levels is a 2, 4, 6-tripyridyl-5-triazine (TPTZ) based spectrophotometric assay that relies on the reduction of  $\text{Fe}^{3+}$  and was developed for use in blood plasma. The modification of this assay for use in cell culture has been the primary aim of this semester's research. A sizable decrease in the concentration of ferric chloride additive is proposed to provide more consistent quantification of uric acid levels. An additional spectrophotometric uricase assay, which serves to measure the breakdown of uric acid in solution over time, is being developed to control for extraneous compounds that may interfere with the TPTZ reaction. With the completion of these adapted methodologies, the effect of uric acid depletion in SH-SY5Y cells via allopurinol will be more accurately observed. With reliable measures of uric acid in cell culture, future work will concentrate on determining the survival rate of cells with different levels of uric acid that are exposed to neurotoxins, which will verify uric acid's role as a neuroprotector.

## **79.**

### **EFFECT OF COCAINE ON THE BRAIN'S REWARD CIRCUIT**

Carrie Disa '09

Faculty Sponsors: Sarah Raskin, Shashwath Meda, Institute of Living

The reward system is a circuit in the brain that is activated by natural rewards such as food, water, and sex that are fundamental for survival. A main component of the reward circuit is the ventral tegmental area. This structure communicates with other brain structures like the nucleus accumbens via dopaminergic pathways and relays information about how well fundamental needs are being satisfied. This reward circuit can also be activated and satisfied by artificial rewards such as addictive drugs like cocaine. When cocaine is used it overstimulates the amount of dopamine released by the ventral tegmental area to the nucleus accumbens and blocks the reuptake of dopamine in the synapse. This causes an increase in pleasure that is more long lasting than natural rewards. Upon constant drug intake, the brain adjusts to the surges in dopamine by producing less dopamine or fewer dopamine receptors that can receive and transmit signals. Dopamine's impact on the reward circuit of a drug abusers brain can then become abnormally low and as a result, their ability to experience any pleasure is reduced.



A study performed at the Institute of Living was conducted to compare fMRI activation patterns during a monetary incentive delay (MID) task in former and current cocaine users as well as healthy controls. The results of the study were analyzed using an independent component analysis (ICA) approach which makes group inferences from fMRI data by detecting neural circuitry rather than isolated regions of the brain. The ICA approach was used to identify and characterize different neural networks in an addicted brain that were engaged during the varying stages of the MID fMRI paradigm. These neural networks were compared across former and current users as well as healthy controls to distinguish which networks acted significantly different in the brain of a cocaine abuser.

**80.**

**UNDERSTANDING RELATIONSHIPS AMONGST OBJECTS IN OUR  
MULTIVARIATE WORLD: HOW TRINITY STUDENTS VIEW ACADEMIC  
DEPARTMENTS**

Fatimah Finney '10

Faculty Sponsor: Dan Lloyd

The brain has the difficult task of making sense of our complex world. In doing this, our brain organizes and categorizes elements of our lives into specific groups: our friends, our hobbies, our music, etc. Even within these groups, our brains create sub-groups such as best friends vs. acquaintances and party music vs. relaxation music. Why do we associate certain songs with each other and not others? What is the nature of the relationships we see between specific friends that is not present with other friends? Are there other relationships amongst objects of our world of which we are not aware? This experiment seeks to gain some insight into how Trinity College students categorize a particular group of "objects" on campus: the academic departments. 25 students completed a survey where they ranked different departments on effectiveness, friendliness, availability, and opportunity. The mean value for each rank was recorded and used in a cluster analysis and multidimensional scaling. These unique visualization tools group objects in certain ways according to undisclosed relationships based on the rank values. The cluster analysis uses a dendrogram to display results. Objects on the same branch are more similar and objects on more distant branches are more dissimilar. The multidimensional scaling method displays results on a map where the distance between the objects represent the dissimilarity between them. Based on a previous similar experiment, I hypothesize that the results will show at least one relationship between two or more departments that the participants did not perceive to be related. Phenomenology is a discipline that studies our mindfulness of our experience. This experiment seeks to study the relationship that students have with different departments phenomenologically by providing a variation of that relationship, using the graphical methods, and comparing it to the relationship the students actually perceive.

**81.**

**EFFECT OF ACUTE STRESS ON SYNAPTIC PLASTICITY IN NEONATALLY ISOLATED ADULT RATS**

Kaitlin Gaffney '09, Courtney Holder '12

Faculty Sponsor: Harry Blaise

Stress can have a great impact on brain function. For example, many studies which have reported a link between experiencing a stressful event and changes in brain electrical activity. These changes have been specifically documented in brain areas such as the hippocampus and the amygdala which are important for learning, memory and emotionality. The exact mechanisms causing these changes have yet to be determined. This study aims to assess whether acute stress alters electrophysiological properties of the amygdala and hippocampus of neonatally isolated rats. For this study, rats which were isolated (ISO) from their mother and siblings for an hour a day on postnatal days 2-9 made up the experimental group. Another group of rats which were not handled (NH) nor experienced isolation served as the control group. Once rats reached 70 days of age, surgery was performed to chronically implant electrodes in the hippocampus and amygdala. Five days following surgery recording of baseline brain signals occurred. Then, synaptic plasticity was measured using induction of long term potentiation (LTP) as the criterion. LTP which represents an enhancement in synaptic efficacy is believed to be involved in the formation and consolidation of memory. One hour after LTP was induced, rats of both groups were subjected to an acute stress consisting of 30 minutes of restraint in a transparent acrylic rodent restrainer manufactured by Harvard Apparatus, Inc. Our original hypothesis was that NH rats would show diminished but prolonged synaptic plasticity enhancement following the acute stress compared with ISO rats. Results thus far are inconclusive due to a small sample size. However the experimental protocol which has been established can be used to collect more data in the future.

**82.**

**EFFECT OF MUSIC ON PERFORMING COGNITIVE TASKS**

Brittany Gay '10

Faculty Sponsor: Dan Lloyd

Inhibition in performing multiple cognitive tasks can be caused by the activation of similar brain regions resulting in slower reaction times of performing the tasks. For the experiment conducted, it was hypothesized that performing different cognitive tasks while listening to music would reduce reaction times since it would be difficult for the central executive (frontal region) to make decisions on the task to be attentive to. To test the hypothesis, subjects performed a counting task and Stroop Test under the following conditions: no music, rap music, alternative music and R&B. For each individual condition, the reaction times were recorded along with the number of mistakes. Using Excel, the results were analyzed using T-Test and average reaction times for each condition. The results showed that although there was a decrease in reaction times when tasks were performed while listening to music, there was no significance in the relation of listening to music and performing cognitive tasks. Further study of this experiment by using more participants and performing more trials could provide better results. Also, finding out the different areas activated using functional magnetic resonance imaging (fMRI) while performing the experiment could show further correlation or non-correlation of the brain areas activated for music and cognitive tasks.

**83.**

**WORKING MEMORY IN SCHIZOPHRENIA: PERFORMANCE AND ACTIVATION ON A VISUOSPATIAL fMRI TASK AND IMPLICATIONS FOR A GENETIC LINK**

Rachel Goodman '09

Faculty Sponsors: Sarah Raskin, Godfrey Pearlson MD, Olin Neuropsychiatry Research Center, Institute of Living

The Figural Memory (FIGMEM) task examines working memory ability via an item-recall paradigm using visually indescribable images presented during concurrent fMRI scanning. Previous research has examined the performance of healthy controls on this task and determined both behavioral scores and blood oxygen level dependant (BOLD) responses vary in relation to activity at the nicotinic cholinergic receptor  $\alpha 7$  (CHRN- $\alpha 7$ ). Using FIGMEM data previously obtained from schizophrenic/schizoaffective disorder patients and healthy controls, functional imaging was analyzed and the relationship between FIGMEM behavioral performance, BOLD activation, and diagnosis was determined for 6 cases and 9 matched healthy controls. Statistical analysis indicated there were no significant differences in FIGMEM behavioral scores between cases and controls; these non-significant findings were likely due to small sample size as numerous previous studies across diverse paradigms found healthy controls consistently outperform schizophrenics in cognitively complex tasks. Imaging data was analyzed via SPM2 and indicated that schizophrenics had greater overall activation throughout the brain for all components of the FIGMEM task. Specific regional differences in activation were analyzed between groups and showed cases consistently recruited different regions than controls on the same task.

**84.**

**LEARNING, MEMORY AND ATTENTION DEFICITS IN FEMALE COLLEGE-AGE SEXUAL ASSAULT SURVIVORS WITH POSTTRAUMATIC STRESS DISORDER**

Elizabeth Gromisch '09

Faculty Sponsor: Sarah Raskin

According to the Rape, Abuse and Incest National Network (RAINN), one in six women will be victims of sexual assault in their lifetimes. The majority of victims are college-age, with the rate of victimization at its highest among 16-19 year-olds. Many survivors of sexual assault develop symptoms of posttraumatic stress disorder (PTSD), which studies have shown to have a negative impact on learning, memory and attention. In addition, the emotional effects of sexual assault make it harder for survivors to focus, which affects their performance in an academic setting. In this study, two test groups: one of thirteen self-identified female college-age sexual assault survivors with PTSD symptoms and another of ten non-self identified female college-age sexual assault survivors with PTSD symptoms, who have no previous brain injury or substance abuse, will be given a neuropsychological battery of memory and attention tests. Behavioral questionnaires, both clinician-administered and self-reporting, will also be used to gauge the emotional effects of sexual assault on learning. The result is a significant difference in the memory and attention tests, and when combined with the answers provided in the behavioral questionnaires, shows that sexual assault survivors with PTSD have a more difficult time with learning, memory and attention than their peers who haven't been assaulted.

**85.**

**EFFECTS OF NEONATAL ISOLATION ON SYNAPTIC PLASTICITY IN THE MPFC-BLA PATHWAY OF FREELY BEHAVING ADULT RATS**

Kaitlin Haines '09, Rachel Clark '12

Faculty Sponsor: Harry Blaise

The amygdala has been implicated in a variety of roles in both the stress response and memory formation. The basolateral amygdala (BLA) mediates the neuronal response to neonatal stress, which subsequently affects normal neuronal processing related to memory. We have recently demonstrated in our own laboratory that neonatal isolation affects bidirectional synaptic plasticity in the BLA-DG synapse, whereby both LTP and LTD are increased in adult animals isolated as neonates compared to their non-handled counterparts. Although there have been numerous studies exploring the relationship between neonatal isolation and hippocampal plasticity, studies have yet to investigate the effects of this chronic early stressor on the neuronal connection between the medial prefrontal cortex (mPFC) and BLA. The mPFC governs memory storage, executive decision making, and the emotional limbic system. Interactions between the mPFC and the BLA have been shown to be essential for integrating emotionally salient information. In order to assess the effects of neonatal isolation on the bidirectional pathway between the mPFC and BLA, neonates were isolated from their mother for one hour each day from PN2 to PN9 and then were permitted to mature into adulthood. Between 70-120 days of age, isolated and non-isolated animals underwent surgery to chronically implant electrodes in the BLA and mPFC. Preliminary data suggests that neonatal isolation (n=1) causes a decrease in LTP in the mPFC-BLA pathway, when compared to non-handled animals (n=2). This study, in which we assess how the neuronal connections between the mPFC and BLA of neonatally isolated adult rats are affected using electrophysiology, will enable us to further understand how chronic stress at an early age affects executive decision making and the emotional memory formation.

**86.**

**TEMPORALITY IN TERMS OF RETENTION AND PROTENTION IN THE BRAIN**

Navneet Kaur '12

Faculty Sponsor: Dan Lloyd

The purpose of this experiment was to analyze the level of protention (prediction and anticipation of future events and objects) and retention (being able to preserve and remember past information) through brain images obtained from fMRIs. In the “observe” condition, a volunteer was instructed to look and observe a scene which mimicked driving a car. In the “driving” condition, the volunteer was to drive a car using a steering wheel and pedals in a virtual reality scenario. Brain images were obtained under these two conditions.

It was hypothesized that in the “observe” condition, the subject would experience an increase in retention and less protention. There would be an increase in retention because it is easier to remember when one’s attention is strictly focused on observing. There would be less protention because one’s attention would be less when one is a passenger versus when one is driving. When driving, one’s attention is everywhere; the focus is on the street, the way one is driving, and on being precautious.

Matlab, a data analysis program, was used to isolate brain images of the volunteer at specific time intervals, while under two different conditions (“observe” and “driving” condition). The results showed that there was a greater increase in protention in the “observe” condition than in the “driving” condition. There was an increase in retention in the “observe” condition and a less retention in the “driving” condition. This data suggests that the level of protention and retention in the “observe” and “driving” condition are directly correlated with the level of awareness and concentration put forth while observing or driving. This may be because of the less demanding task of observation; it allows more time to reflect on the past and future.

**87.**

**PROSPECTIVE MEMORY IN AGE GROUPS 18-29 AND 80+ WITH THE MEMORY FOR INTENTIONS SCREENING TEST (MIST)**

Navneet Kaur ‘12, Eniana Agolli ‘11, Julianne Garbarino ‘11, Virginia Powell ‘10

Faculty Sponsor: Sarah Raskin

The purpose of this study was to compare the prospective memory of normal subjects in different age groups. Data was gathered from the Memory for Intention Screening Test (MIST) which measures prospective memory in the laboratory and in a delayed prospective memory task. Timed and associative cues were given in the laboratory and the delayed task was performed 24 hours after administration of the test. We hypothesized that older subjects would perform better than younger subjects on the delayed task but that the younger people would perform better on laboratory tasks. This hypothesis was based on the age paradox, the tendency of older people to perform better on real world tasks and younger people to perform better on laboratory tasks. This data shows that there is no significant difference between the performance of people who are 18-29 and the people who are 80+ years on the delayed prospective memory task, as the age paradox would predict. However, younger people scored better on the MIST overall and made fewer errors. Further studies could be done to fully understand whether the age paradox applies to prospective memory as tested by the MIST.

