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TWENTY-FOURTH ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

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BIOLOGY

1.

PHYLOGENETIC STUDIES OF TWO LIGULATE RED ALGAE (RHODOPHYTA: GRACILARIALES, PHYLLOPHORALES) FROM BERMUDA

Tayoot Chengsupanimit '14

Faculty Sponsor: Craig W. Schneider

The phenotypic plasticity of many red algal species makes taxonomic identification based on morphological characters alone notoriously difficult. However, the advent of molecular phylogenetics has allowed for a quantifiable method of determining the relatedness/distance of similar-appearing species. Barcoding of red algae using the conserved mitochondrial COI-5P sequence has recently been used to gain quick and reasonable results for species comparisons, and coupled with comparative sequencing using chloroplast *rbcL* and LSU nuclear genes, more robust phylogenetic trees can be elucidated. Using these techniques, we have been able to demonstrate the identity of Bermudian specimens previously determined to be *Gracilaria curtissiae* collected within the past 50 years and resolve the taxonomic classification of a recent Bermuda collection of *Leptofaucea brasiliensis*, a species known morphologically to not be representative of the taxonomic judgment rendered in its protologue by Joly in 1957. Samples taken from August 2010 Bermuda collections were sectioned from 30 to 50 μm thick and mounted in a 20:1 solution of 30% Karo™ corn syrup and 1% aniline blue on standard microscope slides for morphological assessment. Samples from the same collections were sent to URI and UNB for barcoding. *Gracilaria curtissiae* was determined to be *G. occidentalis* from both morphological and DNA material. *Leptofaucea brasiliensis* was found to contain morphological characteristics in conflict with its current genus, and additional DNA material supports its future transfer to a new genus, potentially named *Archaestenogramma* gen. nov. The use of phylogenetics has been shown as an exceptionally effective method for the identification of the Rhodophyta.

2.

THE EFFECT OF NOVELTY OF SOCIAL STIMULI ON BRAIN CELL ADDITION IN WEAKLY ELECTRIC FISH, *APTERNOTUS LEPTORHYNCHUS*

Michael Chung '11

Faculty Sponsor: Kent Dunlap

Physical and social stimuli increase brain cell production in many adult vertebrates. In earlier work with adult weakly electric fish, *Apteronotus leptorhynchus*, I showed that dynamic, changing social stimuli elevated levels of brain cell addition beyond stable, nonchanging social stimuli. The present study investigated whether novelty promotes brain cell addition by elevating brain cell proliferation or brain cell survival. All subject fish were paired on day 0, injected with bromodeoxyuridine (BrdU), a marker of cell birth, on day 11 and sacrificed on day 14. Fish in the “Novelty Before Injection” treatment group had partner fish replaced one day before BrdU injection. Fish in the “Novelty After Injection” treatment group had their partner fish replaced one day after BrdU injection. Control fish received no social novelty. Fish brains were dissected, frozen and sectioned. We used immunocytochemistry to label BrdU in newborn cells to quantify them with a microscope. Preliminary results based on a small sample size suggest that the novelty of social stimuli affects cell proliferation and survival equally.

3.

THE EFFECT OF THAPSIGARGIN-INDUCED ER STRESS ON DEVELOPING OLIGODENDROCYTES AND ITS IMPLICATIONS FOR DEMYELINATING DISEASES

Angela Colantonio '11

Faculty Sponsor: Hebe Guardiola-Diaz

Oligodendrocytes (OLs) are specialized cells in the brain that produce a fatty, protective membrane called the myelin sheath, an essential component of the central nervous system. The endoplasmic reticulum (ER) is responsible for modifying the proteins and lipids required for the creation of myelin. Thapsigargin (TG) is a chemical agent that causes stress in the ER by disrupting calcium homeostasis within the cell, which results in the accumulation of unfolded proteins in the ER lumen. Prolonged ER stress can lead to apoptosis. The following experiment investigates the effect of TG on the proliferation, differentiation, and maturation of OLs in vitro. Enriched OL cell cultures were exposed to TG at various time points during cell development and labeled with a panel of developmental stage-specific antibodies and analyzed via immunofluorescence microscopy. It was discovered that exposure to TG decreases the average cell number of progenitor, immature, and mature OLs. The decrease in cell number of progenitors may be explained by lower rates of proliferation. Although TG does not appear to affect the entry of immature cells into differentiation, it does significantly decrease expression of myelin basic protein (MBP) in terminally differentiated cells. A supplemental study on the ability of OLs to recover from TG treatment shows that the average cell number of early progenitors is compromised, but the ability to differentiate and express MBP in those cells that survive is not. The opposite is suggested for more mature cells –their cell numbers are not significantly affected, but their ability to express MBP is compromised. Further study of the effect of ER stress on OL development is important because recent studies suggest that ER stress is an underlying cause of demyelinating diseases, such as multiple sclerosis.

4.

EXAMINATION OF HUMAN ASSOCIATED MICROBIOTA OF THE UPPER RESPIRATORY TRACT USING TERMINAL RESTRICTION FRAGMENT POLYMORPHISM AND CAPILLARY ELECTROPHORESIS

Tiffany Damiani '12, Melissa Blake '11, Taylor LaRese '11

Faculty Sponsor: Lisa-Anne Foster

Bacterial communities play a vital role in the human body, assisting in the production of essential amino acids and the host's resistance to disease. These host-associated communities colonize various sites in the body, adhering to tissues and organs; consequently assisting in the function of the host. In this investigation, bacterial communities of the upper respiratory tract, known as the normal flora, were examined. The normal flora, more specifically the α -hemolytic strains of *Streptococci*, are known to prevent the colonization of pathogenic bacteria, and thus diseases due to various properties known to interfere with the pathogens' ability to colonize. It is hypothesized that an inverse relationship exists between systemic disease and populations of normal flora. Disruptions in the normal flora communities, such as physical disturbances and harmful human behaviors may have an adverse effect on the normal flora, allowing harmful pathogens to invade healthy human cells. Such behaviors may include smoking and inappropriate or chronic antibiotic use. In order to observe this relationship between the health of the host and the normal flora, terminal restriction fragment length polymorphism was employed

to examine the normal flora present in oropharyngeal samples. tRFLP was used to identify the presence of bacterial strains of interest and detect their abundances. Samples were collected from volunteers at Trinity College, and PCR amplification showed a 50% success rate after protocol modifications. Subjects completed basic health status surveys to accompany the oropharyngeal swabs. Corresponding surveys were examined to illuminate any factors that may affect the bacterial composition. In order to study the potential role of normal flora, it is necessary to construct an extensive database of the fragmentation patterns produced in the tRFLP chromatograms of known bacteria. It was found that bacteria of different genera could be distinguished by restriction enzymes: Mnl1 and Alu1. However, they were unable to consistently differentiate bacterial species within the same genus. The enzyme selection is being further investigated to identify enzymes that can more specifically discriminate between bacterial species.

5.

MERCURY IN TERRESTRIAL DWELLING BIRD SPECIES

Gina Dinallo '12

Faculty Sponsor: Joan Morrison

Mercury contamination is a global issue that affects wildlife as well as humans but has traditionally been studied in relation to aquatic species (including macroinvertebrates, fish, and waterfowl) because human pollution from chemical plants and other sources causes mercury to leach into adjacent bodies of water. In this study, the question of mercury levels in terrestrial avian species was examined using DMA-80 analysis of feather samples from various songbirds and also from red-tailed hawks captured in the urban areas of Hartford. Hawks were expected to have the highest average mercury concentrations due to bioaccumulation; however, in a sample of over 60 individuals, the hawks had lower than expected mercury concentrations. Of the species sampled, Blue Jays and Common Yellow-throats had the highest mercury concentrations—213 and 291 ppm Hg/g respectively—more than triple the next highest species average. Diet may be responsible for the mercury in our samples. Although other species had primarily herbivorous diets or carnivorous diets focused on small mammals, the jay and warbler were unique in that they eat primarily invertebrates. This finding was supported by a previous study in which spiders were found to have especially high mercury concentrations due to their predation on aquatic invertebrates.

6.

EFFECTS OF COPPER (II) SULPHATE ON THE ESTUARINE DIATOM *CRATICULA* SP. (CHROMISTA, BACILLARIOPHYCEAE)

Taina Figueroa '12, Tayoot Chengsupanimit '14

Faculty Sponsor: Craig W. Schneider

Copper (II) sulphate has been and is commonly used as an algicide as most taxa of marine and freshwater algae can not tolerate high levels of copper. In addition to many other negative physiological effects, copper disrupts electron transport in photosystem II and restricts growth at concentrations as low as 0.25 ppm. In this study, the effects of varying levels of copper (II) sulphate were investigated on the estuarine diatom, *Craticula sp.* A unialgal culture was isolated from a Harkness Memorial State Park, Waterford, Connecticut plankton tow made in March 2011, then isolated and grown using a standard Erdschreiber solution. As diatoms require silicon

for the development of their frustules, additional sodium silicate was added to the growth solution. *Craticula* was subjected to six different copper (II) sulphate concentration treatments (0.0, 0.2, 0.4, 0.6, 0.8, and 1.0 ppm), with three replicates at each level, incubated at 15 °C and a 16:8 L:D cycle. Chlorophyll a absorbance of each treatment was tested daily for six days. Results will be presented.

7.

GROWTH RATE OF *CHLAMYDOMONA SP.* (CHLOROPHYTA) UNDER VARYING LIGHT INTENSITIES AND NITRATE CONDITIONS

Lindsay Gibbons '12, Weston Klimas '13

Faculty Sponsor: Craig W. Schneider

Similar to land plants, green algae (Chlorophyta) rely on sunlight and nutrients for growth. The concentration of nutrients in the environment, such as nitrogen, and intensity of light can inhibit or permit logarithmic growth rate. Nitrogen is an essential nutrient for growth, and algae satisfy their nitrogen requirement by absorbing nitrate (NO_3^-) and/ or ammonium (NH_4^+) from the surrounding environment. Just as essential as Nitrogen, light intensity is important in driving the electron transport chain of photosynthesis. Using a unialgal culture of *Chlamydomonas* sp. isolated from Lower Bolton Lake in February 2011, we investigated how varying light intensity and nitrate conditions affect growth rate. Cultures were grown in conditions of 15 °C and 8:16 light: dark cycle initially to establish a unialgal culture. To diminish the light intensity, half of the culture vials were wrapped with screening material, while the other half were left unwrapped and exposed to full light intensity. The alga was cultivated in Bold's basal medium with varying concentrations of NaNO_3 (0- 4 g/l). Final results will be presented at the symposium.

8.

INVESTIGATING THE POSSIBLE LATERAL TRANSFER OF THE ALGAL NUCLEAR GENE *PSBO* TO THE TROPICAL SEA SLUG *ELYSIA CRISPATA*

Caleb Homiski '11

Faculty Sponsor: Kathleen Archer

The sea slug *Elysia crispata* is able to retain the chloroplasts of its green-algal food sources and live from the products of photosynthesis for the remainder of its life cycle. Because photosynthesis requires proteins encoded for by the nuclear genome independent of the plastid genome, the photosynthetic capabilities of *Elysia crispata* are puzzling. Based on previous research [Rumpho, Mary E. et al., 2008] on a related slug species *Elysia chlorotica*, its algal food source *Vaucheria litorea* and the horizontal transfer of the psbO gene, we investigated the possible horizontal transfer of the psbO gene from two of the natural food sources of *Elysia crispata*: *Bryopsis hypnoides* and *Penicillus*. To avoid the classic criticisms of PCR, we aimed to generate specific fragments of the algal psbO gene, tag them and use them as a probe for sea slug DNA on a Southern Blot. We were able to amplify a fragment of the psbO gene from *Bryopsis hypnoides* that was approximately 1200 b.p. Based on the cDNA sequences on which our primers were based, we predicted the amplified fragment would be 400 b.p. This suggests an intron may be present in the genomic sequence. Analysis of the amplified fragment to determine if an intron is present is in progress.