**88.**

**THE EFFECT OF EXPOSURE TO CHEMICALS FOUND IN NAIL SALONS ON THE COGNITION OF THE WORKERS**

Kristen McNamara ‘09

Faculty Sponsor: Sarah Raskin

Workers in nail salons are exposed to potentially neurotoxic substances including toluene, formaldehyde, acetone and (meth)acrylates on a daily basis. Previous studies have shown that overexposures to these substances has negative health consequences. However, not many studies have looked at the effect of low-level, chronic exposure to these substances in places such as nail salons. This research is important because the long-term effects of daily low-level exposure are not known, and there are many people who work in environments where they are exposed to these chemicals. The purpose of this study was to see if the products found in nail salons had any effect on the cognition of the nail technicians. This was accomplished by giving workers a series of cognitive tests that evaluated their attention, memory, executive functioning, and motor coordination. Because of the difficulty involved in recruiting subjects, a case study will be performed on two of the subjects. The results of the two individuals tests will then compared to normative data.

**89.**

**fMRI IN RESPONSE TO NOVEL AND NON-NOVEL VISUAL STIMULI**

Katherine Meltzoff '09

Faculty Sponsor: Dan Lloyd

Processing of novel information is a complex task that humans undertake frequently as they encounter novel information that must be recognized, named, and encoded. This study attempted a replication of previous studies that identified where novelty processing occurs in the human brain. Previous studies showed activation in Brodmann (BA) area 19, the prefrontal cortex, occipitotemporal areas, and occipital lobe for novel stimuli as opposed to non-novel visual stimuli (Kirino, Belger, Goldman-Rakic, & McCarthy, 2000; Pihlajamaki, Tanila, Kononen, Hanninen, Aronen, & Soininen, 2005; Cur, Turetsky, Loughhead, Waxman, Snyder, Ragland et al., 2007). Using data from Isahi, Ungerleider, Martin, & Haxby (2000) and Dianne Patterson (retrieved from <http://merlin.psych.arizona.edu/~dpat/>), we attempted to replicate previous findings using Matlab and SPM to analyze the fMRI data. We replicated the finding that novelty activates certain areas of the brain that are less active in the non-novel condition. Those areas were: BA 19 and the occipital lobes. We hypothesize that these two areas are important for novelty processing in the brain, but also suggest that further studies must be done to localize novelty processing in the human brain.

**90.**

**GENDER AND PROSPECTIVE MEMORY**

Ginger Mills '12

Faculty Sponsor: Sarah Raskin

The relationship between prospective memory and gender is one that is not readily apparent. Prospective Memory, the ability “to remember to remember”, requires an individual to form and retain an intended action as well as carry out the action after an interval of time. This study attempts to examine whether or not there is a relationship between prospective memory and gender. In order to assess gender differences in prospective memory, the MIST, Memory for Intentions Screening Test, was administered to both female and male undergraduate college students between the ages of 18-20. The results were then analyzed and revealed that there was no significant difference between the total scores and total errors, and thus gender and prospective memory, but there was a difference in the kind of errors made by females and males. Prospective memory plays an important role in day-to-day living and so proves to be an important area of research.

**91.**

**ANTICIPATION AND RETENTION IN TWO SUBJECTS DIFFERING IN AGE: THE PHENOMENOLOGICAL PREDICTION**

Mahvesh Mirza '10, Kevin Bardelski '12

Faculty Sponsor: Dan Lloyd

Phenomenology, or the study of experience and consciousness, has long predicted the structure of anticipation and retention of experiences. Only relatively recently has technology enabled the quantitative investigation of these phenomena. The form that experience takes may depend on the age of the experiencer, so the current study predicted a difference in the anticipation and

retention structures for subjects differing in age. In the present pilot study, two subjects experienced a simulated driving task while their brain activity was recorded via functional magnetic resonance imaging (fMRI). The subjects were male and differed in age, one a professor and the other a student. Each subject performed the simulated driving task in three, 120 second trials, alternated with the experiences of a white plus sign on a black surround and of merely observing the driving taking place as a passenger. Data from the fMRI scans were then analyzed with Matlab® and graphical representations of the retention and prediction (anticipation) structures associated with the driving task were generated. The plots of retention and prediction were then compared with a theoretical diagram of the phenomenological account of experience. The present work found that the phenomenological prediction of anticipation and retention holds for the study subjects. The capacity of each subject to predict and retain data from experience differed. Further investigation involving a greater number of subjects and more control of variables is needed to reduce interpretive difficulties.

**92.**

**COMPARATIVE ANALYSIS OF THE EFFECTS OF ALCOHOL ON MORAL JUDGMENT AND DECISION MAKING AT DA TRIN**

William Moffett '10, David Rowe '10

Faculty Sponsor: Dan Lloyd

Joshua Greene's (2004) research on "Cognitive Conflict and Control in Moral Judgment" provides evidence of a significant difference in moral judgments on situations that are either "personal" or "impersonal." Personal judgments occur in emotional situations where one directly harms another, whereas impersonal judgments are more detached and rely on a cognitive cost-benefit analysis. We propose that subjects that are intoxicated from alcohol will be inclined to make more "immoral" decisions than non-intoxicated subjects, or at least lose the ability to discriminate between personal and impersonal dilemmas. Ten randomly assigned sober individuals were read moral dilemmas and asked to make a moral judgment. Ten different subjects that were intoxicated (more than 5 drinks for guys and more than 4 drinks for girls) were then asked the same dilemmas. We did not make these subjects drink, but sequestered them in a "natural environment." The dilemmas that were presented were obtained from Greene's original research. These dilemmas included 10 personal, 10 impersonal, and 5 non-moral control questions. 5 of the questions from the moral dilemmas were deemed difficult and the other 5 were considered easy by Greene. After obtaining the results we will organize and analyze the data by tallying the judgments in the two groups under both conditions and both sub-conditions. We will then make a comparative analysis of these to see if the differences were statistically significant. We will also include an observational summary to discuss the length of the reaction time and whether or not we felt that the participants took the experiment seriously. Further research that could contribute to this study would involve exact measurements of reaction times to the questions under a different condition of an alerted mental state. A future investigation of fMRI images of intoxicated brains could also provide a clearer understanding of the results.

**93.**

**PROSTAGLANDIN E2 REDUCES ROTENONE-INDUCED APOPTOSIS IN SH-SY5Y CELLS**

Ariana Mullin '09, Timothy Liu '12

Faculty Sponsor: William Church

Rotenone, a neurotoxic pesticide, specifically targets dopaminergic neurons and induces Parkinsonian-like pathologies through Complex I inhibition, producing cellular oxidative stress and pro-apoptotic signaling in the form of cytochrome c release and caspase-3 activation. Prostaglandin E2 (PGE2) has been shown to increase anti-apoptotic protein levels in several cell lines. In this experiment, the ability of PGE2 to inhibit rotenone-induced apoptosis was evaluated. Human neuroblastoma SH-SY5Y cells were treated with PGE2 for one, six, or twenty-four hours prior to rotenone exposure. Apoptotic cells were identified by fluorescence microscopy using the Hoechst 33342 nuclear DNA stain. Caspase-3 production was quantified using a spectrophotometric assay. All three PGE2 pre-incubation periods effectively attenuated rotenone-induced apoptosis in a dose-dependent manner. Six hour PGE2 pre-incubation lowered apoptosis levels below that of the control, suggesting inhibition of endogenous apoptosis. Cellular levels of caspase-3 were also significantly reduced in a dose-dependent manner following six hour PGE2 pre-incubation. This research suggests that PGE2 promotes cell survival following rotenone exposure through upstream inhibition of the caspase cascade.

**94.**

**NEUROLAW: EXAMINING THE LEGAL IMPLICATIONS OF ADVANCES IN NEUROSCIENCE**

Tiare Nakata '09

Faculty Sponsor: Dan Lloyd

Neurolaw is an emerging field that examines the legal implications of advances in neuroscience. In the next few decades, neuroscience will penetrate forensics, trials, and sentencing. Neuroscience will be able to better predict future behavior, detect current mental state (used particularly in lie detection), examine one's experiential knowledge of a crime, determine a person's competency and culpability, and enhance the workings of the brain. As the law and legal standards change in response to developing forensic technology, scientists, judges and lawyers should consider the ethical application of neuroscience in and out of the courtroom. Judges are the gatekeepers of admissibility of the neuroscience data as forensic evidence. Lawyers will choose whether or not to present and argue the results of these studies in court. Legislators and the public will need to decide whether the current regulation of the application of neurotechnology is adequate. Electroencephalogram (EEG) and functional Magnetic Resonance Imaging (fMRI) is currently being presented in court rooms to link patterns of brain activity with criminal behavior. Eager and inappropriate application of neurotechnology could undermine judicial trust in the value of neuroscience. This thesis examines the appropriate application of neuroscience to the law. Current methods of brain-based lie detection and forensic functional brain imaging should not be admissible in court as scientific evidence because these methods fail to meet the Daubert standard, which allows a judge to determine the admissibility of scientific evidence and expert testimony. Furthermore, the Daubert standard needs to be rewritten to properly critique developing neurotechnology.



**95.**

**USING INDEPENDENT COMPONENT ANALYSIS TO STUDY FMRI OF AUTISTIC POPULATION**

Jacqueline O'Boyle '09

Faculty Sponsors: Sarah Raskin, Michal Assaf, MD, Hartford Hospital

The incidence of autism is on the rise in the United States; however its cause remains unknown. Previous studies indicate that differences in the strength and organization of connections between various parts of the brain may be the cause of many symptoms of autism. Functional Magnetic Resonance Imaging (fMRI) was performed to study the functional connectivity within the Default Mode Network (DMN), or resting state network, in high functioning autistic people and a control group. In addition, both groups were given cognitive tests and Independent Component Analysis (ICA) was conducted to analyze the fMRI data to identify specific malfunctions in network connectivity. It was determined that those with Autism Spectrum Disorders (ASD) have weaker connectivity in the precuneus region of the DMN than healthy controls. Additionally, there is a negative correlation between the strength of connectivity in the precuneus and the severity of social cognition deficits in ASD subjects. This suggests the more severe social cognition deficits a person with ASD exhibits the weaker his or her connections are in the precuneus region.

**96.**

**TESTING THE EFFICACY OF THE KETOGENIC DIET (KD) AS AN ANTI-INFLAMMATORY AGENT**

David Patrick '11, Tracey Suter '11

Faculty Sponsors: Susan Masino, David Ruskin

The ketogenic diet is a high fat, low carbohydrate therapy commonly used to treat pediatric epilepsy. On this diet, rather than burning glucose, the body uses ketones as the main energy source. Based on recent literature, including increased central adenosine, fewer free radicals, and lowered levels of reactive oxygen species, adherence to the ketogenic diet, and its' ketone-based metabolism, could possibly lead to less pain and inflammation. Juvenile and adult male Sprague-Dawley rats were placed on either a control or a ketogenic diet for 3-4 weeks. For pain response, we measured hindpaw thermal nociception, and for inflammation, tissue swelling and plasma extravasation post local hind paw injection of complete Freund's adjuvant were calculated. Regardless of age, the ketogenic diet resulted in significant reduction in peripheral inflammatory response. There was a significantly longer latency of pain on-set in juveniles on the ketogenic diet compared to those of adults on the diet. The diet reduced weight gain in juveniles, but showed no effect on the weights of the adult animals. This data suggests that a ketone-based metabolism could lead to therapeutic treatments of pain and inflammation. Supported by NIH and Trinity College.

**97.**

**HOW DOES THE KETOGENIC DIET STOP SEIZURES? A GENETIC AND PHARMACOLOGICAL EXPLORATION**

Laura Pomeroy '09

Faculty Sponsor: Susan Masino

The ketogenic diet is a high fat, low carbohydrate diet that can prevent and treat epileptic seizures. It has been shown to be effective in children whose epilepsy is resistant to anticonvulsant medications. In this metabolic state, insufficient glucose causes the body to instead break down fat into fatty acids and ketone bodies for energy; however, ketone bodies themselves are not anticonvulsant. In fact, the anticonvulsant mechanisms underlying the ketogenic diet's efficacy are unknown. We hypothesize that increased adenosine may be responsible. Adenosine is an endogenous anticonvulsant and neuroprotective molecule; furthermore, the ketogenic diet decreases glucose levels, decreases pH levels, and increases adenine nucleotides, all three of which increase adenosine levels.

We used both a genetic approach and a pharmacological approach to test our hypothesis that an increase in adenosine is a critical mechanism underlying the anticonvulsant success of ketogenic diet therapy. Our initial approach used the genetically-engineered adenosine A<sub>1</sub> receptor knockout mouse, which lacks the adenosine A<sub>1</sub> receptor responsible for stopping seizures. Adult and weanling mice (wild type, heterozygous, and knockout for the A<sub>1</sub> receptor) were placed on either a ketogenic or control diet for at least three weeks and each mouse was tested for seizure susceptibility. We predicted that the knockout mice would have greater seizure susceptibility and the ketogenic diet would be significantly less effective in these mice. We also tested our hypothesis pharmacologically by following the same diet treatment and a similar seizure protocol using both weanling and adult Sprague-Dawley rats. Thirty minutes prior to flurothyl testing, the rats were pretreated with injections of either an adenosine A<sub>1</sub> receptor antagonist (DPCPX – 8-cyclopentyl-1,3-dipropylxanthine, Sigma) or a control vehicle.