9.

MOLECULAR-ASSISTED ALPHA TAXONOMIC STUDIES OF *PEYSSONNELIA* AND *POLYSTRATA* (RHODOPHYTA, PEYSSONNELIALES) FROM BERMUDA, WESTERN ATLANTIC

Amy Kivela '12

Faculty Sponsor: Craig W. Schneider

Knowledge of the various red algal crusts of Bermuda is extremely limited, owing to a lack of sufficient research in the area over the historical past. Genera of particular interest are *Polystrata* Heydr (1905) and *Peyssonnelia* Decne (1841), which are low-lying, fan-shaped, and grow on hard substrata. These genera frequently calcify for attachment. Genetic barcoding of red algae using the conserved mitochondrial COI-5P sequence has recently been used to gain quick and reasonable results for species comparisons. By coupling these data with comparative sequencing of chloroplast *rbcL* and LSU nuclear genes, more robust phylogenetic trees can be clarified. After our recent samples were barcoded, species groupings were elucidated, allowing for alpha taxonomy. We conducted morphological studies to find unique characteristics that support the molecular distinctions that led to the species groupings. Over thirty sample collections of *Peyssonnelia* and *Polystrata* were investigated. Samples were treated with 8% HCl to decalcify the crusts and sectioned at 40-50 μm using a freezing microtome. Sections were mounted on standard microscope slides in a 20:1 solution of 30% Karo™ corn syrup and 1% aniline blue. Then, they were observed/measured for traits that would inform on each sample's identity, such as dimensions of hypothallial and upper cortical cells, tetrasporangia, and rhizoids. Initial data suggest one new intertidal Bermuda species.

10.

THE EFFECT OF ROAD SALTS ON THE SURVIVAL OF *CHLAMYDOMONAS* (CHLOROPHYTA)

Amy Kivela '12, Shawna Altdorf '12

Faculty Sponsor: Craig W. Schneider

To combat freezing winter conditions, the Connecticut Department of Transportation and local Connecticut towns deposit large volumes of salt, generally sodium chloride (NaCl), but occasionally calcium chloride (CaCl), on interstates and local roadways. The annual application of these compounds onto roadways undoubtedly affects local terrestrial and aquatic environments. Once in the environment, NaCl and CaCl dissociate into ions, which plants readily absorb and transport to their growing tips and foliage. There, the salts accumulate to toxic levels and result in "burns" or "scorching." While the harmful effects of road salts on terrestrial plants are easily visible, those on aquatic plants are not so apparent. To study the effects of various osmotic conditions on the survival and growth of algae in waterways alongside salted roads and highways, we grew a target organism, *Chlamydomonas*, an alga commonly found in Connecticut freshwater habitats, under varying concentrations of two mineral salts, NaCl and CaCl. A unialgal culture of *Chlamydomonas* sp. was isolated from a February plankton tow from Bolton Lake in Manchester, CT and grown in Bold's basal medium at 15°C under an 8:16 L/D cycle. The generated stock culture was subdivided into stock Bold's solutions with 0, 50, 100, 150, 200, 250, or 300 mg of either NaCl or CaCl. Results were monitored over a 5 da period. Results will be presented at the symposium.

11.

CHARACTERIZING THE GROWTH ZONE IN ARTEMIA BY ANALYZING CELL DYNAMICS AND GENE EXPRESSION

Lorena Lazo de la Vega '14

Faculty Sponsor: Terri Williams

The current knowledge of the development of segments in the phylum Arthropoda has been mainly based on *Drosophila*, while our knowledge of other species is very limited. However, *Drosophila* forms all of its segments simultaneously, while most other arthropods form them sequentially in a region called the growth zone. The lab is using a crustacean, *Artemia*, and an insect, *Tribolium*, to analyze cell dynamics and gene regulators in the growth zone. The initial goal has been to test different mounting and feeding protocols in order to successfully learn more about the normal development of *Artemia*. It was found that leaving the animals overnight in methanol after fixation reduces the chances of distortions found in the posterior part of the body. The feeding regime tested affected body length and it was determined that the animals should be fed every twelve hours with diverse food. In order to proceed, the future goal is apply this knowledge to clearly observe the cell dynamics and gene regulation found in the *Artemia*'s growth zone. Therefore, the dimensions of the growth zone and the expression of two gene regulators, Caudal and Even-skipped, are currently being analyzed.

12.

THE EFFECTS OF VARYING PHOSPHATE LEVELS ON THE GROWTH OF TWO FRESHWATER ALGAE, *MICROCYSTIS* (CYANOBACTERIA) AND *SCENEDESMUS* (CHAROPHYTA)

Alejandro Lerma III '11, Noelle Fura '12

Faculty Sponsor: Craig W. Schneider

Water treatment plants in Connecticut affect the amount of phosphorus that enters the environment through wastewater discharge into rivers and other water bodies. Phosphorus is a common component of commercial detergents where it is used as a water softener. Modern commercial use of detergents has led to a sharp increase in released phosphates into the environment through runoff. Although certain measures are taken to decrease high levels of phosphates some are still present even after treatment. High concentrations of phosphates have been shown to cause eutrophication in water bodies through algal blooms, starving the water of oxygen. High phosphates levels can also negatively affect other algal species by disrupting growth. In either case phosphorous is a macronutrient for aquatic plants and remains essential to their physiology. Using the estimated phosphorus concentration levels in Connecticut water treatment plants in 2009 determined by Mary Beckler and Lee Dunbar from the Bureau of Water Protection and Land Reuse as a base value, various concentrations of phosphorus, in the form of potassium phosphate, were put into a modified Bold's solution. Two aglal species were used, a cyanobacterium, *Microcystis aeruginosa* and a charophyte, *Scenedesmus*. Cultures of each species were allowed to grow in the various phosphate solutions for five days and culture growth was assessed through chlorophyll a fluorescence measured using a fluorometer.

13.

EXPLORING THE FUNCTIONAL DOMAINS OF SERRATE-NOTCH INTERACTIONS

Ayiti-Carmel Maharaj-Best '13, Connor McElligott '14

Faculty Sponsor: Robert J. Fleming

Cell-to-cell communication is an important process in determining the fate of developing cells. The Notch cell signaling pathway is a common form of this type of communication, utilized in a wide range of multi-cellular animals. Its ligands, Delta and Serrate, exhibit both activation and inhibition properties on the Notch receptor. Notch receptors on cells expressing wild-type Serrate cannot be activated, due to the property of cis-inhibition that Serrate exhibits. Serrate is a molecule made up of 14 EGF-like repeats (ELRs). The lab has previously shown that Serrate loses its ability to inhibit Notch when any of individual ELRs 4, 5 or 6 is removed from the sequence. The purpose of our first set of experiments is to simultaneously remove ELRs 4, 5 and 6 to determine if this generates phenotypes distinct from those generated by individual removal of ELR, 4, 5 or 6. This will allow us to determine if the 3 repeats function as a unit or make individual contributions to the inhibition property. Our second set of experiments is aimed to determine whether or not there are any discernable activities for ELRs 7-14 of Serrate, for which no functions have yet been ascribed. To do this, we have constructed a mini-gene that contains all regions of Serrate except ELRs 7-14. These constructs will be used to generate transgenic flies for expression and determination of their properties in vivo.

14.

ADDITION OF ANIMAL-BASED KITCHEN SCRAPS TO COMPOST PILES: EFFECTS ON WILDLIFE VISITATION

Katherine R. Sausen '11, Alejandro Lerma III '11, Samuel Zatzinger '13, Dana Estefan '13,

Emily Thornton '13

Faculty Sponsor: Scott R. Smedley

Composting has become an increasingly popular and environmentally conscious method of disposing of organic household wastes. Advantages of composting include reducing municipal waste disposal and recycling essential nutrients into the soil aiding the essential nutrient cycles. A long held assumption in maintaining household compost piles is that the addition of animal-based products (bones, fat, cheese, etc) increases visitation by scavenging wildlife, however no experimental studies have been done to validate this dogma. This study directly addresses this assumption by monitoring and quantifying the wildlife encounters at differently treated compost piles. Experiments were conducted in the field in Andover, Connecticut over a 78-day period from early June to late August 2010. Three different compost piles, each with a different treatment (vegetable only, a vegetable-animal mix, and a control), were maintained on a weekly basis by assessment of pile disturbance and treatment replenishment. Wildlife visitors to piles were documented using wildlife monitoring cameras. Analysis of images for wildlife classification and independent encounters was conducted and visitation rates were calculated. The mix pile, with its animal based scraps, received the most wildlife visitations followed by the vegetable pile and then the control. The animal pile had the most non-blank images and the most encounters, validating the initial assumption. During this experimental period, approximately 16 mammalian and avian species were documented. Thus, addition of animal-based products led to more disturbances at the pile and a greater diversity of scavengers. This study provides previously lacking experimental evidence that can help shape the understanding and practice of residential composting.

15.

INVERTEBRATE VISITATION TO DIFFERENT TYPES OF RESIDENTIAL COMPOST PILES: WHY DO BEETLES GO HERE INSTEAD OF THERE?

Katherine R. Sausen '11, Bridget K. Tevnan '14

Faculty Sponsor: Scott R. Smedley

Composting allows households to dispose of food waste without adding to landfills and creates a nutrient-rich supplement that can be used for gardening. Most composters add only vegetable-based scraps to their piles, believing the long-proclaimed notion that the addition of animal-based scraps will attract unwanted wildlife visitors. Surprisingly, no experimental data exist to examine this claim. Therefore, an experiment was designed to test this idea in a rural/residential woodland area. Beginning in February 2008 in Andover, Connecticut, 12-week long replicates have been conducted in which three types of compost piles (vegetable products only, vegetable and animal product mix, and control) have been monitored using heat-motion sensitive cameras to collect images of wildlife visitors. Since piles also offer invertebrates habitats, an invertebrate survey was added to the project in early June 2009. Four pitfall traps were placed on the perimeter of each compost pile to collect visiting invertebrates. Specimens were collected from the traps every ten days through late August 2009. Beetles represent a diverse and ecologically important group of insects. Beetle specimens were prepared, identified to at least the family level, and their frequency among pile treatments was analyzed using chi-square (goodness of fit) and Monte-Carlo tests. Fourteen species of ground beetles (Carabidae) were identified, and members of an additional eleven families of beetles were also identified. It was found that four species of carabids showed a significant preference for the MIX pile while one species of carabids showed a preference for the VEG pile. For the other beetle families, there were also significant preferences for pile type. Based on the distribution of beetles among the piles, we hypothesize that beetles may prefer certain piles because species they prey on also visit these piles. In addition, microclimate and location of the pile may have also influenced beetle visitation. Identification and analysis of rove beetles (Staphylinidae) and other invertebrates collected from pitfall traps and Tulgren funnel samples will be conducted to further examine how variable compost constituents impact animal visitation and potential contact with humans.