These studies are ongoing and are supported by Trinity College, the National Institutes of Health, and the National Science Foundation.

**98.**

**AN ANALYSIS OF NAPS, A FULL NIGHT OF SLEEP, AND MEMORY CONSOLIDATION**

Alyssa Rautenberg '09

Faculty Sponsors: Sarah Raskin, Robert Astur PhD, Olin Neuropsychiatry Research Center, Institute of Living

While it has been proposed that sleep plays an active role in memory consolidation, conflicting research has rendered us unable to resolve what this role is, or how it works, if at all. Generally it is believed that slow-wave sleep (SWS) is crucial for the hippocampus dependent consolidation of declarative memories (Smith et al., 2001). Allegedly, during SWS the hippocampal system stabilizes new information at a synaptic level by replaying ensembles acquired during learning. Researchers have found that the mere onset of sleep, even a nap, is enough to promote enhanced consolidation (Olaf et al., 2008). To contrast, others have found there to be no superior memory improvement post-sleep (Ellenbogen et al., 2006). This study set out to clarify these discrepancies by testing declarative memory, including verbal, as well as spatial and procedural

memory improvements in 45 normal subjects. Subjects engaged in a virtual morris water maze, a transverse patterning task, a finger tapping task, and a verbal memory task during two sessions spaced twelve hours apart. The subjects were divided into three groups: the wake group was tested in the morning and then the evening, the sleep group was tested in the evening and then again in the morning, and the nap group took a nap between their morning and evening session. REM and nREM sleep were monitored by a nightcap. It was hypothesized that the subjects in the sleep group, followed by nap, followed by wake, would improve the most between sessions. It was found, however, that sleep and memory have an extremely complex relationship and effect upon one another, and that sleep probably does not have as much of an active impact upon consolidation as is widely believed. For some tasks, sleep between sessions was beneficial, for others, wakefulness, and for others, there was no significant difference.

## **99.**

### **PROSPECTIVE MEMORY AND MEDICATION MANAGEMENT ABILITY IN PEOPLE WITH SCHIZOPHRENIA**

Alexandra Rogers '09

Faculty Sponsors: Sarah Raskin, Robert Astur PhD, Olin Neuropsychiatry Research Center, Institute of Living

Prospective memory is required in order to perform intended tasks in the future. Therefore, if prospective memory is impaired for an individual, there can be grave consequences in the everyday life of that individual. In this study, the Memory for Intentions Screening Test (MIST), the Medication Management Ability Assessment Manual (MMAA), and a virtual reality paradigm was used to assess the prospective memory of people with schizophrenia. The MIST requires the participant to remember to perform actions at assigned times, through time or associative cues. The MMAA assesses the ability of the patient to remember a regime of medication for one day. The time and conditions under which each medication are taken are first explained to the patient, subsequently the patient must repeat this information after a waiting period. Lastly, the virtual apartment paradigm is essentially a real-world application of the MIST. The participant is asked to take a certain dose of medication fifteen minutes from the start of the simulation.

In comparing people with schizophrenia to control subjects, the people with schizophrenia performed worse on the MIST, MMAA, and most tasks of the VRAMMA than controls. Furthermore, results have shown that there is a significant correlation between prospective memory impairment and medication management ability in people with schizophrenia. Those who performed well on the MMAA also performed well on the MIST. This implies that perhaps the MIST could be used as a quick assessment of medication management ability in people with schizophrenia. These results also show that the impairment of medication management ability may be due to this prospective memory deficit, rather than a lack of desire to take medications.

**100.**

**EFFECTS OF THE KETOGENIC DIET ON THE PHYSIOLOGY AND BEHAVIOR OF R6/2 HUNTINGTON'S DISEASE TRANSGENIC MICE**

Jessica Ross '10, Tiffany Ruiz '10, Julia Svedova '11, Ritika Chandra '10

Faculty Sponsors: Susan Masino, David Ruskin

Huntington's disease (HD) is an inherited neurodegenerative disease caused by expansion of CAG polyglutamine repeat in the huntingtin gene. The ketogenic diet (KD) is a restricted diet that is high in fats and very low in carbohydrates. It has been found that the KD is beneficial in several models of neurodegeneration. We tested the effects of the KD in a mouse model of HD to determine whether the diet delays or improves symptoms. R6/2 mice and wild type control mice were placed on either the KD or the control diet (CD) at 6 weeks. The animals were tested at 4, 6, 8, 12 and 16 weeks using the rotarod test of motor coordination and Y-maze to assess locomotion and working memory. Mice were weighed twice weekly, deaths were recorded, and CAG lengths measured. At sacrifice after 16 weeks, blood samples were taken from the mice for ketone analysis. The study showed that the diet has no effect on lifespan; however, it is seen in the R6/2 mice that females have a longer lifespan than males. The only weight gain difference found in regards to the CD and KD was between the wild-type male mice. Rotorod testing demonstrated that the transgene had a general negative effect on the performance of mice, but both control and R6/2 males on the KD performed better than the CD animals. KD increased locomotion in wild-types, but had no discernable effect on the locomotion of the R6/2 mice. Both control and R6/2 males on the KD showed decreasing working memory, whereas females showed no significant difference in scores. We will continue our research on ketone analysis. Overall, the KD did not significantly benefit longevity or improve symptoms in the HD mice.

**101.**

**ANALYSIS OF ATTENTION IN THE BRAIN**

Jas Sandhu '09

Faculty Sponsor: Dan Lloyd

Attentiveness or rather a lack thereof, is a problem that affects humans worldwide. To counteract its effects humanity has created countless techniques and drugs to stimulate, and improve it. To examine the phenomenon of attentiveness, data from fMRIs of participants looking both faces and houses will be manipulated. The data from the face group will be removed leaving 3 30 second blocks of participants viewing half second presentations of pictures of houses. The first 5 seconds from each block will be merged to act as the "novel" stimulus group, as the houses will be a new and unexpected stimulus. Conversely the last 5 seconds of each block will act as the "redundant" stimulus block, as the participants will have been exposed to the pictures of houses for the past 25 seconds, and theoretically be slightly less attentive. The "novel" and "redundant" groups will then be compared and contrasted by taking the brain images from each group, and subtracting the "redundant" group from the "novel" group. What remains will be an area of the brain which is active during the initial 5 seconds of the presentation of a stimulus, but shuts off after repetition of the same or similar stimuli. Since houses are a common stimuli I do not expect there to be any interference from the brain trying to decipher what it is seeing, what will be visible should be purely those parts of the brain that account for increased attentiveness. By discovering areas of the brain that are responsible for specific activities it allows us to improve medications and diagnose potential problems from damage to these regions.

**102.**

**THE SOUNDTRACK TO DRUNK DRIVING**

Karl Sandrich '12

Faculty Sponsor: Dan Lloyd

fMRI is able to measure how brains respond to stimuli. The result of an fMRI is a picture of highlighted parts of the human brain, a picture that scientists can understand easily. However an important aspect of science is to help the public understand new findings. The picture produced from an fMRI can be confusing to someone who is not educated in neuroscience. But there are other ways to present information gained from an fMRI; one is by turning the information about the brain into sound. The sound produced is a representation of which parts of the brain are working together during a task. The task for this experiment was a driving simulator that had the fMRI running simultaneously. The participants also performed the task under different levels of intoxication. This experiment, conducted at Olin Neuropsychiatric Research Center, was measuring the affects alcohol had on brain functioning and the test produced the usual form of fMRI data. This data can then be changed into sound, and the differences between sober and drunk can be distinctly heard. This difference between drunk driving and sober driving is more visceral this way. The exact differences in brain functioning between these two states should be looked into, but so to should the use of sound to explain these findings. Scientists are not the target group of PSAs about drunk driving, so why should the only explanation of the science on this topic be understandable by them? The public is the group that benefits the most from truly understanding the difference between sober and drunk driving, and thus it is the scientist's responsibility to make sure the public does understand. And the way to do that is to make the medium of explanation palatable for all.

**103.**

**A STUDY OF ANTICIPATION AND RETENTION OF EVENTS IN PATIENT A.F. DURING VARYING STATES OF INTOXICATION**

Hannah Smith '10, Courteney Coyne '10

Faculty Sponsor: Dan Lloyd

Since the invention of the fMRI (functional magnetic resonance imaging) machine in the 1970s researchers have been able to view the brain in ways they never dreamed possible. Using analysis tools such as Matlab, researchers can view and compare brain scans from various patients and studies. For this pilot study, we looked at previously recorded data of a single patient, A.F., who was scanned by the fMRI machine at the Olin Neuropsychiatry Research Center under three separate conditions; when he was sober, semi drunk and drunk. Under each condition, A.F.'s brain was scanned three different times, all during the same session (which could be up to three hours). During these sessions he was asked look at a scene which simulated driving a car and to use a steering wheel and pedals to control his driving. We hypothesized that, because of his blood alcohol levels, the scans would show that as time went by he would become less interested in the task at hand. We expected to see that when he was sober, his level of anticipation would go down because he is bored of the task and is no longer focusing. When he was semi-drunk, we would expect to see his protention go down as well because, as he became more sober, he would be less concerned with performing the tasks correctly. When he was drunk, we would expect to see his anticipation of events go up because, as he sobers, he becomes more concerned with his actions and more aware that what he is doing has an immediate effect. To test my hypothesis we used Matlab to create a graphical representation of anticipation and retention

that was occurring in A.F.'s brain at each time point. We used all three trials from each condition so we could see the effects of time on his protention and retention of events. My results showed that when A.F. was sober, his anticipation and retention of the events he was experiencing increased slowly over time and was overall much higher than when he was drunk. When he was semi-drunk, his anticipation and retention remained the same throughout the experiment and was also slightly higher than the drunk session but not as high as the sober session. When he was drunk, his anticipation and retention went down from the first session to the next but then went back up for the last session. These results were not conclusive with our hypothesis and are somewhat puzzling. In order to further understand the results, we would like to perform the experiment again, this time asking A.F. what his experience was after each session. The data suggests that he has better long term focus than we originally predicted and that he didn't allow his slight intoxication to interfere with his focus over time. The effects of alcohol clearly affect his ability to predict and retain information, which is not surprising. Overall, more tests are in order to establish his personal experience of the event and relate it to the physical data we found.

**104.**

**NEUROPSYCHOLOGICAL AND COGNITIVE ASSESSMENT OF CHRONICALLY HOMELESS ADULTS IN HARTFORD, CT**

Lydia Turner '09

Faculty Sponsor: Sarah Raskin

It is currently estimated that between 55-80% of the homeless population in the United States is suffering from some form of mental illness; if you include drug or alcohol dependence and addiction, those statistics can reach as high as 95%. The most common mental illnesses seen in this population are depression, schizophrenia, and bipolar disorder. The cognitive impairments seen in people suffering from any one of these illnesses are extremely debilitating, and require long term management and care to maximize the function of these to people in society; however, it is evident from social studies and statistics that the majority of people suffering from homelessness and mental illness do not receive adequate care for either their social or mental conditions.

Currently, there is limited research quantifying the cognitive functions of chronically homeless people. This study used a battery of neuropsychological tests to establish measures of a variety of cognitive functions in the chronically homeless population in Hartford, CT, including attention, working memory, motor function, and intelligence. Results indicate that although chronically homeless individuals with a mental health condition perform within normal ranges in many areas of cognition and intelligence, their working memory and attention are severely impaired. These cognitive deficits could be a factor in their chronically homeless condition. Without working memory and attention, holding a job and maintaining a home are impossible. The implications of these findings are that as a society, we should be providing cognitive remediation for the chronically homeless, specifically to help them improve their working memory and attention skills.

# PHYSICS

**105.**

## **TESTING AN OPTICAL QUANTUM RANDOM NUMBER GENERATOR**

Matthew Bermudez '09, Adam Katcher '12, Holly Maykow '12

Faculty Sponsor: David Branning

Quantum physical processes such as the decay of unstable nuclei or the reflection of photons at a barrier can be used as cryptographic random number generators. So far, limited statistical tools have been applied to test the randomness of these processes. In this experiment, photons from a laser source were annihilated into photon pairs through spontaneous parametric downconversion in a nonlinear crystal. When polarized to 45 degrees and confronted by a horizontally-oriented polarizer, quantum physics predicts that each photon has an equal probability of being reflected or transmitted. The reflected and transmitted photons were detected in coincidence with their trigger photons and processed in LabView. Each coincidence-count results from logical “AND” outputs based on inputs from two detectors; detection events within 10 ns of each other were regarded as simultaneous. A binary string was generated from the coincidence counts by assigning a “1” to vertical polarization and a “0” to horizontal polarization. The National Institute of Standards and Technology (NIST) Statistical Test Suite was applied in Mathematica to test this binary string. Seventeen strings of one million bits passed all tests of the NIST battery within a p-value of 0.05. Additionally, the von Neumann unbiasing procedure can be applied to a single seventeen-million bit string of biased data to extract an unbiased string which can also be subject to the NIST tests. The rigorous NIST tests stringently demonstrate the cryptographic strength of the optical quantum random number generator. These results support the foundations of quantum physics and demonstrate that coincidence counting from spontaneous parametric downconversion can serve as an optical quantum random number generator for cryptographic tools.

**106.**

## **ANALYSIS OF RUPERT’S DROPS FRAGMENTS**

John Bower '12, Lynda Ikejimba '09

Faculty Sponsor: Mark Silverman

Rupert’s drops are molten glass droplets rapidly cooled by quick submersion into water, forming most often tear or tadpole shapes. They exhibit unique properties such as inner tension beneath a thin skin of compression and the ability to withstand enormous pressure at the head, while spontaneously and violently exploding when the tail is snapped under even minute stresses. A sample population of the leaded glass particles was manually sized using Motic software and the entire batch was sieved using eleven sieve sizes. Ten binning sizes of the particle length, width, perimeter, and cross-sectional area were then created, and the log of each bin size was plotted against the log of its respective frequency to ascertain the distribution of particle sizes. Further analysis of the aggregate mass of the particles in each sieving category is to be conducted. As the log-log plots of the manually sized dimensions did not follow a linear trend, the drops appear not to follow the normal power distribution of how passive materials fracture. For this reason we postulate that they follow a unique distribution which could arise from their uniquely existing conditions. Through further studies, we hope to elucidate the stress process by which fractionation occurs.

**107.**

**FINDING A MODEL FOR THE DIFFUSION OF SOLAR HEAT THROUGH SOIL VIA THE ANALYSES OF TEMPERATURE DATA TAKEN AT MULTIPLE DEPTHS UNDER THE TRINITY COLLEGE FOOTBALL FIELD**

Sarthak Khanal '11

Faculty Sponsor: Mark Silverman

As the topic suggests the research pertains to developing a mathematical model for the diffusion of solar heat through soil. Diffusion is one of the most common phenomena in nature. It occurs in a variety of different natural and physical systems and also in the everyday world. For example, the migration of perfume molecules from one point in the room to the other is a diffusion process and so is the transfer of heat through a solid. Thus, understanding the nature of one diffusion problem – the diffusion of solar heat through soil in this case – would reveal important properties about several other natural and physical systems. Like all other diffusion problems, the time series that was recorded by sensors placed at various depths in the Trinity College Football Field was subjected to various statistical tests in order to yield the phase shift, spectral frequency content, and other important variables that will help us understand the diffusion process. Besides performing statistical tests on the data, a theoretical model for the diffusion was generated that would enable us to determine the diffusion constant of the solid medium.

## **PSYCHOLOGY**

**108.**

**UNAUTHORIZED AUTOBIOGRAPHY: WE UNKNOWINGLY SPEAK POSITIVELY ABOUT MEMORIES WE CONSIDER TO BE POSITIVE**

Lea C. Dickson '09

Faculty Sponsor: Karl Haberlandt

In a cued-recall study, I prompted the retrieval of autobiographical memories with 35 words. In order to observe the effect of cue word pleasantness and arousal, two known facilitators of memory, I manipulated these variables in a 2x2 factorial design. I divided cue words into five categories: High Pleasantness/High Arousal (e.g. *rollercoaster*), High Pleasantness/Low Arousal (e.g. *pillow*), Low Pleasantness/High Arousal (e.g. *ambulance*), Low Pleasantness/Low Arousal (e.g. *rusty*) and Neutral (e.g. *journal*).

Participants were asked to respond to each cue word by describing a specific event from their past, and I assessed these memories in terms of two evaluative measures, a positivity measure and a pleasantness rating. The positivity measure was based on the difference between the positive and negative words (P-N) in each memory as calculated by a linguistic analysis program. This measure was implicit, as it reflects the spontaneous words produced by participants as they retrieved each memory. Pleasantness ratings were assigned to memories by the participants themselves after they had finished responding to each cue word. This measure was therefore retrospective and explicit.



Pleasant cues reminded participants of events that were more positive when measured by the proposition of positive versus negative words in the protocols .Pleasant words also elicited memories that participants judged in retrospect to be pleasant. Additionally, both measures exhibited an interaction between pleasantness and arousal. The effect of pleasantness depended on the degree to which the cues were arousing. Arousing words tended to produce memories that were more emotionally intense in terms of both net positivity and pleasantness rating.

Thus, the pattern of the implicit positivity and explicit pleasantness ratings were consistent. Inspection of the protocols for individual word effects revealed a great degree of variability, especially in the positivity measure. Future research is required to replicate these results and refine the positivity measure.

### **109.**

#### **COPING STRATEGIES AMONG INDIVIDUALISTIC AND COLLECTIVIST CULTURES**

Lea Dickson '09, Rebecca Freedman '09, Sari Fromson '10, Mignon Hills '09  
Faculty Sponsor: Dina Anselmi

Culture influences human behavior, which includes how individuals cope with injury and disease. In highlighting cultural differences, psychologists have increasingly been exploring the distinction between individualistic and collectivist cultures. Individualism refers to societies in which people seek independence from others and attend primarily to their own needs and desires (Greenwald, 1980). Many Western nations, including the U.S., are individualistic. By contrast, collectivistic societies, which include many Eastern cultures, stress the importance of relating to others (Marcus & Kitayama, 1991). Because these cultural attitudes pervade many aspects of our lives, they may have some predictive value in how individuals choose to cope with disease and injury. The present study examined the differences of coping strategies employed by individuals from collectivist and individualist cultures. We hypothesized that individuals from a collectivist culture would be more likely to utilize palliative and instrumental coping strategies when dealing with a chronic illness. Additionally, we hypothesized that individuals from individualist cultures would be more likely to use distraction and negative emotion coping strategies in dealing with chronic illness. We did not expect to see a significant cultural impact on coping strategies in dealing with an acute illness.

### **110.**

#### **INTERRACIAL DATING AT TRINITY COLLEGE: STUDENT'S ATTITUDES, PREFERENCES, AND PERCEPTIONS OF PARENTAL INFLUENCE**

Maria Dixon '09, Cintli Sanchez '09, Carla Thompkins '09, Li Jin Yan '10  
Faculty Sponsor: Dina Anselmi

This study investigated attitudes towards interracial dating at Trinity College. The study also looked at the correlation between students' attitudes and their perceptions of their parents' attitudes towards interracial dating. Specifically, males and females dating preferences and familial beliefs were examined for Asian Americans, African Americans, White/Caucasian, and Hispanic/Latino/a participants. It was expected that family values would coincide with the college student's values about dating preferences. Specifically, it was expected male participants would be more open to inter-racial dating, while female participants would be more likely to date within their own race. It was predicted that White participants would be less likely to date

someone from a different race, while Black and Hispanic students would be more likely to date other minorities. 136 participants filled out the survey. Results showed that a participant's race was a more significant factor than their gender concerning interracial dating preferences.

### **111.**

#### **METROSEXUALITY IN RELATIONSHIP TO HEGEMONIC MASCULINITY AND MATERIALISM**

Rebecca Freedman '09, Mignon Hills '09

Faculty Sponsor: Dina Anselmi

The term "Metrosexual" was originally coined by Mark Simpson in 1994. The article, titled "Here Come the Mirror Men," defined a metrosexual as "the single young man with a high disposable income, living or working in the city (because that's where all the best shops are)" (Simpson, 1994). In recent years, the term has evolved to describe a type of man who exhibits traits stereotypically associated with women including grooming habits, increased emotional expression, and consumerism (Salzman, Matathia, & O'Reilly, 2005). Our study examined the relationship between metrosexuality, hegemonic masculinity, and materialism in a sample of 277 self-identified heterosexual males. The sample included males from the Trinity College student body, male faculty, staff and administrators and males who were contacted through a snowball sample. We hypothesized that metrosexuality would have a negative correlation with hegemonic masculinity and a positive correlation with materialism. Additionally, we investigated the relationship between demographic items and metrosexuality, hegemonic masculinity, and materialism. Pearson Correlations were performed and indicated a strong positive relationship between metrosexuality and materialism. ANOVA analyses showed that age, income, political party and fraternity membership all predicted metrosexuality.

### **112.**

#### **EMBODIED COGNITION PATTERNS OF STUDENTS IN A COLLEGE LIBRARY**

Breanne Hawes '09

Faculty Sponsor: William Mace

The act of "studying" such as reading, memorizing or taking notes is often considered a purely cognitive activity. Yet, the theory of embodied cognition emphasizes that to "study" is a physical act, as much as a mental act. In order to "study" a person makes decisions of place, position, timing, etc. It is reasonable to observe these episodes of studying in a setting such as a college library. Very little psychological research has been conducted this way, using natural observations. Thus, this study uses the Trinity College Library as a cross section to understand the embodied conditions of "studying". Over a span of two months, observations were made in 21 visits to the library. The observations were taken at varying times of day and days of the week. A total of 35 hours were spent observing one section of five 2-4 person tables and four chairs of soft seating (section 1a). All activities that occurred at this spot were recorded as continuous narrative records. The activities recorded were arrivals, departures, seat selection, user gender, and socialization. Activity of the entire library was also noted based on gate counts and counts in large study areas. In addition, four library faculty interviews were conducted to note their observations of student activity. In section 1a of the library, a total of 139 anonymous students visited the spot and were observed. The results of the data describe seating patterns that occurred in 1a. The results show patterns of student occupancy for every seat and table in 1a.

Analysis of this data shows patterns based on day of the week, time of day, gender of the student, and seat selection. Data also shows usage patterns of the entire library, this is compared to usage patterns of section 1a and other study sections.

**113.**

### **HIP-HOP CULTURE: AN ANALYSIS OF RACE AND GENDER PERCEPTIONS**

Keith Hernandez '09, Amanda Garbatini '09, Isabella Glaser '10

Faculty Sponsor: Dina Anselmi

Hip-Hop is a music genre, which in the past three decades has developed into a cultural movement. Hip-Hop culture has grown to represent urban, rural, suburban, and global communities of all ages, genders, religions, economic classes, and races (Price, 2006). Although the culture of Hip-Hop has spread across the globe, there still remain several conflicting definitions and perceptions of Hip-Hop music and its artists. The current study examined explicit Hip-Hop songs and perceptions of diverse Hip-Hop artists by students with varying levels of attachment to Hip-Hop culture. A sample of Trinity College students listened to four separate Hip-Hop songs and completed a questionnaire in response to each song. We expect that male and female students will feel a greater sense of identifying with an artist of the same sex. It is also hypothesized that White students will identify more with White Hip-Hop artists and non-White students will identify with non-White Hip-Hop artists. Lastly, we predict male students will enjoy song lyrics and female students will emphasize enjoying the beat/rhythm of a song.

**114.**

### **THE EFFECTS OF DATA REPRESENTATION ON HOW INDIVIDUALS PERCEIVE RESULTS**

Devlin Hughes '09

Faculty Sponsors: Janet Chang, William Mace

The ways in which data are presented to an audience can greatly affect how the information is interpreted. Certain graphical representations of data better allow viewers to interpret what the data say, while other representations mask or distort it, and certain designs are more suited for some data than others. Using the data collected during the course of my research with Professor Janet Chang on cultural factors related to coping as examples, I will explain what happens when humans and data interact. Our dataset, consisting of approximately 800 participant responses to 12 psychological measures, presents an enormous quantity of data, which, when analyzed and properly represented can be made understandable to anyone. Using a series of examples of tables, bar charts, and pie charts, I will discuss what representations of data are best used for truthful representation of research findings, how to make more effective representations, and some of the perceptual psychology behind it. In comparing these graphics and tables to ones published in journals of psychology, I will explain what common mistakes are easily avoided when creating these representations. Lastly, I will discuss how simple modifications to a graph's axis or axes, changing the colors used, and reconfiguring the numbers and percentages included in a table, as well as other manipulations to the graphics, can be used to deceive an audience and distort results.

**115.**

**DIFFERENCES IN AMOUNT AND PERCEIVED HELPFULNESS OF SELF-DISCLOSURE IN ASIAN AMERICANS AND LATINOS**

Allison Matt '09

Faculty Sponsor: Janet Chang

This study looked to compare the amount and perceived helpfulness of self-disclosure of general problems to family members between Asian Americans and Latinos based on their different cultural values. Self-disclosure has been defined as the willingness to tell others information about yourself on a personal level and has been recognized as one method of coping with stressors. While both Asian and Latino cultures are considered to be collectivistic, there are different cultural values specific to each ethnic group that may be related to differences in self-disclosure. Specifically, the Asian cultural values that were looked at in this study include emotional suppression and face loss concerns. These cultural values discourage self-disclosure as Asian Americans try to avoid hurting others and maintain a good reputation for their families. The specific Latino cultural values that were studied include familism and personalismo. Familism promotes closeness and feelings of loyalty toward your family, while personalismo actually promotes the disclosure of personal information to establish closer relationships. Two hundred and eight Asian American and 84 Latino students from a California University completed an online survey. Consistent with the hypothesis, Latinos were found to perceive self-disclosure as being more helpful in resolving stressors than Asian Americans. Latinos were also found to self-disclose more frequently, but the difference only approached significance. In support of the hypothesis, familism and personalismo were positively correlated with self-disclosure and the perceived helpfulness of self-disclosure for both ethnic groups. Face loss concerns and emotional suppression were negatively correlated with self-disclosure and the perceived helpfulness of self-disclosure in the Latino group, but the correlations were not significant. These results will be useful for understanding culturally appropriate methods of coping with stressors.

**116.**

**THE EFFECT OF PERCEIVED PARENTING STYLES ON FIRST YEAR STUDENTS' COLLEGE ADJUSTMENT**

Rachel McHugh '09, Beverly Herr '09, Karli Del Rossi '09

Faculty Sponsor: Dina Anselmi

Parenting styles have been shown to have numerous effects on children. In order to explore whether there is a relationship between parenting style and adjustment to college, we investigated the relationship between perceived parenting style (Authoritative, Authoritarian, and Permissive types) and adjustment (academic, social, personal-emotional and attachment to the specific institution) in Trinity College first year students. We also looked at several other variables including race, income level, and parents' marital status to see how they might influence student adjustment or parenting style. The Student Adaptation to College Questionnaire (SACQ) was used to assess student adjustment during their first year of college and the (PPSS) Perceived Parenting Styles Survey was used to assess students' views of the parenting style that most closely matched their rearing situation growing up. Our results showed type of parenting style has a significant effect on first year students' academic adjustment performance and that there is a significant interaction between the race of the student and the perceived parenting style with regard to students' attachment specifically to Trinity College.