16.

GROUP DYNAMICS OF THE WEAKLY ELECTRIC FISH *APTERNOTUS LEPTORHYNCHUS*: AGGRESSION AND STIMULUS FREQUENCY CONTENT

Lorenzo Sewanan '12, Anson McCook '12

Faculty Sponsor: Kent Dunlap

The weakly electric fish *Apternotus leptorhynchus* has been observed to be a highly aggressive species when paired in the lab, yet evidence suggests that this species displays group behavior in the wild. Field studies have shown that fish frequently cohabitate in groups of 3 or 4 conspecifics and that fish prefer being with other conspecifics rather than being in seclusion. As these weakly electric fish produce near-sinusoidal electrical signals with individual frequency (EOD) used for communication and electrolocation, it has been suggested that group living allows an enhancing of these senses through an electrical effect known as global interference patterns which arises with the superposition of EODs more than 10 Hz in difference. However, very little has been done in characterizing the behavior of the fish to stimulation by multiple electrical signals and in understanding the physiological effects of this stimulation, especially neurogenesis. This preliminary project focused on constructing multiple frequency sine wave signals, playing single

frequency signals and composite frequency signals back to fish with realistic amplitudes, and then measuring the response by recording their EOD. The EOD of the stimulated fish were short-time Fourier-transformed and then studied in the frequency domain; of particular interest was counting the chirps, a specific frequency-domain signal of aggression by the *Apteronotus leptorhynchus*. Preliminary data have indicated that the fish have a more aggressive response towards single-frequency stimulus than towards composite-frequency stimulus. Further work will include testing this response in a different signaling order and in a different signaling paradigm and analyzing the EOD with different techniques including empirical mode decomposition and the Hilbert transform.

17.

CHARACTERIZATION OF SIGNALING PATHWAYS INVOLVED IN THE ENDOPLASMIC RETICULUM STRESS RESPONSE IN OLIGODENDROCYTES

Khine Wai '11

Faculty Sponsor: Hebe Guardiola-Diaz

Endoplasmic reticulum (ER) stress which causes misfolded proteins and apoptotic cell death is characteristic of many neurodegenerative diseases. Cells respond to ER stress by reducing protein translation to reduce the level of unfolded proteins. The signaling mechanisms that control the oligodendrocyte response to ER stress are not known. This study aims to determine whether the AKT.mTOR or MEK/Erk cell signaling pathways counteract ER stress in oligodendrocytes. To trigger ER stress, we treated oligodendrocyte progenitors (OLPs) and mature oligodendrocyte (OLs) with thapsigargin (TG) in the presence of the MEK1 inhibitor U-0126 or the mTOR inhibitor rapamycin. Cell viability was studied using the Alamar Blue cell viability assay. We discovered that OLs have higher ability to withstand ER stress than OLPs. FGF2, a known activator of both AKT.mTOR or MEK/Erk cell signaling pathways was able to counteract the effects of TG in the presence of U-0126 but not in the presence rapamycin. This suggests that mTOR signaling pathway may play an important role in responding to ER stress in OLPs. Further investigations into the mechanism of activation of the Akt.mTOR pathways by ER stress and the downstream targets of these signaling pathways will help us understand how OLPs and OLs respond to ER stress and its relationship to neurodegenerative diseases that result in demyelination.

CHEMISTRY

18.

METHOD DEVELOPMENT AND ANALYSIS OF DIMETHYLTRYPTAMINE IN SALIVA USING HS-SPME/GC-MS

Erika J. Adams '13

Faculty Sponsor: Janet F. Morrison

N,N-dimethyltryptamine (DMT) is a Schedule I hallucinogen which occurs naturally in many plants and seeds and is additionally produced synthetically. While it has a long history of use, including its use by indigenous cultures of South America in traditional religious ceremonies, it has recently received increased media attention due its popularity among college students and young adults. In October of 2010, students at Georgetown University were arrested for operating a clandestine DMT manufacturing laboratory out of their dorm room (Hartford Courant, October 25, 2010).

The goal of the present study is to develop a reliable analytical method based on headspace solid-phase microextraction (HS-SPME) and gas chromatography-mass spectrometry (GC-MS) for the rapid laboratory confirmation of DMT in saliva. Saliva testing provides a convenient and noninvasive way to assess whether a subject was under the influence of drugs at the time that the saliva sample was obtained. Saliva test kits based primarily on immunoassay have been developed for roadside screening of a variety of drugs and alcohol; however, the results of these 'on-site' tests are considered preliminary and require laboratory confirmation for forensic defensibility.

Results of method optimization experiments designed to maximize SPME recoveries of DMT will be presented. SPME parameters such as fiber type, incubation temperature and time, extraction temperature and time, and desorption time were investigated. Preliminary data suggests that SPME extraction temperatures between 95°C and 115°C provide efficient recoveries of underivatized DMT; additionally, on-fiber (or in vial) derivatization of DMT to its trimethylsilyl analog was demonstrated. It was observed that the sample matrix has a profound effect on DMT recoveries by SPME; the influence of sample pH, solvent, and the presence or absence of salt will be discussed.

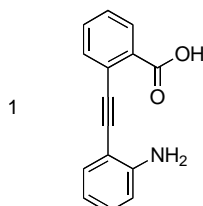
19.

COORDINATION OF A PEPTIDE β -TURN MIMETIC TO TUNGSTEN: POSSIBLE APPLICATIONS FOR THE STUDY OF β -SHEETS

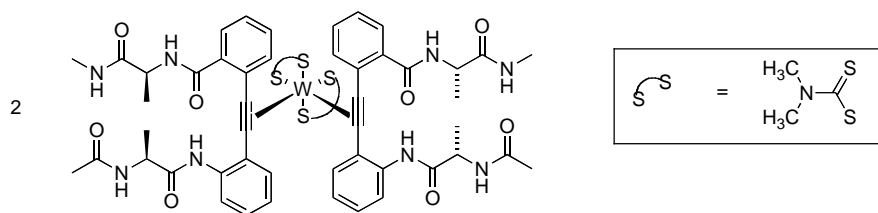
Adam N. Boynton '12

Faculty Sponsor: Timothy P. Curran

In 1995 Kemp and Li described the synthesis of 2-amino-2'-carboxyphenylacetylene (**1**) and its use as a peptide turn mimetic.^{1,2} Their work showed that **1** does function as a β -turn mimetic, and that



peptide derivatives incorporating **1** adopted β -sheet structures. A key structural element in **1** is the alkyne group that links both phenyl rings. Because of our ongoing interest in the use of tungsten-alkyne coordination for generating constrained peptides,^{3,4,5} we have begun investigations into whether peptide derivatives of **1** can be reacted with $W(CO)_3(dmtc)_2$ to yield tungsten-bis(alkyne) complexes (like **2**), and whether the peptides maintain a β -sheet structure after coordination to tungsten. If the peptides do maintain their sheet structure, then it would be of interest to know whether the two β -sheets interact with each other via stacking arrangements. Owing to solubility and oligomerization issues, there are very few model systems for investigating β -sheet stacking interactions.



This presentation will detail the status of our efforts to prepare and study these novel bioorganometallic species.

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20.

DETERMINATION OF BISPHENOL-A CONTENT IN RECEIPTS VIA SOLID PHASE EXTRACTION-MASS SPECTROMETRY

Adam Boynton '12, Sam Scinto '12, Alicia Rodriguez '12

Faculty Sponsor: David Henderson

In this experiment, the bisphenol-A (BPA) content in store and restaurant receipt samples was investigated. The National Toxicology Program (NTP) has deemed BPA a hazardous chemical, naming it a middle concern toxic chemical¹ and an environmental pollutant.² Also, high exposure to BPA poses human health risks such as neurodevelopment disorders³ and heart disease,⁴ among others. Receipts are a pertinent target for BPA analysis because BPA is frequently found in thermal paper, a common paper source for receipts.² BPA was extracted from receipt samples and analyzed using on-line solid phase extraction (SPE)-mass spectrometry. In order to quantify the BPA present in each sample, an internal standard calibration method was employed using deuterated BPA. This presentation will outline the findings from our investigation.

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2 Mendum, T.; Stoler, E.; VanBenschoten, H.; Warner, J.C. (2011) Concentration of bisphenol A in thermal paper. *Green Chemistry Letters and Reviews*, 4, 81-86.

3 Ishido, M.; Masuo, Y.; Kunitomo, M.; Oka, S.; Morita, M. J. (2004) *Neurosci. Res.*, 76, 423-433.

4 European Union Risk Assessment Report 4,4'-Isopropylidenediphenol (bisphenol-A), Environmental Addendum of February 2008; Office for Official Publications of the European Communities: Luxembourg, 2010.

21.

DEVELOPMENT OF A RAPID HS-SPME/GC-MS METHOD FOR THE DETECTION OF MDMA (“ECSTASY”) IN SALIVA

David M. Correll '13

Faculty Sponsor: Janet F. Morrison

The serious threat posed by drivers who operate under the influence of drugs has led to the development and commercialization of a variety of roadside screening tests designed to rapidly detect the presence of illicit drugs in saliva. Saliva provides a convenient biological sample for the detection of drug use because it can be easily and readily obtained in a non-invasive manner by non-medical personnel, and studies have shown that for many drugs, detection in saliva is highly predictive of the detection of the drug or its metabolites in serum. For forensic defensibility, results of such on-site drug screening tests must be subsequently confirmed in the laboratory by a different analytical technique.

The goal of the present study is to develop a reliable analytical method based on headspace solid-phase microextraction (HS-SPME) and gas chromatography-mass spectrometry (GC-MS) for the rapid laboratory confirmation of 3,4-methylenedioxy-methamphetamine (MDMA or “Ecstasy”) in saliva. MDMA is a synthetic drug which possesses both stimulant and hallucinogenic

properties. While commonly referred to as a “club” or “rave” drug, the abuse of MDMA has expanded outside the rave scene, including to college campuses. A recent government-funded study found that hospitalizations related to MDMA use increased by 75% between 2004 and 2008. Considered one of the most widely abused recreational substances worldwide, MDMA is classified as a Schedule I controlled substance under the Federal Controlled Substances Act.

Results of preliminary method optimization experiments designed to maximize SPME recoveries of MDMA will be presented. Parameters such as fiber type, column type, incubation temperature and time, extraction temperature and time, desorption time and GC temperature programs were investigated. The influence of sample pH, salting out effects, and the potential for on-fiber derivatization will also be discussed.

22.