**117.**

**ELECTROPHYSIOLOGICAL MEASURES OF CHILDREN WITH AUTISM IN RESPONSE TO SPEECH AND NON-SPEECH STIMULI**

Katherine Meltzoff '09, Nicole Landi PhD Haskins Laboratories, Julia Irwin PhD Haskins Laboratories

Faculty Sponsor: William Mace

This study examined event-related potentials (ERPs) of children with autism spectrum disorder (ASD) and typically developing (TD) controls in response to native speech, non-native speech, and non-speech sounds to investigate potential differences between the two populations. The goal was to test whether ERP measures of these stimuli would reveal differences among children with ASD exhibiting low versus high verbal abilities, and between children with ASD and TD children. The Mismatch Negativity (MMN) component reflects the ability to differentiate environmentally important stimuli (Näätänen & Winkler, 1999; Escera, Yago, & Alho, 2001). Preliminary results show, as predicted, that in TD children the MMN is larger for native compared to non-native sounds (as shown by Rivera-Gaxiola, Silva-Pereyra, & Kuhl, 2005), and nearly non-existent for the non-speech stimuli.

**118.**

**CIGARETTE SMOKING IN TRINITY COLLEGE STUDENTS: HABITUAL AND NON-HABITUAL USE AND RELATIONSHIP TO STRESS AND DEPRESSION**

Danielle Michaud '09

Faculty Sponsor: William Loftus

Because college students have poorly received antismoking initiatives and smoking cessation programs, a better understanding of the smoking practices of this population is crucial for developing more highly effective interventions. Smokers consistently report higher levels of stress and depression relative to nonsmokers, using tobacco as a means of coping with stress and regulating mood. The present cross-sectional study investigated the relationship between habitual and non-habitual cigarette smoking and stress and depression among Trinity college students. Trinity students were asked to complete an email survey consisting of items relating to their general smoking patterns, history of smoking initiation and maintenance, and levels of perceived stress and depression. A total of 452 surveys were completed from 300 females and 152 males, more or less evenly distributed across all four years. Of these, 6.6% considered themselves regular smokers, 24.1% smoked occasionally or little, 9.7% no longer smoke, and the remaining 59.5% never smoked. A principal components analysis revealed two underlying factors. The type of smoker that subjects rated themselves as (e.g. regular vs. occasional) was significantly correlated with their reports of smoking habits. The age at which a subject first smoked a cigarette was highly correlated with several items related to nicotine dependence. Stress and depression were highly positively correlated ( $r = .728, p < .001$ ). The smoking item which showed the strongest correlation with stress and depression was the number of previous attempts to quit (stress:  $r = 0.383, p = 0.01$ ; depression:  $r = .530, p < .001$ ). These data suggest that although stress and depression may be related to regular smoking, it may not be related to the reasons for so-called 'social smoking' in college students. This should be considered when profiling students at risk for developing nicotine dependence.

**119.**

**HOW FAMILISM AND FATALISM RELATE TO PRIMARY AND SECONDARY CONTROL COPING IN LATINO AND ASIAN AMERICAN COLLEGE STUDENTS**

Radmila Paneva '09

Faculty Sponsor: Janet Chang

Cultural values (familism, a value that stresses close family ties, and fatalism, the belief that life's events are uncontrollable) were examined and how they relate to coping with distress (primary control, defined as the belief that one can influence a situation's outcome, and secondary control, defined as coping by accommodation) in 77 Latinos and 194 Asian American college students. It is important to contrast Asian Americans with Latinos in terms of primary and secondary control to understand the similarities and differences between the role of cultural values in collectivist cultures. Familism may provide insight into psychological functioning, and fatalism has been found to be associated with adjustment and coping. Research has shown that Mexicans tend to engage in primary control use, while Asian Americans tend to engage in secondary control. It was expected that familism would be positively associated with primary control in Latinos and secondary control in Asian Americans due to varying cultural definitions of familism. It was expected that fatalism would be positively associated with the use of secondary control for both groups. As hypothesized, Latinos were more likely to use primary control than Asian Americans, and Asian Americans were more likely to use secondary control than Latinos. Primary control was positively correlated with secondary control and familism for Asian Americans, but there were no significant correlations regarding primary control for Latinos. Secondary control was positively correlated with familism for both groups and with fatalism for Asian Americans. Acculturation and other cultural values (i.e., machismo, saving face) may have been associated with primary control use in Latinos and secondary control use in Asian Americans. These findings imply that cultural differences are present between the two groups in terms of coping; however, further research is necessary to clarify the explanations for the cultural differences between Asian Americans and Latinos.

**120.**

**THE EFFECT OF SITUATIONS PREDICTED TO INFLUENCE ADENOSINE ON THE STEREOTYPICAL BEHAVIORS ASSOCIATED WITH AUTISM**

Louisa Plotkin '09

Faculty Sponsor: Susan Masino

Autism is a developmental condition caused by differences in brain anatomy and function. People with autism have atypical social, behavioral and psychological development. I conducted a study that looked at the effect of situations predicted to influence the neuromodulator adenosine on the stereotypical behaviors associated with autism. Adenosine is a naturally occurring anticonvulsant and sleep-promoter, and people with autism have an increased risk of seizures, have disturbed sleep, and engage in activities that are predicted to increase adenosine. We hypothesized that stimuli and behaviors that increase adenosine will decrease symptoms of autism. Conversely, we hypothesized that stimuli and behaviors that either decrease or have no effect on adenosine will not decrease symptoms of autism. In collaboration with the University of Connecticut Psychology Department, we created a questionnaire that was distributed to members of the Interactive Autism Network (IAN), a national database comprised of parents of children with autism. This questionnaire asked the parents to rate specific behaviors in relation to topics such as diet, physical injury, massages, anesthesia, amusement park rides, exercise,

fever, and caffeine intake. After analyzing the data, we will determine if there is any correlation between stimuli predicted to change adenosine and systematic changes in symptoms of autism. By conducting this experiment, we hope to find ways to improve symptoms of autism.

**121.**

### **DO PLEASANTNESS AND AROUSAL FACILITATE AUTOBIOGRAPHICAL MEMORY RETRIEVAL?**

Diana Rice '09

Faculty Sponsor: Karl Haberlandt

In two cued-recall experiments, Lea Dickson and I prompted the retrieval of autobiographical memories with 35 cue words. Our aim was to assess the effects of pleasantness and arousal. Prior research has shown that these variables facilitate memory recall. We divided our set of cue words into four categories of several words each: high pleasantness/high arousal (e.g. *adventure*), low pleasantness/high arousal (e.g. *terrorist*), high pleasantness/low arousal (e.g. *bed*), and low pleasantness/low arousal (e.g. *iron*). My dependent variables were latency, frequency of response, and protocol length.

Research by past thesis students has revealed that autobiographical memories are positively biased (Herter, 2007; Keith, 2008). Monnier and Syssau (2008) found that subjects responded to pleasant words faster than neutral words. They attributed this finding to the rich and varied semantic representations of pleasant words. Previous studies have suggested that arousal also has a facilitating effect on memory retrieval (McGough, 2006). Arousal is thought to increase the attention given to experiences during their encoding and as a result, the post-encoding consolidation process is enhanced for arousing stimuli. Based on these studies, I hypothesized that pleasant and arousing cue words would elicit faster latencies than unpleasant and less arousing words. I also predicted that pleasant and arousing words would elicit more frequent and longer responses than unpleasant and less arousing words.

Results of our exploratory study revealed that pleasant words elicited faster responses than unpleasant words. However, arousal did not affect latencies. Because the response rate was uniformly high across all cue words and the length of protocols did not differ among categories, future research should focus on latencies. Inspection of the latencies of individual items and participants in our two experiments suggests that there was considerable variability among words. So as to minimize the variability, future studies might replicate our design with a larger sample of words. Doing so will hopefully provide an answer to my question above.

**122.**

### **EFFECT OF MATURITY LEVEL ON FAMILY DECISION MAKING PROCESSES AND BELIEFS ABOUT CHILDREN'S RIGHTS**

Bianca Sims '09

Faculty Sponsor: Dina Anselmi

In 1989 the United Nations adopted the Convention on the Rights of the Child (CRC). This document requires all countries that ratify the Convention to ensure that basic human rights are being provided to every child. An important aspect of the CRC is that it requires these countries to provide social, economic, cultural, political and civil rights to children despite their parents'

beliefs. This has led to research on adolescents' understanding of their own rights, in correlation to already existing research on maturity and decision-making. A study conducted by Heller and Smith (2005) demonstrated that both adolescents and their mothers felt that it was the parents' responsibility to provide nurturance rights, such as food, shelter and protection from harm. However, adolescents were significantly more likely than their parents to believe that they should be responsible for decisions regarding their self-determination rights, such as religion and clothing style.

In the current study, I assessed the difference between adolescent and parent beliefs regarding children's rights and family decision-making in terms of parents' perceptions of teen's level of maturity. I surveyed students in both the eighth and eleventh grades at a private co-educational school. I predicted that there will be an increase in maturity level based on the adolescents' age, which will correspond to increased autonomy in family decision making processes and beliefs about which rights children should be entitled to.

### **123.**

#### **ACADEMIC AND SOCIAL PREDICTORS OF A SUCCESSFUL TRANSITION TO COLLEGE**

Michelle Snyder '09

Faculty Sponsor: David Reuman

Previous research on the transition to college has emphasized the importance of initial experiences as predictors of success. Some studies have even shown that first-year experiences outweigh pre-college characteristics in determining a student's success in transitioning to college. The current study examines the aforementioned factors as well as the role that expectations play in the transition to college. There is much evidence to suggest that having unrealistic expectations of college may result in dissatisfaction for first-year students. This study examines how having positive versus negative social and academic expectations influences how students perceive the initial stages of college. I also observe if and why students choose to transfer when their expectations are not met. I worked with data from the New England Consortium on Assessment and Student Learning (NECASL). This included three rounds of extensive qualitative interviews with 216 members of the class of 2010 at Bates, Bowdoin, Colby, Smith, Trinity and Wellesley. I found that while there were no gender differences in academic expectations of college, males were more likely than females to have positive social and personal expectations. International students held the most optimistic expectations of college. There were striking institutional differences in the optimism of students. Reflecting back on their first semester, males and females showed no difference in the number of academic low points mentioned; however, females recalled more social and personal low points. Hispanic and Black students were more likely to mention low points overall. By the end of the first year, males were less likely than females to think about transferring. Additionally, males and females evenly reported that while they did not want to transfer, their friends were thinking about doing so. Implications for improving the transition to college will be presented.



**124.**

**PERCEPTION OF THROWING MOTION PATTERNS THROUGH POINT-LIGHT DISPLAYS**

Marc Spagnoletti '09

Faculty Sponsor: William Mace

This study explores visual perception of motion patterns characteristic of people throwing a ball. Johansson (1973) discovered that ten to twelve bright spots, attached to body joints, could specify motion of the living body. The relative motion of these ten to twelve points alone (with nothing else visible), could evoke compelling perceptions of many actions, including: walking, running, dancing, gender, and identity. I investigated throwing by comparing an expert versus a novice, and the effect of mass on the motion by having each actor throw a wiffle ball, a tennis ball, a baseball, a softball and no ball at all. Both the skill of the thrower and the mass of the object thrown have consequences for the motion pattern. The question is: How evident are these motion patterns to observers? Nine observers were asked to judge 100 trials of these point light displays. The results showed that seven of the nine subjects were able to correctly identify which actor was throwing 60% of the time or better. This indicated that enough information was present in the point light displays to clearly delineate the skill of the actor throwing. One observer showed a very clear ability to identify each condition, correctly perceiving the correct condition 59% of the time. This particular observer showed acute proficiency in identifying the “no ball” conditions, correctly scoring nineteen out of the twenty-one trials. This observer was further able to identify both “softball” conditions reasonably above chance, correctly scoring twelve out of the nineteen trials. Furthermore, this observer was able to identify the “baseball” condition reasonably above chance, correctly scoring twelve out of the twenty trials. While this particular observer was the only one to show such success, it does show that the displays contained specific information although not immediately apparent to every viewer.

**125.**

**THE EFFECTS OF CULTURE AND MENTAL HEALTH TREATMENT ON COLLEGE STUDENTS' LOCUS OF CONTROL**

Lydia Turner '09, Erika Klotz '10, Ada Avila '11

Faculty Sponsor: Dina Anselmi

In today's society, mental health conditions are most commonly treated with prescription drugs and behavioral therapy. Locus of Control refers to a person's beliefs about what causes the good or bad results in life, either in general or in a specific area such as health or academics. This study explored locus of control in college students, specifically looking at cultural and mental health treatment trends in locus of control. A randomly selected group of 353 Trinity College students completed a survey exploring cultural background, mental health status (including depression, anxiety, and ADHD), and locus of control scales (Internal, External Powerful Others, and External Chance). Participants who were not self identified as Caucasian scored higher on the chance locus of control scale. We also found that people receiving treatment for a mental health conditions exhibited both higher scores in External locus of control and lower in Internal locus of control. There were no interactions between mental health status and cultural background.

**126.**

**THE RELATIONSHIP BETWEEN ASIAN AND LATINO CULTURAL VALUES,  
PRIMARY AND SECONDARY CONTROL, AND EMOTION REGULATION**

Jenny Vince '09

Faculty Sponsor: Janet Chang

An online survey was given to 233 Asian American and 85 Latino college participants to explore the relationship between cultural values (i.e., face loss concerns “FLC” and machismo), primary control (PC) and secondary control (SC), and emotion regulation. The Asian cultural value of FLC (avoidance of shame-based behavior and situations), the Latino cultural value of machismo (emphasis of male dominance), PC (a mechanism allowing one to alter the environment), SC (a self-modifying mechanism), reappraisal (antecedent-focused emotion regulation), and suppression (response-focused emotion regulation) were investigated. Past research has found that Asian culture emphasizes both the inhibition of emotion experience and expression, while Latino culture encourages open expression of emotion within the extended family and inhibits negative emotion. However, there is a gap in research on the relationship between cultural values, the use of PC and SC, and the utilization of emotion regulation strategies between collectivist cultures. As expected, Asian Americans were more likely to use SC than Latinos, and SC and reappraisal were positively correlated with FLC for both groups. Also, Latinos were more likely to use PC than Asian Americans, which was hypothesized. However, while it was expected that machismo would be positively correlated with PC and suppression, there was not a significant difference between ethnic groups in machismo, and machismo was not correlated with PC or suppression among Latinos, which may have been affected by the small Latino sample. There was a positive correlation between machismo and suppression among Asian Americans; supporting prior research findings that Asian culture encourages the inhibition of emotion expression. The implications for this research suggest that there is heterogeneity among collectivist cultures in relation to differing cultural values, the use of control, and emotion regulation, which is relevant in light of previous research that has focused primarily on similarities between collectivist cultures.

**127.**

**PERCEIVED MODIFIABILITY OF QUANTITATIVE REASONING ABILITY IN  
COLLEGE STUDENTS**

Kaitlyn Wilbur '09

Faculty Sponsors: Dina Anselmi, David Reuman

Beliefs about intelligence have been correlated with motivation and academic achievement. Individuals hold different attitudes and beliefs about intelligence. An incremental theory of intelligence is the belief that intelligence is malleable and changeable by learning and effortful practice, whereas an entity theory refers to the belief that intelligence is a fixed, innate ability. Past research has shown that it is possible to influence an individual's beliefs about modifiability, which has led to an increase motivation and higher achievement scores (Blackwell, Trzesniewski, & Dweck, 2007). In the current study, we were interested in college students' beliefs about the modifiability of quantitative reasoning (QR) ability.

Six Math 101 sections were divided into experimental and control groups. The experimental groups participated in two incremental theory interventions, in which students were taught that learning changes the brain's neural connections by making them stronger and that students are

responsible for this change. All students completed questionnaires that measured their beliefs about academic ability, achievement goals, and attitudes toward effort, values, and expectancies in addition to taking a Quantitative Literacy Exam. These measures were filled out once at the beginning of the semester (Time 1) and again following the intervention period (Time 2).

The results revealed that during Time 1 students viewed writing as significantly more modifiable than general intelligence and QR. During Time 2, perceived modifiability of intelligence and writing decreased significantly; however, perceived modifiability of QR remained the same suggesting that the incremental theory intervention may have helped maintain this stable belief. The experimental groups showed significantly more positive values and expectancies following the intervention period compared to control groups. Although the intervention did not have a significant effect on the experimental groups' beliefs about QR, this study has shown that students have varying beliefs about different domains and that these beliefs can change over time.

## **SOCIOLOGY**

**128.**

### **LOCATIONS AND LEARNERS: UNDERSTANDING THE AFFECTS OF GEOGRAPHIC LOCATION ON COLLEGE CHOICE**

Taylor Burns '11

Faculty Sponsor: Theresa Morris

My presentation will examine the effects of geographic region on a student's choice to attend a public or private college. I hypothesized that in the Northeastern regions, the Mid-Atlantic States and New England, more students choose to attend private colleges. In other regions of the country, including the Pacific states, the Western and Midwestern states, and the South, students are more likely to attend public universities. Therefore, my general hypothesis is that where a person comes from within the United States will affect what type of educational institution they choose to attend. The theory I will use to explain this is the symbolic interactionist theory, which states that people behave towards things based on the meaning they prescribe to them. In the case of college choice, the ideologies and differing values unique regions around the country have shape a certain picture of college and what a student should aspire to gain from the experience. This in turn directly affects the type of school they choose to attend. To test this hypothesis I examined a data set from the ISPCR database titled the Higher Education General Information Survey XVI: Fall Enrollment, 1981. My initial findings indicated that there is a relationship between geographic location in the United States and type of college choice.

**129.**

**REACTIONS TO ISLAM BASED ON GENDER**

Ashley Clackson '09

Faculty Sponsor: Theresa Morris

This paper will analyze the relationship between males and females and their opinions towards Islam. As the fastest growing religion in the world it is important to look at its aspects of desirability and which gender is more compelled to join the faith. Furthermore, we can see from a recent study done on the ARTA database that males are more likely to join the Islamic faith than females. This paper will not only examine the likeliness of joining Islam based on gender it will also control for employment status. Through secondary data analysis this paper will depict the possible reasons as to why males are more drawn to Islam than females. My overall findings for this paper are based on a chi square and multivariate chart. From these charts I am able to identify the statistical significance of the study and draw conclusions based on overall percentages.

**130.**

**IMPACT OF MEDIAN FAMILY INCOME ON ROBBERY RATE**

Frank Cui '11

Faculty Sponsor: Theresa Morris

Crime has been an issue in our society today. People fears criminals and there are many social facilities which are designed to prevent individuals from committing crimes. However, despite the efforts put in to decrease the crime rate, we often ignored to consider one of the most important factors which contribute to the increase of crime rate, poverty. In my research, I would explorer the affect of income for individuals on their likely hood of committing crime such as robbery. The data set I am going to use is from the ICPSR data base and is the Social Correlates of Official Index Crime Rates for States, SMSAs, and Cities: A Macro-Level Dataset for 1950, 1960, 1970, 1980. My focus is the data in 1980s. My independent variable would be family median income rate in different cities and my dependent variable would be robbery rate per 100000 populations. I will use scatter graph to examine the relationship between these two variables, and then draw a linear regression to see how significant the relationship is. In addition, I had add a controlled variable, percent of kids not living with both parents, to see the impact of independent variable on robbery rate. The finding supported my hypothesis that the lower the family median income, the higher the crime rate. The purpose of this research is to reveal the inferior structure of our system which ignores one of an important factor contributing to increase in robbery rate in lower class areas.

**131.**

**AGGRESSION IN THE HALLWAYS: A STUDY OF STUDENT ALIENATION AND SCHOOL VIOLENCE**

Elizabeth DeWolf '10

Faculty Sponsor: Theresa Morris

Why does student violence occur so often on school grounds? I propose that there is a relationship between a student's level of social integration at school and the likelihood that he or she will commit a violent act. My main hypothesis is that students who do not feel socially connected to their educational institutions will be more likely than their peers to act out or cause violence at school. For these students, the school provides a social framework in which they cannot succeed, and this frustration eventually leads to a sense of alienation. It is this alienation that often leads to acts of aggression. I use Durkheim's theory of anomie to explain this process, which asserts that institutions of social control, such as educational institutions, force expectations and definitions of success on individuals. When the beliefs and attitudes of these individuals do not coincide with those of the source of social control, social exclusion results. This exclusion provokes a rejection of the social norms, which in the school setting can often result in violence. I use a 1994 data set titled School Culture, Climate, and Violence: Safety in Middle Schools of the Philadelphia Public School System from the ICPSR social research database to test this theory and hypothesis. After identifying proper variables and running correlation tests on the data, I conclude that a lack of social integration at school increases the chance that a student will participate in violent behavior.

**132.**

**THE MINIMUM LEGAL DRINKING AGE AND ALCOHOL-RELATED FATAL TRAFFIC ACCIDENTS AMONG 18-20 YEAR OLD DRIVERS: A STUDY OF THREE NORTHEASTERN STATES**

Erin Flanagan '09

Faculty Sponsor: Theresa Morris

The purpose of this study is to examine the effects that the Minimum Legal Drinking Age (MLDA) has had on alcohol-related traffic accidents among 18 to 20 year old drivers. It is a natural experiment that analyzes secondary data from the National Highway Traffic Safety Administration's Fatal Accident Reporting System (FARS) to determine whether a drinking age of 21 has caused fatalities to decrease among the 18-20 year old age group in Pennsylvania, Massachusetts or Vermont in 1977, 1983 or 1989. The states were chosen based on the years in which they experienced a change (or not) in the MLDA. Pennsylvania served as a control, as it maintained a drinking of 21 throughout all three years of study. The study is grounded in the Neutralization Theory, which suggests that deviants have the ability to neutralize illegal actions by denying injury to another. I suggest that underage drinkers will rationalize their illicit drinking activities because they are considered an adult by society at age 18 and that, if people continue to drink, they will continue to drive. The hypothesis of this study is that an increased drinking age will not cause fatal traffic accidents among drivers of this age group to decrease. The hypothesis was supported.

**133.**

**ANALYSIS OF ARTS PARTICIPATION AND GENDER**

Alison Ford '11

Faculty Sponsor: Theresa Morris

Almost every aspect of American life is to some degree impacted by sex. Gender expectations assist in predicting the decisions and choices men and women will make everyday. Leisure time is an important aspect of the American life . Arts activities are viewed as worthwhile uses' of leisure time as they have educational, social, and cultural advantages. Exposure to the arts is a privilege that is socially beneficial to both genders, however the arts are generally viewed as feminine. Using a data set from The National Endowment for the Arts (ICPSR) study number 04205, the "Survey of Public Participation in the Arts, 1997," I examine the effects of sex and education on the attendance of arts events in a year, with the expectation that females, because of the typical gender roles and expectations in American society, attend more arts events on average than males in a given year. A bivariate test of significance shows no relationship between sex and arts event attendance, however another bivariate test shows a relationship between arts event attendance and education level completed. A chi square test shows no multivariate relationship between sex and arts event attendance, controlling for education. There is no significant evidence indicative of sex impacting arts event attendance and thus serves to reject my hypothesis that women are more likely than men to attend arts events. This research study attempts to answer some of the vital questions regarding the connections between sex and education as factors impacting how Americans choose to spend their leisure time with special attention paid to support of the arts and entertainment industry, as choices for free time activities increase and become more varied.

**134.**

**DOES GREEN IN YOUR WALLET MEAN GREEN ON YOUR PLATE? THE RELATIONSHIP BETWEEN INCOME AND HEALTH FOOD CONSUMPTION**

Stephanie Mannino '10

Faculty Sponsor: Theresa Morris

Food is something that most people in the United States takes for granted. A balanced, nutritious diet is necessary to live a healthy life. However, it seems that more recently than ever food prices have become so expensive it has become nearly impossible for someone on a limited income to be able to afford the types of fresh fruits and vegetables necessary for a healthy lifestyle. Using a data set from the National Center for Health Statistic's continuous survey, "National Health and Nutrition Examination Survey (NHANES) 2005 – 2006", I examine the possible link between the frequency of health foods consumed and income with the expectation that as income increases so too does the ability to afford more expensive fruits and vegetable and thus the frequency of health food consumption will also increase. However, when a chi-squared test for significance was run, there was no relationship between income and frequency of food consumption ( $p = .630$ ). An additional bivariate test was run to determine if there was a relationship between the dependent variable and control variable, race, which also proved to not be statistically significant ( $p = .106$ ). The multivariate test in which the dependent, independent and control variables were all included also showed there to be no statistical significance. Further research needs to be done in order to determine conclusively whether or not a relationship does or does not exist. The study of income and health food intake has important broader implications including further study of methods for reducing fresh food prices, increased inclusion of fresh foods in government food programs, and an overall healthier population.

**135.**

**THE RACIAL INEQUALITY OF THE MASS INCARCERATION MOVEMENT -  
EXAMINING STRUCTURAL RACISM THROUGH US PRISON DATA**

Alexander Palma '09

Faculty Sponsors: Theresa Morris, Rachael Barlow

Over 2.3 million Americans are currently incarcerated by the Justice Department and within this group there is great racial inequality. African American men are seven times more likely to find themselves in jail than white men. In many impoverished urban neighborhoods African American men live their lives, cycling in and out of prison. This paper will use the U.S. Justice Department's 2004 cross-sectional "Survey of Inmates in State and Federal Correctional Facilities" to statically investigate factors contributing to the disproportion of African Americans serving time in U.S. jails. The survey data was analyzed with three variables. The first was to determine the racial distribution of the sample population. My hypothesis was that the survey data would mirror Justice Department statistics on the American prison population and this was affirmed when I found that 42% of the sample was African American. The next variable investigated was the relationship between an inmate's race and whether or not one of the prisoners' parents had spent time in jail. Basing my hypothesis on social research on the justice system, I assessed that African American inmates would more likely have a parent who had served time. The data showed a statistical relationship between being African American and having a parent who had also served time. As a control variable, I investigated if the inmate had been employed in the formal economy prior to his or her arrest as many social scientists have pointed to a lack of economic opportunity as a motivating factor of criminal activity. I hypothesized that more non-African American inmates were employed at the time of their arrest than African-American inmates. I made this assessment due to the high percentage of African Americans serving time for petty drug charges. The data confirmed a statistical relationship between being unemployed prior to being arrested and African-American inmates.

**136.**

**BODY IMAGE BASED ON GENDER AND SOCIOECONOMIC STATUS**

Emily Paton '10

Faculty Sponsor: Theresa Morris

The paper will analyze the differences between young men and young women and how they perceive the size of their body. By looking at the relationship between gender and body image, as well as the economic standing of the family I will see which demographic is most at risk of having an abnormal body image. The paper will look at the perception of body as the dependent variable, using gender as the independent variable and family income as a control variable. The paper hopes to understand and explain the recent phenomenon of eating disorders among young women based on body image. Using qualitative and quantitative data, bivariate/multivariate charts and chi square tables, I will draw the conclusion that women are at higher risk of developing an eating disorder than men while women from families of low income are at a higher risk than girls from high income families.