ISOLATION AND CRYSTALLIZATION OF MAL3 USING THE HANGING DROP METHOD

Matthew J. Eremita '12

Faculty Sponsor: Richard V. Prigodich

Mal3 is a maltose-binding protein found in the thermophilic bacterium *Thermatoga maritima*. The protein's primary structure has already been sequenced and is significantly different from that of either Mal1 or Mal2 (other maltose-binding proteins whose primary and quaternary structures have already been determined). Mal proteins are a subclass of Peripheral Binding Proteins (PBPs), which are proteins embedded in the bacterial cell membrane that transfer material from the periplasm (the space between the bacterial cell wall and cell membrane) to the cytoplasm. The 3D structure of both Mal1 and Mal2 is characterized by having two domains that are attached at a hinge. In their open conformation, the protein's ligand-binding site is exposed to the periplasm. When bound to maltose, the two domains rotate about their hinge to enclose the maltose. That hinge is broken when maltose is released into the cytoplasm. Whereas the quaternary structures of Mal1 and Mal2 (both ligand-bound and unbound) are known, the quaternary structure of Mal3 has not yet been determined. It is hypothesized that, despite having different primary structures, Mal3 will adopt a three-dimensional structure that is similar to both Mal1 and Mal2. X-ray crystallography will be conducted on Mal3 crystals to determine its three-dimensional structure.

Our research has been aimed at optimizing the hanging drop method to crystallize Mal3 that has been isolated in solution. This method involves plating a single drop of a 1:1 mixture of protein solution and precipitant (polyethylene glycol-MgCl₂) solution. The plate is then inverted so that the drop hangs over a well containing the same precipitant solution, and is sealed from the environment. Water from the drop evaporates into the well which causes the protein to concentrate and possibly crystallize. Previous work has shown that crystals will form when the protein solution is 20 mg/mL and the precipitant solution is 22% polyethylene glycol, 0.2M MgCl₂. By optimizing these conditions, we expect to obtain a larger quantity of better quality of Mal3 crystals. Conditions are currently being optimized using precipitant solutions that are 14-22% polyethylene glycol and 0.1-0.4M MgCl₂, and protein solutions that are 16-24 mg/mL. X-ray crystallography will be conducted on the crystals obtained using this method to determine the quaternary structure of Mal3.

23.

**PROGRESS TOWARDS THE ASYMMETRIC SYNTHESIS OF
BENZOCYCLOBUTENOLS BY DIRECT ADDITION OF CHIRAL ENOLATES TO
BENZYNE**

Christopher M. Gromisch '11

Faculty Sponsor: Olivier J.-C. Nicaise

Benzocyclobutenols are an important class of chemical and biochemical species. Benzocyclobutenols are capable of isomerizing into quinodimethanes, which is useful in the generation of polycyclic compounds.¹ A class of chiral, tricyclic, benzocyclobutenol derivatives can also be used as anticonvulsive, bronchorelaxant, and β 2-blocking agents.² Both applications require the generation and isolation of specific benzocyclobutenol derivatives, and optically pure benzocyclobutenols can be obtained through asymmetric synthesis.

Caubère et al. reported several years ago the generation of benzocyclobutenols through the arynic condensation of ketone enolates.³ In an asymmetric variant of this reaction, one of the starting materials must be enantiomerically pure, allowing for the formation of diastereomerically enriched products.

One of the research interests of our laboratory is the development of a diastereoselective reaction to maximize the yield of benzocyclobutenols derived from five-, six-, and seven-membered ring ketones. Previous work in our laboratory has consisted of using dialkyl amide bases at low temperature for the generation of benzyne and the cyclic ketone enolates. However, a novel approach was needed for a more efficient preparation of the benzocyclobutenol derivatives at low temperature.

The focus of this presentation will be the development of an effective low temperature reaction scheme, and the progress towards the successful generation of chiral benzocyclobutenols will be also reported.

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24.

COMPARATIVE INSTRUMENTAL ANALYSIS OF BPA IN URINE

Gabe Hayek '12, Andrew Janiga '11, Thomas McTeague '12

Faculty Sponsor: David Henderson

Although BPA is considered an endocrine disrupting chemical (EDCs), it remains commonly used in the synthesis of polycarbonate plastics and epoxy resins, and it continues to be produced at a rate of 8 billion pounds per year. While BPA levels remain currently unregulated by the FDA, BPA exposure can lead to a disruption of the thyroid gland and estrogen receptors, causing drastic changes in metabolism and growth rates throughout the body. While a variety of human samples may be used for the analysis of BPA within the body, such as blood or tissue, one noninvasive manner in which this may be accomplished is by investigating the levels of BPA present in urine. In order to investigate students' daily exposure to BPA, several derivatized and underivatized methods of analysis were probed and compared within the laboratory; including SPME-GC-MS and direct injection GC-MS. In addition to the instrumental methods tested, the efficiency of several extraction techniques, including ultrasound assisted emulsification microextraction (USAEME) and vortexing and the use of various extraction solvents, namely octanol and chloroform, were analyzed. Of these three methods, only direct injection GC-MS preceded by a vortexing and extraction using octanol was found to be useful in detecting the presence of derivatized BPA in urine. With the use of this method and an internal standard calibration the BPA content of 3 Trinity students was then quantified and compared. The results of this study are presented in this poster.

25.

INVESTIGATING THE BINDING OF OSTEOCALCIN TO BOVINE TYPE I COLLAGEN AND THE STRUCTURE OF STOICHIOMETRICALLY DEFICIENT HYDROXYAPATITE

Andrew M. Janiga '11, Joseph C.C. Lim, Chung Su Hong

Faculty Sponsor: Richard V. Prigodich

Osteocalcin and type I collagen are two of the main proteins that play a role in bone structure. It is known that these two proteins bind together. A quantitative analysis of amino terminal peptides of 10, 12, 14 and 16 amino acids in length was performed and binding constants were calculated. The binding constants increased with the length of the N-terminal peptide. The dissociation constant of the 16-mer is close to that of the intact protein. This identifies the amino terminus of osteocalcin as the type I collagen binding site.

In addition, cadmium hydroxyapatite samples were analyzed using x-ray diffraction. Rietveld analysis was performed on x-ray diffraction spectra, and the deficiencies of cadmium in non-stoichiometric cadmium hydroxyapatite were calculated. These deficiencies were found to be in the triangular cadmium sites of cadmium hydroxyapatite. Further analysis will be performed to determine if an additional metal site is present in non-stoichiometric cadmium hydroxyapatite.

26.

SYNTHESIS AND STRUCTURE ELUCIDATION OF TERNARY MIXED CALCIUM RUTHENIUM HYDRIDES/DEUTERIDES (Ca₂RuHxD_{6-x}) THROUGH X-RAY CRYSTALLOGRAPHY AND INFRARED SPECTROSCOPY

Pathik Khatri '13

Faculty Sponsor: Ralph O. Moyer Jr.

The purpose of this research was to synthesize ternary compounds of the formula Ca₂RuHxD_{6-x} in order to elucidate the structures and possible applications of the compounds. The compounds were synthesized by solid state reactions of molar amounts of CaH₂ and CaD₂ with ruthenium metal under either a hydrogen or deuterium atmosphere at high temperatures to yield one of several combinations of Ca₂RuHxD_{6-x}. The compound was ascertained to be a face-centered cubic lattice of the K₂PtCl₆ structure by use of X-ray crystallography. Isomeric positions of hydrides and deuterides coordinated to ruthenium in the Ca₂RuHxD_{6-x} compounds were established with the use of infrared spectroscopy. Due to the hydrogen storage capabilities of Ca₂RuHxD_{6-x} compounds, there are possible alternative fuel applications.

27.

NMR EXPERIMENTS ON β-CYCLODEXTRIN AND FLUORESCEIN

Richard Kim '13

Faculty Sponsor: Richard V. Prigodich

β-cyclodextrin is a seven sugar cyclic molecule with a cone like structure with two openings. This structure is important to study due to the fact that this molecule can behave like a container in interactions with other molecules. A particular use of this characteristic of β-cyclodextrin is to bind to fluorescein and delay its retention time in capillary electrophoresis experiments. Fluorescein is a dye commonly used to track and label cells in fluorescence microscopy. It has hydrophilic ends that has the potential to interact with the hydrophilic parts of the β-cyclodextrin. Through a series of proton NMR experiments, the structures of β-cyclodextrin and fluorescein were first studied individually. A COSY NMR experiment of fluorescein was done to assign the proton spectrum peaks to the protons on fluorescein. Finally, a NOESY NMR experiment was done on a sample with a 1:1 mole ratio of β-cyclodextrin to fluorescein to analyze the proton to proton through space interactions in the respective molecules to discover how fluorescein may interact with β-cyclodextrin.

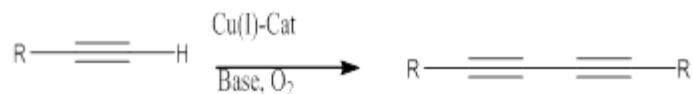
28.

CROSS COUPLING OF TERMINAL ALKYNES VIA A MODIFIED HAY COUPLING METHOD

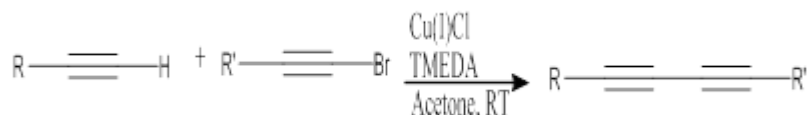
Darleny Lizardo '12

Faculty Sponsor: Thomas Mitzel

As recurring building blocks found in nature and manufactured intermediates, the properties and reactivity of diynes have been carefully looked at for many years now. In 1869, the Glaser group was the first one that successfully coupled similar terminal alkynes and obtained a symmetrical diyne as their product.



As the reactivity of alkynes was being understood more thoroughly, other scientist adapted the Glaser method of coupling and made a few adjustments of their own. The Hay group (1962), for instance, employed a very similar approach to coupling as the Glaser group, except that instead they used the tetramethylethylenediamine (TMEDA) complex of copper (I) chloride as their catalyst. The Eglinton group also coupled terminal alkynes under oxidative conditions using a copper (II) salt instead of a copper (I) salt. Then the Cadiot-Chodkiewicz group altered the Glaser coupling a bit more and was the first to try to couple two different terminal alkynes, a typical terminal alkyne and a haloalkyne, in order to obtain an asymmetrical diyne. They followed similar coupling conditions to those of the Glaser group without employing oxidative conditions. In our research lab we have endeavored to make asymmetrical diynes via a coupling condition that combines the hay coupling and the cadiot-chodkiewics methods using acetone, which is cheap and benign, as a solvent and no oxidative agent. Our conditions are therefore very useful and practical for the creation of asymmetrical diynes.



29.

DETERMINATION OF PURINE CONTENT CHANGES IN RAT BRAIN FOLLOWING CHRONIC KETOGENIC DIET

Sean S. Mansoori '11, Arturo Lopez-Casanova '13, Tracey Suter '11

Faculty Sponsors: Susan Masino, David Ruskin, William Church

Previous studies indicate that the high fat/protein and low carbohydrate ketogenic diet (KD) reduces pain and inflammation in rats.² However, the exact mechanism of the KD-induced attenuation of nociception is unclear. The ketogenic diet has been shown to alter purine biochemistry in the brain.¹ Purines are known to be involved in pain response so the present work was carried out to evaluate purine content in central nervous system (CNS) pain pathways through high-performance liquid chromatography (HPLC).³ Brain tissue from the following areas were analyzed: thalamic ventral posterolateral/posterolmedial nucleus (VPL/VPM), somatosensory cortex, hippocampus/periaqueductal grey (PAG), and cerebellum. Xanthine, hypoxanthine, uric acid, inosine, and adenosine were separated and quantified in brain homogenate using a Luna® C18 reversed-phase column with dual-wavelength UV detection. Optimization of separation parameters are reported. Quantitation of the purines is linear over 4 orders of magnitude. Peak assignments in brain tissue homogenate chromatograms were based on retention times and absorption ratio values. Preliminary quantification results will be presented.

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30.

RECRYSTALLIZATION OF AMINE-PROTECTED PROPARGYLCYSTEINE FOR TUNGSTEN COORDINATION

William McCarthy '14

Faculty Sponsor: Timothy P. Curran

Achieving different conformations of small peptides outside of a larger protein would have many applications. The larger project aims to achieve two of these conformations, the α -helix and the β -sheet, by using a foreign constraint. In this case, the constraint will use tungsten-alkyne coordination. For this, alkynyl amino acids are needed. One such amino acid is propargylcysteine. The specific project here is to determine which derivatives of propargylcysteine can be prepared and then purified by recrystallization. This is an important project, because recrystallization is the only purification method that is workable for large scale (5 g or more) syntheses of propargylcysteine. Our lab will need large amounts of propargylcysteine in order to prepare the peptides that will be coordinated to tungsten. Two derivatives will be explored. In one the amine on propargylcysteine will be acylated with a Boc protecting group; in the other the amine will be acylated with an Fmoc protecting group. The route of synthesis for the Boc-protected compound is pictured below. First the propargyl group is attached to the amino acid cysteine in a solution phase reaction. Then the Boc-protecting group is added, again in a solution phase reaction. A similar method is used for addition of the Fmoc group. The protected propargylcysteine is then used in a solid phase peptide synthesis with Wang resin to attach the amino acid phenylalanine. The crude product is then triturated with ether to encourage crystallization. So far, the Boc-protecting group has been evaluated; it was found that this derivative does not lend itself to purification by recrystallization.

31.

CONSTRAINED PEPTIDES CONSTRUCTED BY COORDINATION OF PROPARGYLCYSTEINES WITH TUNGSTEN

Thomas A. McTeague '12, Zephyr D. Dworsky '10

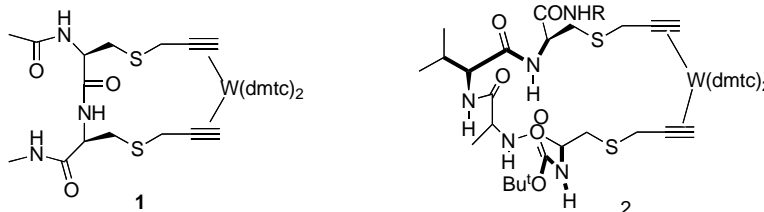
Faculty Sponsor: Timothy P. Curran

In prior work we have demonstrated that alkynes can be appended to peptide carboxylic acids (via acylation with propargylamine) and amines (via acylation with propargylchloroformate), that peptides bearing two alkynes can be prepared, and that reaction of these dialkynylpeptides with $W(CO)_3(dmtc)_2$ yields a cyclic peptide that incorporates the tungsten atom (which is called a metallacyclicpeptide).^{1,2} We have sought to use the tungsten-alkyne coordination to constrain peptides to specific three-dimensional conformations; in one case peptide turns were constrained by the tungsten-alkyne coordination.² In an effort to create helical peptides we have appended alkynes to the side chain amines of lysines, and have constructed peptides having two of these alkynyllysines. Coordination of these dialkynylpeptides to tungsten has produced metallacyclicpeptides. Investigations using NMR spectroscopy has shown that these metallacyclicpeptides are too flexible to constrain the peptide to a specific conformation. In particular, in these metallacycles we have found that the two alkyne groups can rotate around the tungsten center, generating a number of conformational isomers in solution.

We have hypothesized that appending the alkyne group to the side chain amine of lysine locates the π -ligand too far from the peptide backbone for coordination to tungsten to constrain the peptide. Accordingly, we have begun investigations to see whether locating the alkyne group

closer to the peptide backbone will make the complexes more rigid. Towards this end we have been investigating the use of propargylcysteine as our alkynylamino acid. Attractive features of propargylcysteine are that it can readily be prepared in multigram quantities from cysteine, and derivatives of propargylcysteine are easy to work with in peptide synthesis.

This presentation will discuss the preparation of peptides possessing two propargylcysteines, the coordination of both alkynes in these peptides to tungsten, and the conformational analysis of the resulting metallacyclicpeptides. Particular emphasis will be on the study of compounds **1** and **2**.



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32.

PHOTOCHEMISTRY OF THE LIQUID-VAPOR INTERFACE

William Tyler Nebel '14, Baltazar Ramos '11, Teddy Harrington '11, Andres Delgadillo '13

Faculty Sponsor: Maria Krisch

The liquid-vapor interface describes the region where a bulk liquid comes into contact with its surrounding vapors. A liquid-vapor interface is formed wherever a liquid comes into contact with the air, and are therefore very common on earth, as its surface is largely aqueous. It is thought that potentially important photochemical reactions take place at the liquid-vapor interface, and that the physical properties of the interface influence those reactions. These effects are studied by creating uniform droplets of a solution of a chemical of interest, exposing the droplets to ultraviolet light, and determining the change in UV absorption. By creating droplets of different sizes from 150-50 um in diameter, the surface area to volume ratio is altered, and if the liquid-vapor interface plays a role, then the smaller droplets should have a greater change in signal between exposed and unexposed samples. Analysis is done using gas chromatography-mass spectrometry and a mix of spectroscopic techniques. Currently, there appear to be no changes in photochemistry attributable to droplet size. However, the chemical systems that have been observed thus far are very simple, and greater effects might be seen when additional chemicals are introduced. Because of the prevalence of liquid-vapor interface in natural systems, for example the ocean surface, wave spray, and clouds, characterizing the effects of the liquid vapor interface on photochemistry could lead to new insights into atmospheric chemistry.

33.

TOWARD THE EFFICIENT SYNTHESIS OF (S) -5,5'-DITERTBUTYL-N-(9-FLUORENYLMETHYLOXYCARBONYL)-4-CARBOXYGLUTAMATE

Alicia Y. Ortiz '12

Faculty Sponsor: Richard V. Prigodich

This study investigates an efficient new route for synthesizing Fmoc-L-Gla(OtBu)₂-OH. Glutamic acid is one of the twenty proteinogenic amino acids. Gla is the post-translationally modified form of Glu, having been carboxylated at the gamma position, and is found in many proteins. Fmoc-L-Gla(OtBu)₂-OH is the protected version of Gla suitable for solid-phase peptide synthesis, but is very expensive. For this project, a six-step synthetic route was devised for producing Fmoc-L-Gla(OtBu)₂-OH. Mass spectrometry and proton NMR spectroscopy were used to determine the products of each step. The current result is a small trace of the third of six products needed to complete the synthesis.

34.

MEASURING METAL ION STABILITY CONSTANTS BY ³¹P NMR

David A. Patrick Jr. '11

Faculty Sponsor: Richard V. Prigodich

The binding of metal ions and other cations to phosphorus containing compounds is of general interest and has great relevance to the behavior of nucleic acids in the presence of electrolytes. ³¹P NMR chemical shift changes can be induced by the binding of cations to phosphorus containing acids because of the increased possibility in shielding or deshielding. Using tetramethylammonium chloride to control chloride concentration and the non-ionizable compound trimethylphosphate as a chemical shift standard, the chemical shift and coupling constants were measured for methylphosphonic acid, methyl phosphinic acid, 5' adenosine monophosphate, and cyclic 5' adenosine monophosphate (cAMP). The concentration of metal chloride salts was also varied for each experimental compound. The association constants varied for each metal ion and phosphorous compound. All studied compounds have more shielding with the metal, except for magnesium and guanidine with AMP, and potassium with phosphonate, though the latter contains larger standard error. Other cationic ligands and retrials of the current ligands will be used to further this study.

35.

DETERMINATION OF BISPHENOL A IN CANNED FOODS USING GAS CHROMATOGRAPHY-MASS SPECTROMETRY

David A. Patrick Jr. '11, Baltazar Ramos Jr. '11, Darleny Lizardo '12

Faculty Sponsor: David Henderson

Bisphenol A (BPA) is a commonly used plastic monomer found in many consumer products, such as toys, eyeglass lenses, safety equipment, and electronics.¹ Additionally, BPA is also used to line cans of food, in order to prevent contact between the food and metal, and plastic bottles, in order to make them more rigid and durable.² Previous studies have shown that BPA leaches from cans and plastic bottles into food and beverages due to either increased temperatures or incomplete polymerization when made.³⁽⁴⁾ Currently, in the U.S., the Environmental Protection Agency (EPA) has defined the safe level of BPA for humans as 50 ug per kilogram of body mass

per day.² This has recently become a concern because many studies have shown adverse health effects, including reproductive and neurobehavioral dysfunction, on lab animals given doses of BPA lower than that considered safe for humans by the EPA. Since the main form of exposure to BPA is thought to be through ingestion, and because of the negative health effects caused by BPA, it is important that a good method to analyze BPA is developed to quantify how much leached BPA is in canned food products. Canned food samples analyzed included: green beans, split peas, carrots, tomato soup, sweet corn, and cream of mushroom soup. The BPA in the homogenized food samples was extracted with acetonitrile and derivatized into BPA diacetyl with acetic anhydride. Derivatized BPA was analyzed via gas chromatography-mass spectrometry (GC-MS) with derivatized deuterated BPA-d16 internal standard in the food samples for easier quantification. Thus far, BPA has been detected in the food samples but has not been quantified at the time of abstract submission.

36. SYNTHESIS OF β -PLEATED PEPTIDES BY COORDINATING TUNGSTEN WITH ALKYNYL LINKED AMINO ACIDS

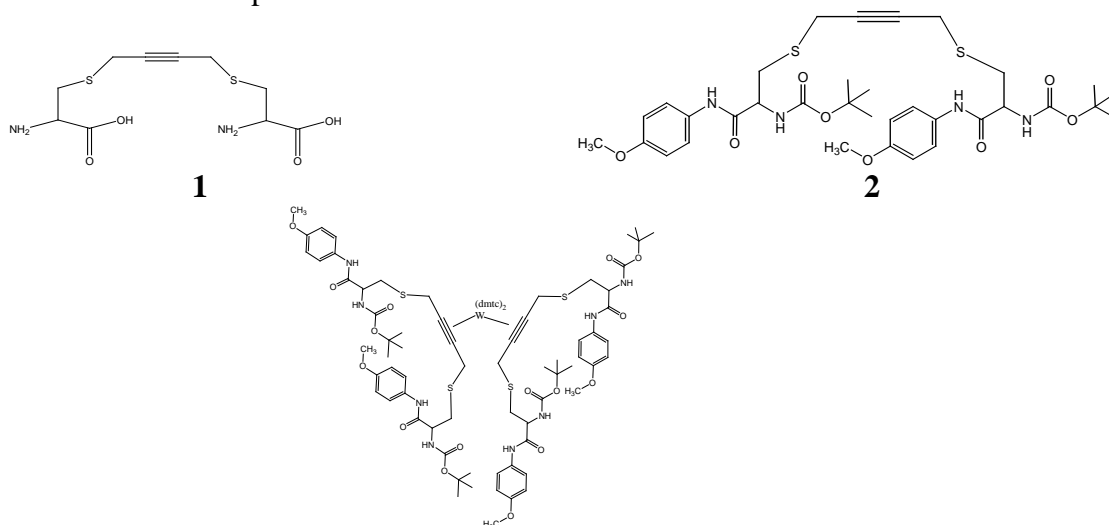
Panida Pollawit '12

Faculty Sponsor: Timothy P. Curran

The forces that govern the formation of β -pleated sheets have yet to be fully characterized. Developing a simple method of synthesizing β -pleated sheet peptides will provide an easy way to further study these forces.