**137.**

**ADVERTISING: A WASTE OF MONEY OR A GOOD INVESTMENT?**

Sarah Quirk '11

Faculty Sponsor: Theresa Morris

Each year, millions of dollars are spent on advertising campaigns for nearly every product that is mass produced in the world. The following investigation presents the effectiveness of the advertising industry on consumer purchasing and behavior in order to determine if such a large industry is beneficial to companies. This is done by looking specifically at one product, cigarettes, and how the independent variable, the brands most advertised and the distribution of free/promotional products, affects how often people smoke and what brand of cigarettes they buy, which account for the dependent variable. I hypothesize that there will be a strong statistical relationship between individual exposure to advertising for a particular product and consumer purchasing for the corresponding product. The data used was collected by The Gallup International Institute on an individual level of analysis and specifically asked teenagers about their experiences with tobacco products. After analyzing the teenagers' various responses about their experiences purchasing, using, and being exposed to tobacco products, I have concluded that while promotional items and free samples do not affect purchasing, other, more general, means of advertising do.

**138.**

**FINANCIAL STRESS AS AN ENVIRONMENTAL EFFECT ON CONSUMER BEHAVIOR**

Amy Ramirez '11

Faculty Sponsor: Theresa Morris

This research identifies how one's consumerist behavior may be influenced by other outside factors such as their location or stress caused by financial difficulties. This consumer behavior is being measured by the amounts of holiday spending a respondent had claimed to have done in 2006 compared to the past. The specific locations of where they live are classified by population size: such as whether it is a city of over 50,000 people, a suburban town or a rural town. I hypothesized that those who tend to stress more about their money would spend less during the holiday season, and those who do not stress would spend more of their money on holiday products. This is also dependent of their location. If one is located in an urban city, it is more likely that they would spend more money than those living in a rural town. Those in a suburban town are likely to have spent the same amount as they had in the past. The greater amount of a population, the greater the desire would be to purchase items especially during the holiday season. The data I analyzed was from the ICPSR dataset #4649, called the "CBS News/New York Times Monthly Poll #1, December 2006". The results were interesting since for the most part it was as expected yet urbanity location was not a factor to the holiday spending versus the past.



**139.**

**CUTURAL CAPITAL AND ITS MARK ON HIGH SCHOOL VIOLENCE**

Jonathan Rivas '10

Faculty Sponsor: Theresa Morris

The objective of this paper is to examine the issue of cultural capital amongst public high school students and its relationship with peer support. The reason why I decided on this is because it is a major underlying factor in the issue of violence in schools, especially bullying. My hypothesis looks at the effect of household income on an individual's belief that he has a support system amongst his peers, with participation in school sports as a control. My reasoning behind choosing those two variables to be my independents is that they signify two important measures of cultural capital to high school adolescents, a student's class, as well whether he is an athlete or not; most of the aggressors tend to be in the upper echelon of the class spectrum, as well as part of an athletic team of sorts, whereas those who are bullied tend to be the vice versa. In short, I posit that students who are of lower income households do not have as much support from their peers as more affluent ones; because of their lack of cultural capital, they are more likely to be ostracized. The perpetration of the many stigmas associated with one's attainment of status through cultural capital can be best explained through interactionist theoretical perspective. The data set that I use is the 2005 National Crime Victimization Survey, which comes from the ICPSR database.

**140.**

**COLLEGE ALCOHOL POLICIES AS INSTITUTIONAL MYTH**

Molly Rose '09

Faculty Sponsor: Theresa Morris

This case study examines how alcohol policies are made and enforced on college campuses. Four Connecticut colleges were compared: a private urban college, private sub-urban college, urban public college and sub-urban public college. Neo-institutional theory is used to explain how rules were made and enforced on college campuses. I collected information in a two-tiered manner: First I interviewed the Dean of Students and examined the official student handbook to obtain the official stand on underage drinking. Second, I provided surveys about campus alcohol policies to a group of students at each school. The data were used to compare how differences in location and whether a school was public or private affected the rule enforcement. The results of this study suggest that while students at all four colleges consume alcohol when underage, there is greater existence of institutional myth at private colleges and more rule breaking at public colleges.

**141.**

**ACADEMIC ACHIEVEMENT: A RACE TO THE TOP  
AN ANALYSIS OF THE RELATIONSHIP BETWEEN RACE AND EDUCATIONAL  
SUCCESS**

Alexandra Stein '11

Faculty Sponsor: Theresa Morris

This paper examines the relationship between race and academic achievement. Specifically, I am studying the difference in grade averages between Caucasian students and African American students aged 14-24. I hypothesize that Caucasian students are more likely to have higher grade averages than African American students. I will explain the discrepancy in grade averages among African American and white students using the conflict model. The data that I will use to study this phenomenon is a cross-sectional survey that was conducted via telephone by CBS News in March of 2005. My findings indicate that the relationship between race and academic achievement is in fact statistically significant. I also found that the variable "mother's education" affects the grade averages of white and black students, but this relationship is only statistically significant when mother's education is above a high school level.

**142.**

**THE HIGHEST DEGREE: THE EFFECT OF EDUCATIONAL ATTAINMENT ON  
PUBLIC OPINION OF POLICE USE OF FORCE**

Timothy Stiefler '11

Faculty Sponsor: Theresa Morris

This paper examines how one's socioeconomic status (SES) affects one's attitude towards the police's use of force against citizens. My hypothesis states that the higher one's educational level the more likely they are to approve of police use of force regardless of whether they are African American or Caucasian. One's educational attainment is an indication of one's socioeconomic status and the higher one's SES is the more likely they are to live in less-crime ridden neighborhoods. I am illuminating this phenomena through the Marxist conflict theory, explaining that America is structured by class and the control of resources. By this approach, it is through educational attainment, and the subsequent acquisition of income, that one is able to avoid a life of crime, or a life around crime, which can shape one's perspective of the police in a negative manner. The data I utilized to study this phenomena is taken from five General Social Surveys conducted between 1996 and 2006. The initial results show that educational attainment does affect one's likelihood of approving police use of force and there is a rise in approval between those without any education and those who've achieved their bachelor's degree for both African Americans and Caucasians.

143.

**MAKING THE GRADE, MAKING THE TEAM: CAN ATHLETES REALLY KEEP UP?**

Katherine Stoltenberg '11

Faculty Sponsor: Theresa Morris

This research paper examines the effect of participating in athletics on academic success. Secondary data from an ICPSR database was used for this research. The main hypothesis I examined is whether participating in athletics enhances academic performance. I used Chi square to test for statistical association. I found that students who participated in sports were more likely to earn an academic honor than those who did not participate in sports, controlling for gender. This academic phenomenon can be explained by the symbolic interaction theory by stating that athletes have different interactions in their life than non-athletes and that socializes them in a different way to value academics in a varying light.

144.

**TEENAGE MOTHERS AND THE ACADEMIC SUCCESS OF THEIR CHILDREN:  
ARE THEY REALLY AS DISADVANTAGED AS SOCIETY PERCEIVES THEM TO  
BE OR IS THIS ONLY A WIDELY HELD MISCONCEPTION?**

Lee Ziesing '11

Faculty Sponsor: Theresa Morris

I have decided to examine the idea of teenage mothers and the academic success of their children and how that compares to the successes of older mother's children. I chose to measure this idea by using the highest degree earned by both the mother and the respondent and looked at that in context of how old the mother was when she had her child. It is widely believed within our society that children of teenage mothers are born with a significant disadvantage just by the age of their mother, and it is often assumed that they will be less successful. Are these gaps of children of teenage mothers and children of older mothers really that large or is this just a social norm that we have grown accustomed to, yet has little evidence to back it up? The symbolic interaction approach believes that people construct their own realities and that others follow, which is why it is so easy to have such a stigma attached to teenage pregnancy when there are so many negative views that influence the general public's opinion fueling the fire of what may be a false claim.

## **FORENSIC CHEMISTRY**

145.

**THE WOOD CHIPPER MURDER: A BODILESS CRIME SOLVED WITH  
INCLUSIONARY PHYSICAL EVIDENCE**

Victoria Done '11, Stanita Clarke '10

Faculty Sponsor: Janet Morrison

In November 1986 Helle Crafts, a Pan Am flight attendant, returned to her house in Newtown, Connecticut, which she shared with her husband, Richard Crafts. After a severe snowstorm, Helle's friends called the house to check on her, but her whereabouts were unknown. No one

expected her to be missing but everyone suspected Richard. When detectives questioned Richard he claimed he was in the house all day while Helle visited her sister. However, a credit card receipt showed Richard bought bedding when he was supposed to be home the entire day. Further investigation of his spending habits over the past few days led to the discovery of an odd string of purchases, starting a week before Helle's disappearance. This included an industrial freezer and a reservation for a wood chipper, both of which were strong arguments for the defense during his trial. In addition, a witness came forward about a wood chipper sighting on the banks of the Housatonic River early November 19th. Investigators searched this site for her body on January 10, 1987 and found small pieces of human remains. Insufficient remains were collected which prevented visual identification of the victim, but Helle was identified using other forensic techniques. Every hair was examined microscopically, small bone fragments were ground and tested to reveal blood type O positive (the same as Helle) and dental records proved that tooth caps found at the river bank belonged to Helle Crafts. Even though a whole human body was never discovered, forensic science was central to the eventual conviction of Richard Crafts. This poster will present the trace physical evidence which was crucial to the case decision, the underlying scientific principles of the forensic techniques used for its analysis, and the interpretation and evidentiary value of the results.

**146.**

**PROVING THE FALSE CONVICTION OF JIMMY RAY BROMGARD USING DNA PROFILING TECHNOLOGY**

Donnie Driscoll '09, Jon Stone '09

Faculty Sponsor: Janet Morrison

In 1987 Jimmy Ray Bromgard was convicted for the rape of an eight year old girl in Billings, Montana. In the early morning of March 20<sup>th</sup> an intruder broke into the girl's home and raped her in her bedroom. The young girl picked Bromgard out of a police line-up and her testimony proved to be the crucial element that led to his conviction. The only other evidence in the case involved hairs found on the young girl's bed which were confirmed to match the hair type of Bromgard. Since hair is at best class evidence and the conviction was primarily based on testimony, the Montana State crime lab decided to undergo further investigation in 2002 using more appropriate and developed scientific methods which adequately examined the physical evidence of the case. DNA profiling was conducted on the semen collected from the scene and Bromgard was officially exonerated for this crime despite having served 15 years in prison. The underlying principles of the DNA profiling techniques used in this case (short tandem repeat analysis) will be presented, along with the actual results obtained. The results obtained in the DNA profiling analysis clearly demonstrated that the semen present at the scene was not that of Jimmy Ray Bromgard.

**147.**

**THE GRUESOME MURDER AT MORSE'S POND**

Emily Fink '11, Colin Leroy '10

Faculty Sponsor: Janet Morrison

In 2001, Mabel "May" Greineder, age 58, was found murdered near Morse's Pond in Wellesley, MA. The husband, Dr. Dirk Greineder, who was initially not considered a suspect, called 911 to report the brutal murder of his wife. Dr. Greineder, well respected as a doctor, husband, and

father, was eventually indicted as a key suspect in the murder and a jury was selected from around Norfolk County, MA to decide whether or not Dr. Greineder was guilty. Many key items of evidence were used to convict Dr. Greineder; most importantly, DNA evidence and bloodstains provided the crucial forensic evidence that linked Dr. Greineder to the scene, the victim, and the murder weapon. The scientific techniques by which each piece of vital evidence was analyzed and ultimately utilized to convince the jury to convict Dr. Greineder of first-degree murder will be presented. As a widely popular case, the Morse's Pond Murder is often cited as a prime example and reinforcer of the ever-growing importance of forensic science in murder trials.

**148.**

### **USING TOOLMARK AND WOOD ANALYSIS TO IDENTIFY THE LINDBERGH KIDNAPPER**

Christine Ganley '12, Ashley Monter '12

Faculty Sponsor: Janet Morrison

On March 1, 1932, Charles Augustus Lindbergh Jr., the twenty month old son of the famous aviator Charles Lindbergh, was kidnapped from his home near Hopewell, New Jersey. A series of ransom notes were sent to the Lindbergh family demanding money, and eventually, the family paid the ransom. On May 12, 1932, the baby's body was found about 4 miles from the Lindbergh home. His skull had been crushed by a blow to the head, and the coroner's examination showed that he had been dead for about two months. After finding the body, the police used the recorded serial numbers of all the ransom bills, and waited for the kidnapper to use this money so they could locate and arrest him. Eventually a man named Bruno Hauptmann was discovered using the ransom bills and was arrested. Forensic science was key in proving his guilt. The wood of the ladder used to climb up to the baby's window on the day of the kidnapping matched the wood that Hauptmann used to furnish the floor of his attic. In addition, toolmarks on the ladder were matched using toolmark analysis to tools owned by Hauptmann. Bruno Hauptmann was sentenced to death in February of 1935 for the kidnapping and murder of Charles Lindbergh Jr. This poster presents the scientific basis of toolmark analysis and wood analysis, the application of these techniques to the evidence in the Lindbergh kidnapping, and the forensic significance of the results obtained in this case.