The ultimate goal of this study is to first crosslink two cysteines with an alkyne group to generate 1. Once 1 is in hand, amino acids will be appended to it to generate two peptide chains that are connected via the alkyne crosslink (2). Finally, the alkyne group in 2 will be coordinated to tungsten to generate 3. It is hypothesized that coordination of the alkyne to the tungsten will encourage the two peptides to hydrogen bond to each other, generating a beta-sheet structure.

To date, the synthesis of a symmetrical alkyne linked to L-cysteine and anisidine has been successful. The amide on the L-cysteine currently has a Boc protecting group on it (2). The alkyne product was confirmed with ¹H-NMR, COSY-NMR and ES-MS analyses. Details about this synthetic work will be provided.



37.**PHOTOCHEMISTRY AT THE LIQUID-VAPOR INTERFACE**

Baltazar Ramos '11, Teddy Harrington '11, John Hasychak III '11, Andres Delgadillo '13,
Tyler Nebel '14

Faculty Sponsor: Maria Krisch

Unique aspects of the liquid-vapor interface cause its composition, and sometimes chemistry, to be different from bulk liquid. Here we discuss the development of a droplet train apparatus, using a vibrating orifice, to study photochemistry at the liquid-vapor interface. Our goal is to compare bulk and interfacial photochemistry to see whether differences between the two are substantial, with atmospherically interesting organics in solution serving as a proxy for atmospheric aerosols. We use gas chromatography-mass spectrometry (GC-MS) as an analytical method to follow the photochemistry of CH_2ICl exposed to an ultraviolet laser light and broadband ultraviolet lamp. Orifices of 30, 50 and 75 μm were characterized to produce the UV exposed droplet trains. Thus far, the data collected does not seem to show any surface effects. Future work will consist of examining more methods to track photochemical products, characterization of different orifice sizes, and reducing variability of GC-MS CH_2ICl data.

38.**MEASURING URIC ACID PRODUCTION IN NERVE CELLS UNDER OXIDATIVE STRESS THROUGH THE OXIDATIVE RADICAL TRIURET**

Jessica Williams '12

Faculty Sponsor: William Church

Uric acid is an antioxidant that is produced in vivo in response to periods of oxidative stress in nerve cells. Uric acid has the ability to scavenge reactive oxygen and nitrogen species including peroxynitrite which causes the nitration of tyrosine residues. In the reaction with peroxynitrite, uric acid decomposes via an oxidation reaction to form the radical called triuret (diimidotricarbonic diamide). There are no present methods to measure the amount of uric acid nerve cells produce in response to oxidative stress. We seek to devise a method for measuring triuret and using its amount as a direct measure of uric acid that was initially produced in the cell. Urea has a structure similar to triuret and we used it as a model to determine the fluorescent capabilities of triuret. We used a CBI derivation method to measure the fluorescence of urea with varying concentrations of NDA. We have found that urea fluoresces at a 400nm excitation wavelength and its maximum emission is around 510nm. We will continue these fluorescence studies and vary reaction time, temperature, reactant amounts and molecule choice in order to ultimately measure triuret in homogenous cells.

COMPUTER SCIENCE

39.

PROJECT THOR: SIMULATING DISTRIBUTED HASH TABLES ON ADHOC NETWORKS

Prasanna Gautam '11

Faculty Sponsor: Timothy Richards

Distributed Hash Tables (DHT) is a storage system that provides a hash-table interface distributed over many individual devices on the network. Commonly used by Bittorrent applications and network providers for redundancy, in both cases the nodes can come in and out of the network unpredictably. This is analogous to Mobile Ad-hoc networks in mobile devices where devices communicate without a common network provider. Project Thor was developed to simulate these DHTs over Adhoc networks. Since the existing network simulators were focusing on low level link or network layer, Thor was developed to study DHTs at a higher abstraction level using Clojure - a functional programming language running on Java Virtual Machine (JVM). A domain specific language called Hammer was written to facilitate this task. Hammer is evented and allows for Clojure functions in the simulation which provides concise and expressive syntax. Upto 10,000 nodes were simulated running DHT on Adhoc network and time, power degradation and network performance were measured.

40.

GPGPU WITH CUDA: THE CONVEX HULL PROBLEM

Dimitar Gochev '11

Faculty Sponsor: Peter Yoon

This project explores the area of General Purpose Graphics Processing Unit (GPGPU) programming with nVidia's CUDA technology. More specifically, it concentrates on the Convex Hull problem, which has various applications in computer visualization, pattern recognition, geographical information systems, statistics and other fields. The experiment tries to determine whether a parallel Convex Hull algorithm running on the nVidia Tesla GPU can achieve better runtime performance than a conventional CPU implementation. It is known that this problem cannot be solved faster than sorting, and has a computational complexity of $O(n \log n)$ in the general case. Parallel solutions to the problem have a higher level of complexity, but make up for it by utilizing multiple processing cores simultaneously. Runtimes are compared for different-sized inputs to see if this new technology is more suitable for solving this problem.

41.

THE TREE HEIGHT CALCULATOR

Xu Huang '14, Vlad Burca '14, Nyi M. Htet '13

Faculty Sponsors: Trishan de Lanerolle, Jonathan Gourley, Ralph Morelli

Conventionally, measuring tree height is demanding and time-consuming. Different tools are required for measurements and time is wasted in manually storing calculating results. In this paper we present the Tree Height Calculator app developed for Android-based phones. This application is designed to determine the height of the trees by using inclinations calculated with the phone's built-in sensors, by saving data in the phone's memory and by syncing data with an online database. It can also be used to retrieve data from an online database and rearrange them into spreadsheets that can be easily managed for future use. The application was first tested in an Environmental Science laboratory at Trinity. On the first trial, 103 data samples were collected, stored, and uploaded to the online database with a couple of dropped data points. On the second trial, 98 data samples were gathered with no loss of data. In the near future, the Tree Height Calculator will be launched onto the Android market as a free app to serve both academic and educational purposes.

ENGINEERING

42.

OPTIMIZATION OF BRIDGE DESIGN DURING SIDE IMPACT LOADING

Jack Burkhardt '11, Luke MacDougall '11, Ryan Moriarty '11

Faculty Sponsor: John Mertens

The goal of our project was to determine what bridge design could best withstand the impact of a ship collision in the span of the bridge (side impact loading). After researching the structural characteristics of numerous bridge designs, we chose to focus on truss bridges due to their simplicity and structural integrity. After researching the various types of truss bridges, we decided to concentrate on three types: the Howe truss, the Pratt truss, and the Warren truss. These designs are very similar and often the most frequently used. To implement our study, we chose to test our models in a physical setting as well as in computer simulation. For our physical models, we built model trusses out of basswood and used a pendulum to test the trusses ability to withstand side impact loading. The strength of the truss design was determined using the law of conservation of energy. COMSOL Multiphysics was used to test our trusses in a computer simulation. COMSOL Multiphysics is a finite element analysis software that allowed us to perform stress-strain analysis on our model trusses. In order to do this, our three truss designs were first constructed in COMSOL Multiphysics. After constructing our trusses, various time-dependent forces were applied to the trusses and the distribution of the stresses in the trusses were analyzed. When the physical analysis and computer simulation were completed, the results were compared to determine which truss design best withstands side impact loading.

43.

HYDROGEN EXPLOSION LIMITS IN A SLOW COMPRESSION CHAMBER

Orhan Gazelle '11, Jason Wagner '11, Ben Wheatley '11

Faculty Sponsor: John Mertens

While much of the auto-ignition limits of hydrogen gas have been mapped, there remains large uncertainties at higher pressure limits (~30 atm). A slow compression machine allows for measured pressurization and temperature readings to explore this auto-ignition limit. Using finite element analysis software for thermal and structural investigation a steel chamber and piston system was designed. Electrically powered cartridge heaters and a mass lowering system will allow for over 900 Kelvin temperatures and over 30 atmospheres of pressure within the ignition chamber. Structural support design and computational analysis for pressurization and premature ignition calculations were used to ensure safe operation.

44.

THE SWARM PROJECT

Osama Mahmood Khan '14

Faculty Sponsor: David J. Ahlgren

The development of independent activity platforms has reduced human interaction in a number of adverse tasks. The Trinity Firefighting Robot Contest is a step towards encouraging such modern indigenous designs. The Swarm project was aimed at the construction of a robotic design, which could efficiently extinguish multiple flames while intelligently navigating through a complex maze. As the swarm team was competing in the expert division, it had the option of fielding more than one robot in the maze. This introduced the concept of multiple information sharing, activity platforms which could operate towards carrying out the defined task. Therefore, the construction of the first prototype started, with the process being divided into three set divisions, namely, hardware assembly, processor programming and network protocol. The chassis for the platform was constructed out of webbed steel, which was then installed with PING ultrasonic sensors for distance detection. A Hamamatsu heat sensor was used assisted by four infrared sensors, enabling the robot to home on the flame. The extinguishing mechanism consisted of a water reservoir, with a pump and an atomizer to convert liquid into spray. The programming was completed for the Arduino Duemilanove processor, in order to ensure adequate flow of command data. The network protocol was then accomplished, which enabled the information sharing between the two platforms. However, once the testing was completed, it was observed, the usage of the second platform congested the space and hence slowed the extinguishing process. Therefore, Swarm team competed with a single robot, which was able to navigate and extinguish the fire successfully. It won the best robot in Connecticut award for its design, and hence with further modifications would perform with two sister robots in the next contest.

45.

DESIGN AND CONSTRUCTION OF A MAGNETIC LEVITATION TRAIN

Sarthak Khanal '11, Stevon Judd '11, Gerald Antoine '11, Simon Lin '11, Chris Landis '11

Faculty Sponsor: Taikang Ning

In today's world where travel is one of the most integral parts of society, new and improved methods of commute are needed. This new means of transportation should not only be faster and more economical but also should cause minimal impact on the eco-system. The current state of public transport does not meet this vision. Bus and conventional trains are too slow and most of them are extremely fuel-hungry and impact the environment adversely. Airplanes offer a fast and easy way to travel, but they are too expensive and are only feasible for long distance/overseas travel. One of the new and upcoming ways to travel that may overcome this problem is the Magnetic Levitation Train (Maglev). We propose a small prototype design of such a train. Our train is a 20cm X 18 cm rectangle made of balsa wood and the track is 25cm X 43cm rectangle, with 25 cm high walls, made of bass wood. Electromagnets mounted on the bottom of the track provide the magnetic flux to lift the train by repelling disc shaped permanent magnets on the underside of the train. Similarly, permanent magnets mounted on the side of the track are used to pull electromagnets on the side of the train for propulsion. A sensor is used to measure the distance between the track and the train at all times and a feedback control system is used to bring the train to equilibrium levitation.

46.