**149.**

### **IDENTIFYING THE GREEN RIVER KILLER USING DNA AND PAINT ANALYSIS**

Tarun Gulati '09, Chris Gardner '10

Faculty Sponsor: Janet Morrison

In 1982 Gary Ridgway began a killing spree which resulted in his becoming America's most prolific serial killer. Ridgway was eventually convicted of forty-eight murders near the cities of Seattle and Tacoma in Washington State, and confessed to having been involved in over seventy killings. Most of the murders took place during a two-and-a-half-year period in the early 1980's. The first few bodies were found near the Green River, giving the previously unidentified killer the name "Green River Killer." Most of Ridgway's victims were either prostitutes or teenage runaways who were picked up along Pacific Highway South (State Route 99) and strangled. The bodies were often left in clusters, sometimes posed and usually nude. Ridgway would occasionally contaminate the dump sites with gum, cigarettes, and written materials that

belonged to others in a largely successful effort to confuse the police. Often times the bodies were not discovered until skeletonized, and as a result, four victims remain unidentified. Ridgway became a suspect in the Green River killings in 1983; however, in 1984 he took and passed a polygraph test. On April 7, 1987, police took hair and saliva samples from Ridgway that were subjected to DNA analysis almost 20 years later, providing the evidence for his arrest warrant. Ridgway was arrested on suspicion of murder of four women. DNA evidence conclusively linked semen left in the victims to the saliva swab previously taken by the police in 1987. In addition to the DNA evidence, forensic laboratories detected microscopic paint particles on three of Ridgway's victims, similar to those used at Ridgway's place of work at Kenworth. DNA and paint analysis will be presented, along with the results obtained and how those results were used to establish a link between Ridgway and his victims.

**150.**

**PAJAMAS TELL ALL: HOW FIBER, BLOOD, AND FINGERPRINT EVIDENCE LED TO THE CONVICTION OF JEFFREY MACDONALD**

Stacy Hathcox '09, Shannon Quinn '09

Faculty Sponsor: Janet Morrison

Captain Jeffrey MacDonald, an army doctor, was convicted on August 29, 1979 for the murders of his wife, Colette, and daughters, Kimberly and Kristen. Jeffrey MacDonald claimed that four intruders were responsible for the murders, but the evidence presented during the trial led to his conviction. Evidence presented against Jeffrey MacDonald included fiber, fingerprint, and serology evidence. Blue fibers matched to Jeffrey MacDonald's pajama top through microscopic analysis were found throughout the MacDonald home, but were absent in the room where he was supposedly attacked by intruders with an ice pick. The blue pajama top was also important to the case, for it contained cylindrical holes. Jagged edged holes would be characteristic of defense from an ice pick. Investigators found an ice pick, knife, and paring knife which all lacked fingerprints. Blood matching Jeffrey MacDonald's was found throughout the house, except in the room where he claimed to have fought the attackers. Many people still believe Jeffrey MacDonald is innocent for a variety of reasons. For example, the crime scene was unsecured, leading to questions regarding the collection of evidence. Jeffrey MacDonald was convicted of the murders after the FBI reopened the case nine years after they occurred. He is currently serving three life terms. This poster will present the scientific principles underlying the fiber, fingerprint, and serology evidence, and the interpretation and evidentiary value of the results obtained after examining the physical evidence in this case.

**151.**

**IDENTIFYING THEODORE BUNDY AS THE PERPETRATOR OF THE LISA LEVY MURDER CASE UTILIZING FORENSIC ODONTOLOGY**

Lexi Hawley '10, Kristi Autote '09

Faculty Sponsor: Janet Morrison

From 1974 until 1978, it has been estimated that Theodore Robert Bundy viscously murdered up to 35 young women all over the United States. While all of these cases carry great importance, the intention of this study will be to focus upon the Lisa Levy murder case. Lisa Levy was a first year college student who Bundy raped and murdered in the early morning of January 15, 1978. Witness testimony and initial evidence indicated that Levy was murdered in her bed at the Chi

Omega house at Florida State University. However, there was limited basis for prosecution of Bundy due to a lack of physical evidence. As it turns out, during the attack, Levy's assailant bit her on the buttock and left two impressions of his teeth on her corpse. Due to the individual identifying nature of bite marks, forensic odontology was utilized to determine the identity of the individual who made the impression. Dr. Richard Souviro was the odontologist that provided expert witness testimony at the State of Florida vs. Theodore Bundy trial. He testified that he was able to create an impression of Bundy's teeth and then confirm that the impressions left on Levy's buttock were indeed made by Bundy. Without this physical evidence the prosecution would not have been able to convince the jury that Bundy was guilty beyond a reasonable doubt. He was ultimately charged with the murder of Lisa Levy and was eventually executed. This study will present the underlying principles of forensic odontology, specific information regarding the bite marks left on Levy's body, and how the molding of Bundy's teeth eventually led to Bundy being charged and convicted for the murder of Lisa Levy.

**152.**

**ANALYSIS OF FORENSIC SCIENCE TECHNIQUES USED IN THE JEFFREY MACDONALD CASE**

Bridget Johnston '09, Rachel McHugh '09, Nancy Grosvenor '11

Faculty Sponsor: Janet Morrison

In 1970 Colette MacDonald and her two daughters, Kimberley and Kristen, were found dead in their home. Colette's husband, Jeffrey MacDonald, was home at the time of the attack and was found to still be alive. MacDonald claimed that three men and one woman broke into the home and attacked the family with a club and knives. MacDonald sustained several superficial wounds including bruises and lacerations. Colette, Kimberley and Kristen all sustained multiple stab wounds and blunt trauma injuries. Several factors led investigators to believe that the murders were not carried out by intruders. The lack of disorder in the MacDonald home, the presence of pajama fibers and blood belonging to Jeffrey MacDonald near all three bodies, and the lack of trace evidence at the scene indicated that Jeffrey MacDonald may have committed the crime. This poster presents the different types of physical evidence recovered at the scene, the forensic techniques employed for its analysis, and the role this evidence played in the ultimate conviction of Jeffrey MacDonald. Blood typing, blood spatter analysis, fiber analysis, and several related forensic techniques used in this case will be explored.

**153.**

**USING PHYSICAL EVIDENCE TO IDENTIFY THE GREEN RIVER KILLER**

Elizabeth Kong '09, Nora Becker '09

Faculty Sponsor: Janet Morrison

The bodies of five women were found within a six month span in 1982 around or in the Green River in Seattle, Washington. The victims, who were prostitutes, were raped and strangled; consequently, the investigation was concentrated along the Sea-Tac Strip that was highly populated with prostitutes. The police noticed a trend and realized the increase of inexplicable disappearances of prostitutes; by 1986 the count in Seattle escalated to 40 bodies, all of whom were prostitutes. The person responsible for these deaths was nicknamed the Green River Killer. A man by the name of Gary Ridgeway became a prime suspect in the investigation in 1987. Ridgeway, a local truck painter, was a frequent visitor of the Sea-Tac strip; however, Ridgeway

had passed a lie detector test in 1984. Saliva and hair samples were collected from Ridgeway's home, but the evidence was insufficient to hold him in custody. Aside from a murder in 1998, the killings came to a halt in 1990, and the case remained unsolved for 10 years. Because of scientific advances in DNA profiling technology, the investigation was reopened in 2001. The DNA from the saliva collected from Ridgeway in 1987 was compared to the DNA from semen samples collected from the Green River Killer's earlier victims. Not only did the DNA profiles match, but additional paint evidence was discovered that linked Ridgeway to the crime. Ridgeway ultimately confessed to murdering forty-eight women and was spared the death penalty. Due to the advances in DNA profiling technology, investigators were able link multiple crimes to a person with extreme reliability. This poster will examine the DNA and paint evidence, the principles underlying the forensic analysis of this evidence, and the interpretation and evidentiary value of the results which were crucial to Ridgeway's conviction.

**154.**

**IDENTIFYING THE REMAINS OF THE BUCK RUXTON DOUBLE HOMICIDE USING FORENSIC ANTHROPOLOGY**

Michael Levy '12, Kenneth Sommer '12

Faculty Sponsor: Janet Morrison

On September 14, 1935, Dr. Buck Ruxton murdered his long time girlfriend, Isabella Ruxton, in a jealous rage. To prevent the murder from being discovered before he had time to dispose of the body, he also murdered his children's nursemaid, Mary Jane Rogerson. Before disposing of the bodies, Dr. Ruxton dismembered the corpses of his victims to keep them from being identified, then drove over 100 miles from his home in England to Scotland to dispose of the remains. Fourteen days later the scattered human remains were found wrapped in newspaper in Scotland. A thorough analysis of the physical evidence based on general anatomical principles, radiographs of the skeletons, and the radical new technology of forensic anthropology led to the eventual identification of the victims and the subsequent conviction of Dr. Ruxton. These technologies helped assign the dismembered body parts to a specific victim, and the use of superimposed photographs helped to assign the specific bodies to missing people. This investigation also led to the first use of modern fingerprint evidence in a British trial. The principles underlying the forensic anthropology and fingerprint techniques employed for the analysis of the physical evidence, as well as the forensic significance of the results, will be presented. The vast amount of class evidence pointing to Dr. Ruxton led to an eleven day trial, ending in his conviction.

**155.**

**CATCHING THE KANSAS BTK KILLER: USING DNA PROFILING TECHNOLOGY AND FORENSIC COMPUTER ANALYSIS**

Stephanie Mannino '10, Tiare Nakata '09, Justin Hall '09

Faculty Sponsor: Janet Morrison

Beginning in 1974 and ending in 1991, Dennis Rader "bound, tortured and killed" (his modus operandi ) ten victims and wounded one. He was able to successfully elude the police for years, all the while taunting them with letters, copies of "souvenirs" from the murders and a floppy disk, which eventually led to his arrest. After 1991, he took a hiatus before resurfacing to taunt the police and media again in 2004. Through the use of forensic analysis software, EnCase,



police were able to retrieve previously erased data from a floppy disk that Rader had sent them. The data on this disk was linked back to Christ Lutheran Church of which he was church council president and deacon. Forensic scientists were also able to establish a match between the DNA evidence found at the crime scenes to Dennis Rader through the use of his daughter's DNA. The underlying principles of the DNA profiling technologies employed for analysis (short tandem repeat (STR) analysis) and the forensic significance of these results in the arrest and conviction of Dennis Rader in 2005 will be presented.

**156.**

### **FORENSIC DNA PROFILING IN THE GUY PAUL MORIN CASE**

Samantha Moorin '09, Michael Magdelinskas-Vazquez '11

Faculty Sponsor: Janet Morrison

Guy Paul Morin was wrongly convicted, in Canada, of raping his nine-year old next-door neighbor. Morin was originally acquitted during his first trial in 1986; however, The Crown believed the trial was improperly influenced by the sitting judge. The Crown called for a retrial that was delayed until 1992, at which time, Morin was found guilty. However, many believed Morin innocent as evidence arose of police and prosecutorial misconduct. More importantly, it was determined that the forensic evidence, hairs and fibres found on the victim and in Morin's car, was grossly misinterpreted by the Ontario Center for Forensic Sciences. In 1995, the DNA was retested and Morin was found innocent. An examination of how DNA profiling data obtained from semen samples could be misinterpreted is critical to understanding the importance of forensic interpretation. This poster presents the fundamental principles underlying forensic DNA profiling technology, and the interpretation and evidentiary value of the scientific results obtained in the Guy Paul Morin case.

**157.**

### **LEANNE TIERNAN CASE RECONSTRUCTION AND ANALYSIS**

Kathryn Murdock '11, Eric Anderson '10, Nastaran Hakimi '11

Faculty Sponsor: Janet Morrison

Sixteen-year-old Leanne Tiernan, a resident of Leeds, UK, disappeared after a shopping trip on November 26, 2000. It was not until nine months after her abduction that her body was found in a wooded area near her home. The recovery of her body in August allowed local police to reconstruct the crime. Using evidence collected at the crime scene and her body the police department was able to arrest and convict John Taylor on October 16th 2001. Physical evidence found at the scene of the body consisted of fibers, twine, dog hair, dog collar, and cables used to tie the body. For the first time in forensic history dog DNA profiling was used in an investigation, to link the dog hairs found of Leanne's body with the dogs owned by John Taylor. The scarf around Leanne's neck held fragments of hairs. There was not enough DNA attached to the roots of the hairs for a typical DNA profile; however, analysis of mitochondrial DNA in the hair shafts implicated John Taylor. A search of Taylor's turned up burnt carpet fibers that matched the pink fibers found of Leanne's jumper. Police also found bloodstains under the floorboards of Taylor's home that matched Leanne Taylor. In July of 2002 Taylor was sentenced to two life sentences and was later convicted of two additional rapes with the penalty of two more life sentences. Class evidence and DNA profiling played a key role in this investigation. The underlying principles of the scientific methods employed for the analysis of this evidence and the forensic significance of the results obtained will be presented.

**158.**

**SOLVING THE MURDER OF THERESA HALBACH USING VARIOUS FORENSIC PROCEDURES**

Harold Pike '10, Lauren Kobernick '10

Faculty Sponsor: Janet Morrison

On October 31st, 2005 Theresa Halbach disappeared. This mysterious Halloween disappearance would begin to yield evidence when witnesses led the police to Steven Avery's Salvage Yard and his nearby live-in trailer. Upon conducting an investigation the police collected various items of physical evidence, including a dried bloodlike substance on Avery's washing machine; pornographic materials and items of sexual restraint in his trailer; a car key matching the victim's vehicle in his trailer; the victim's license plates; a rifle with unique striations matching a bullet found in the victim; a burn barrel containing clothing remains as well as bone fragments and teeth; and DNA evidence in the victim's car matching Avery's DNA sample. With this evidence, it was the forensic scientist's job to use forensic procedures to link the suspect, Steven Avery, to the victim and the crime scene. The principles underlying the techniques employed for the examination of the evidence, including DNA profiling, individual toolmark analysis, ballistics testing and fiber analysis, will be presented, along with the forensic significance of the results. Forensic science allowed the police to assemble a slam-dunk case and convict Steven Avery to life in prison without parole and his nephew accomplice, Brendan Dassey, to life in prison with a chance of parole after serving 41 years.