AUTONOMOUS WATERCRAFT

Jaynie Murrell '11, Tom Charley '11

Faculty Sponsors: Emilie Dressaire, David J. Ahlgren, Lin Cheng

A considerable body of work has shown that environmental reservoirs such as lakes and dams collect and thus concentrate biological pathogens and chemicals. Detecting pathogens and chemicals to monitor water quality requires the collection of water samples for laboratory analysis. The project undertaken consists of designing and building a watercraft that can autonomously navigate around a lake and visit a series of predetermined locations, defined by their GPS coordinate points. The watercraft is designed to accommodate a custom built water sampling system (beyond the scope of this project).

The watercraft designed is a catamaran-style boat (4' x 3'6") that allows level sailing and greater stability. The boat is steered by two independently powered paddlewheels to improve its maneuverability. This allows for the boat to not make wide turns and eliminates the need for a rudder. The watercraft is equipped with a navigation system composed of a GPS chip module and digital compass chip module to get latitude/longitude coordinates of current and target locations. The navigation system transmits information to an Arduino microcontroller board that calculates the distance between locations, determines the angle to the desired bearings, and controls the DC motors.

47.

MODULAR UNIFORM FLOW FEED SYSTEM FOR THE APPLICATION OF CONDUCTIVE COATING

Christopher Palatucci '11, Clayton R. St. Dennis '11

Faculty Sponsors: John Mertens, Harry Blaise, FLEXcon Company

FLEXcon is an international company specializing in roll-to-roll pressure-sensitive thin films processing located in Spencer, MA. In recent years, a new division called Flexible Electronics was established, through which the company is developing a clear conductive film product. The film must be unwound at one end of the coating machine, have the coating applied through a feed system, then go through an oven where it will be baked, and then rewound on the other side of the oven. Much of the process has been perfected, but the company is in need of a precise feed system. The entire system will need to be completely automated with minimal user inputs. A programmable logic controller (PLC) will control the various components of the system.

The feed system must apply the conductive coating to the film at a fixed constant rate due to the highly sensitive coating process. If the flow rate from the feed system is altered during production, even for a short period of time, it will be detrimentally reflected in the finished product. To fix this issue, there must be a feedback system that measures the rate at which the coating is being applied and adjusts the flow from the feed system accordingly. The feed system must store enough coating to last an entire production run, and cannot allow any foreign particulate matter onto the product. Since the coating is acidic, every part of the system that will come in contact with the acid must be able to withstand it. There can be no safety risks due to the acidic coating associated with the feed system. Also, since the system will be a closed pressurized container, it must be evaluated and verified for being explosion proof.

48.

DESIGN OF AN AUTOMATED TORSION TESTING FIXTURE

John Poletto '11, John Montalvo '11, Kristopher Reichlen '11

Faculty Sponsors: Joseph Palladino, Emily Gumkowski, Covidien Medical

When designing a product for mass production, it is often necessary to perform failure analysis on various components of a complex system. These calculations require the knowledge of various material properties, such as its elastic or rigid modulus. While information regarding commonly used metals and composites is readily available, certain materials are not well documented. In order to select the proper material for a design, it is necessary to collect this information by rigorous material testing.

The purpose of this project was to design a testing apparatus to be used in a research lab at Covidien Medical Corporation. The apparatus will be used to test the material properties and failure modes of metal cables that will be used in surgical devices. The principal application of the device is to test these cables in torsion (twisting one end of a cable while the other is held fixed). The device needs to be versatile: it can accept samples of different diameters and lengths, as well as test the samples under user specified conditions. For instance: A 1/8" diameter, 20" long cable sample loaded from -30 to +30 oz-in of torque, for 50 cycles.

The fixture is comprised of three main components: Torque application, feedback, and information processing. The torque is applied to a sample mounted between two chucks with an electrical motor on one end, while feedback is acquired with a load cell (a type of force-

measuring device) on the other. Different cables, each of varying lengths, are accommodated using a sliding carriage on a track to which the load cell is fixed. This carriage can be locked in place or a load—either tensile or compressive— can be applied with the use of a spring gauge. Information processing is handled by a computer running LabVIEW software. The software takes user input to control the electrical motor, while using feedback from the load cell. The software also records information and provides a test summary to the user.

With the fixture we have designed and constructed utilizing these components, Covidien Medical will be able to successfully analyze various material properties of metal cables and wires of various lengths in multiple modes of material testing, allowing for the proper selection of materials for use in their surgical devices.

This project is sponsored by Covidien Medical, and is the work of three senior mechanical engineering majors: Kris Reichlen, John H. Montalvo, and John Poletto. The project's faculty advisor is Professor Joseph Palladino, Ph.D and its Covidien advisor is Emily Gumkowski.

49.

MECHANICAL SPINE JIG

Matthew Quigley '11

Faculty Sponsor: John Mertens, Allegheny General Hospital

Over the past 50 years spinal fusion has become the standard of care when treating back pain. The long-term viability of this procedure has become an issue due to these procedures being performed in younger patients. Adjacent level disease is believed to be a consequence of spinal fusion surgeries. The mechanical spine jig is a three-degree of freedom static testing device for spine cadavers. The three-degrees of freedom refer to lateral bending, flexion and extension, and translation along the compression axis. The jig is designed to be “load-control” because all axes will be loaded to a specific torque to simulate the maximum loading conditions a person would experience during everyday life. As the cadaver is loaded within the jig, the spine will then be imaged in a MRI and CT scan. The MRI scan will allow for the study of articular cartilage and surrounding tissue during these maximum load conditions. CT scan will allow for virtual study of the kinematics during these loading conditions by providing three-dimensional representations to be constructed. High-density polyethelene was used in the construction of the jig as it is non-magnetic which is compatible with MRI scan. The images received from scans during maximum loading conditions will be analyzed to help verify the effect of adjacent level disease from spinal fusions. These images will also aid in determining the need for dynamic spine stabilization systems, which are the most recent technique of treating back pain.

50.

WIRELESS UNDERWATER COMMUNICATION ANALYSIS

Erica Salk '11

Faculty Sponsor: Lin Cheng

Modern underwater communication systems that exchange information efficiently as well as wirelessly employ physical waves as information carriers. These physical waves include sound waves, radio waves, and light waves. After a thorough investigation of the benefits and drawbacks of all three types of physical waves, sound waves were selected for an in depth analysis due to their low signal attenuation as compared with radio and optical waves. Components of the analysis for the acoustic waves include the total attenuation of the signal, ambient noise, signal-to-noise ratio, transmit and receive power settings, multipath properties, propagation delay, and the power delay profile. The analysis was implemented in MATLAB, and the theoretical aspect of the project can provide recommendations for a future project involving the detection of nitrates in Connecticut reservoirs.

51.

PICO

Bicky Shakya '14, Rahul Ratna Shakya '11, Shraddha Basnyat '13

Faculty Sponsor: David J. Ahlgren

Robotics is an expansive field which is pushing the boundaries of technology and innovation in today's world. Here, at Trinity's annual 'Trinity College Fire-Fighting Home Robot Contest', robotics enthusiasts from around the globe come together to showcase their robots which model a fire-fighter and put out a candle placed in a maze. For this year's competition, the Trinity Robotics Team developed 'Pico', a robot that was built to be miniature in design. The robot was built around the Picoduoino board, a minimalistic board with the Atmel 328p processor at its heart. The robot featured two front wheels, which were driven using DC motors, and a rear caster for support. The robot included distance-ranging Sharp infrared sensors (for detecting obstacles), a stripe sensor (combination of a light and infrared sensors) for detecting color patterns in the maze, and a flame sensor for detecting the candle. The robot was powered by a 9V and a 1.5V battery. The final robot had a footprint of just 8cm * 8cm and had a cost of \$120. The actual performance of the robot during the competition however, was not as successful as expected. The ranging sensors gave erroneous data due to deteriorating battery health and consequently, the robot was only able to navigate half the maze. But this robot, although not successful, has served as a good example of intuitive and economical design. Further developments are now pending to improve its performance in subsequent years.

52.

DESIGN AND IMPLEMENTATION OF A RAT EYELID MOVEMENT DETECTOR

Rahul Ratna Shakya '11

Faculty Sponsor: David J. Ahlgren

Facial nerve injury often results in a condition called facial synkinesis, the involuntary movement of facial muscle accompanying a voluntary movement. To get a better understanding, researchers at Massachusetts Eye and Ear Infirmary have developed a model to study the onset of facial synkinesis in rats. This study involves the simultaneous monitoring of eyelid and whisker movement. However, the current optoelectronic method for eyelid movement detection used in this study is unable to give accurate eyelid movement data for passive eyelid movement. The new system presented here, provides a solution to accurately detect eyelid movement. The system uses a linear CMOS image sensor to capture a vertical line scan of the rat's eye at 200Hz. Using a user set threshold level, the system is able to discriminate between the rat's eye and eyelid to provide eyelid movement data. A VGA display provides real-time feedback for sensor and threshold adjustment.

53.

DESIGN OF A ROBOTIC THROWING ARM USING EMG SIGNAL INPUT

Andrew Zoller '11, Ben Rosenblum '11

Faculty Sponsor: Taikang Ning

As the field of prosthetics is becoming more advanced with human-robot interfacing, the ability to improve the functionality of such prosthetic devices is becoming more promising. Previous studies have attempted to use electromyographic (EMG) signals from the patient to control prosthetic arms but have not yet been able to coordinate their motion beyond day-to-day functions. In this paper, we controlled a robotic arm using EMG signals from the user's arm in real time in order to have the robotic arm throw a lightweight ball ten feet forward. The arm was constructed entirely out of aluminum with a hand mimicking the classic shape of a jai alai throwing stick. We used a signal acquisition program in LabView in order to acquire, amplify and filter the EMG signal coming from both the bicep and triceps muscles of the user. The absolute value (RMS) of the amplitude of the signal was used to control three DC servo motors on our robotic arm. We implemented four motor activation thresholds for speed control based upon the RMS value of the EMG signal generated by the arm. The accuracy of the robotic arm was assessed by performing a simple toss at a designated target ten feet in front of the arm. Our study proved that it is possible to utilize EMG signals for the control of a ball-throwing prosthetic arm in real time.

ENVIRONMENTAL SCIENCE

54.

DESALINATION IN THE WATER CYCLE: CAN THE PURIFICATION OF OCEAN WATER MEET HUMAN WATER NECESSITY AND BRING BETTER STABILITY IN THE HYDROLOGICAL SYSTEM?

S.L. Saam Aiken '13

Faculty Sponsor: Jonathan Gourley

Of all the water the covers the planet, only 2.5% of it is freshwater and less than 1% of it is accessible for direct human usage. This means that of the total 6.9 billion people on Earth today, we have access to only 0.007% of its water from lakes, rivers, reservoirs, and aquifers, which are renewed by rain and snowfall. With today's hydration rate, daily diet, and activeness, the average human requires 2 to 4.5 liters of water per day in order to survive. However, water use today also includes principal demands such as irrigation (70%), industrial (20%), and household and municipal (10%) water use. Considering the human population today and its expected growth rate in years to come, many questions and concerns have risen in societies around the world as to how such little access to water will be able to sustain them because as long as the human population continues to rise, so too will the demand for freshwater. Looking at how nations use water today, it is very clear that the world's current extraction rate of water is much greater than the hydrological system's ability to replenish itself and maintain a consistent and stable distribution. In terms of the water cycle, such disequilibrium has resulted in cases such as depletion in groundwater and over flooding of surface water.

In today's advancement in water purification, a new method in water supply is slowly unfolding that would allow society to finally have access to the other 97% of the planet's water. The process, known as desalination, produces drinking water by removing dissolved salts and other impurities from seawater or brackish water. Using models and graphs from STELLA, a replica of the hydrological cycle will be constructed along with society's global extraction rates. By adding desalination to our global extraction method, it may be possible to find a suitable extraction rate from the surface water, groundwater, and ocean that would allow society to maintain its current water necessity and at the same time reduce its impact on the hydrological system so that its sustainability will last longer.

In order to insure that this new method could work, the economic and environmental cost of desalination over time must also be considered. Like the purification of surface and ground water, desalination requires an extensive amount of energy, which would most likely be determined by the use of fossil fuels. Observing the emission rate and economic cost of desalination, it is important to determine whether or not this kind of purification is reasonable and realistic to adopt into our methods of water supply for humanity.

55.

ANALYZING RED-TAILED HAWK MIGRATION PATTERNS ON THE EAST COAST

Jason Baird '14

Faculty Sponsor: Joan Morrison

Migration studies are essential in determining which areas support threatened species and must be protected. The red-tailed hawk is one of the most common hawks in the United States, yet its migration patterns have not been analyzed. Researchers in the US and across the world place numbered metal bands around birds' legs, noting critical information about the birds such as location, age, and date. The United States Geological Survey keeps records of birds that are banded in the US and of the recoveries of those birds, which usually happen after their death. In this study, data of all red-tailed hawks banded on the East Coast and recovery data of those same birds were obtained. Relationships between hawk age and distance travelled, between season and latitudinal movement, and average direction of travel were analyzed. Adult hawks tend to move shorter distances, and in a large number of cases stayed in the same area. In general, the hawks were recovered in colder seasons than they were banded, but this was far more true for hawks that travelled south between banding and recovery, loosely implying that hawks move south as the season gets colder. Likewise, hawks that were banded in the summer and recovered the following winter had a strong tendency to move south. Some hawks seem to migrate seasonally, while others do not. Along with information from radio-tagged hawks, this data helps to confirm the current general theory of red-tailed hawk migration, but to determine more detailed patterns, larger data sets are needed, along with more time to analyze them.

56.

POPULATION MODEL

Nour Bahgat '12

Faculty Sponsor: Jonathan Gourley

Population dynamics play a significant role in determining some environmental phenomena. Studying the interactions between the factors of the birth and death rates could be very helpful in understanding current environmental problems. This could also provide us with some predictions for changes that could take place in the environmental surrounding in the future. Population changes affect the availability of resources on Earth. As a result, these changes shape the economic status and the developmental process of any society. Through STELLA modeling, we can observe the interactions between population dynamics using a clear scale. In my model, I take a close look at birth and death rates and how they are affected by pollution, food resources availability, and potential land yield. Changes occurring in any factor explain the resulting effect of the population growth. If we give more attention to the root cause of the problems that our environment faces today, we can save it from some major problems that are threatening the Earth and the life expectancy age of humans on Earth. This attention could be best directed to population dynamics, and for this reason, the study of human population is indeed related to Earth sciences.

57.

THE OCEAN-ATMOSPHERE CARBON CYCLE'S IMPACT ON CORAL REEFS

Penelope Carpenter '12

Faculty Sponsors: Jonathan Gourley, Christoph Geiss

Despite the public being flooded with research on harmful anthropogenic carbon emissions, few people are able to look past its effect on the atmosphere and notice the impact on our oceans. The ocean is absorbing all of the added carbon that is put into our atmosphere, and in response, it alters the entire ocean carbon cycle. In order to show a real life example, the model focuses on coral reefs and other marine biota. By using a STELLA model, a combination of the ocean and atmosphere carbon cycle can show how marine biota can be directly influenced by anthropogenic carbon emissions. With real world percentages of carbon in each reservoir, the model is able to show how specific components of ocean life will be altered. An increase in the amount of carbon in the warm surface ocean will cause ocean acidification, therefore harming coral reefs, which leads to habitat destruction and loss of biodiversity. Because carbon circulates through the ocean and then back into the atmosphere, it is extremely important for humans to think about all sorts of pollution, erosion, mining, and coastal development. All the carbon is recycled and reused through the biosphere, meaning that any extra production will become a permanent addition to this cycle.

58.

SIMULTANEOUS ALBEDO AND CARBON EFFECTS ON THE DAISYWORLD MODEL

Daniel Chow '13

Faculty Sponsor: Jonathan Gourley

Despite the numerous models used to analyze the Earth's carbon cycle and albedo, little is known about the correlation between albedo and carbon. Individually, carbon can easily be analyzed by perturbing Dave Bice's carbon cycle model, and albedo can be analyzed using his Daisyworld model. The objective of this research project is to examine the carbon cycle model under daisy world conditions using the modeling program, STELLA. The model assumes "biota" only consists of black and white daisies. This condition allows us to observe the effects of carbon changing the planetary albedo through daisy growth as well as daisy growth's effect on the carbon cycle simultaneously. In addition, global temperature is affected by two feedback loops: one caused by the greenhouse effect, and the other by the albedo effect which helps explain under what conditions does the greenhouse effect or albedo effect take precedence in affecting global climate temperatures.

59.

PARK RIVER WATERSHED MODEL

Amy Duggan '12

Faculty Sponsor: Jonathan Gourley

The Park River once flowed naturally through the middle of Hartford but the area became more urbanized and the threat of flooding increased and in the 1940's the river was channelized in many areas and diverted into underground tunnels in others. The Park River has suffered from a lot of anthropogenic manipulation including the paving of much of the watershed and the overflow from sewers and sewage that end up in the river. Understanding how these changes influence how the river flows during rain events is important for understanding flash floods that could potentially occur in the highly populated urban areas the river flows through. In order to understand the system a generic watershed model was constructed using the STELLA program and information provided by the Pennsylvania State University Department of Geosciences. This watershed model was then modified to reflect the geology and hydrology of the Park River Watershed.

60.

THE TRINITY COLLEGE SEISMOGRAPH STATION

Daniel Echavarria '12

Faculty Sponsor: Jonathan Gourley

On November the 10th 2009 the Trinity College Environmental Science department installed an EQ-1 seismometer on the first floor of the McCook building. This instrument measures the vertical ground motion in the form of seismic waves that are generated by earthquakes around the World. Since it was installed it has recorded 35 earthquakes including the recent earthquake in Japan on March 2011. In addition, the seismograph was used to compare the building vibrations with the changes in wind speed. During a storm event on January 11th 2011, the amplitude of the waves generated by the building vibrations increased with faster winds, suggesting a correlation between wave amplitude and wind speed.

61.

THE FATE OF DDT IN THE ENVIRONMENT

Madeleine Hardy '12

Faculty Sponsor: Jonathan Gourley

DDT is an insecticide that began its widespread use in the 1940's to protect crops and fight against insect transmitted diseases such as malaria. This highly fat soluble chlorinated hydrocarbon however has harmful effects on other life such as fish and birds via bioaccumulation. This model, designed using the computer software STELLA, simulates the flow of DDT and its ultimate accumulation in fish. The model monitors the flow of DDT from the reservoirs of soil, ocean, rivers, and fish and studies the effect of varying DDT concentrations in the environment.

62.

EXAMINATION OF TOXICOLOGICAL EFFECTS OF TERBUTALINE ON DAPHNIA MAGNA

Airelle A. James '14

Faculty Sponsor: Alison J. Draper

Increasing prescriptions of pharmaceutical drugs and lack of official regulatory limits regarding their existence in the environment have contributed to the continual influx of pharmaceutical drugs in the environment. Newer prescribed drugs are designed for once-a-day dosing to improve compliance, and this has had the unintended consequence of escaping wastewater treatment systems which results in the release of biologically-active pharmaceutical drugs in surface water. In order to analyze the toxicological effects of pharmaceutical drugs in aquatic environments, the toxicity of the drug terbutaline on the organism *Daphnia magna* was examined. The toxicity experiments using terbutaline and *Daphnia magna* were performed according to Standard Methods. Groups of ten neophyte daphnia were placed in hard water and exposed to five different concentrations of terbutaline. After 48 hours, the surviving daphnia for each exposure were counted and an average LC50 value for terbutaline was calculated. Further work will explore the effects of terbutaline on the toxicity of metoprolol, propranolol, and metformin and may indicate one pharmaceutical drug's ability to reduce or enhance the toxicity of another drug.

63.

GLOBAL METHANE CYCLE

Tomas Kavanagh '11

Faculty Sponsor: Jonathan Gourley

Methane is the most abundant organic species in the earth's atmosphere. It is chemically reactive and influences the amount of ozone in upper segments of our atmosphere. It is also a relatively short-lived greenhouse gas that causes many short-term greenhouse problems. My study will examine the various stores of methane contributing to the global methane cycle. In order to track methane's journey, I will use STELLA Modelling Systems to map global methane (CH₄) sources and sinks. The model will illustrate methane's path throughout the atmosphere and will project the possible path methane would take should current quantities and trends persist.

64.

THE FATE OF THE HUMAN POPULATION

Daniel Lofrese '13

Faculty Sponsor: Jonathan Gourley

Questions concerning the fate of the Human Population have been being asked for years. What is going to happen to our race? The population of planet Earth has been increasing at a rapid rate. In 1804, the global population reached one billion, in 1927, some 123 years later, it passed two billion, and now, the global population is almost seven billion people. How much more can our planet handle? It cannot continue to grow like this without consequences. At one point or another, our planet will not be able to sustain such an exponential growth and the human race

could face more than just a problem but a drastic decrease in number. It is unknown what the carrying capacity, or the maximum population size of a species that the environment can sustain indefinitely, given the food, habitat water and other necessities available in the environment, for the human race is. Researchers have used different methods such as logistic equations to predict the future maximum of the human population; others generalize from existing “maximum” population density and multiply this by the area of land that could be inhabited. What it comes down to is us, if humans do not communicate the nature of the problem of population growth and do not work together to think of ways to solve this crucial problem, the human race will most likely overshoot our carrying capacity and a catastrophic population collapse is likely to follow. In order to grasp this concept I experimented with STELLA modeling, which is a flexible computer modeling package with that allows users to construct dynamic models that realistically simulate biological systems. One of the most obvious potential limitations to the growth of the world population is the global reservoir of soil, since it is essential to the production of food. There is a finite amount of arable (farmable) land on Earth, and given a typical productivity level, each person needs something like 0.5 hectares (one hectare is 104 m² or 2.4 acres) to have a diverse, healthy diet, assuming average yields from the land. Using STELLA I modeled Population, Soil, and the Food System, I focused on Soil because it is one of the main controls on how much food can be produced. I created models such as the reduction of waste, increases in technology, and fluctuations in soil erosion and observed the affects all had on things such as population, life expectancy, and soil.

65.

GROUND PENETRATING RADAR

David Mallick '14, Jess Smith '14

Faculty Sponsor: Christoph Geiss

Ground penetrating radar (GPR) can be used to analyze subsurface geography using electromagnetic pulses that traverse the ground. It is used mainly to measure the structural soundness of materials in the ground for use by industries in placing heavy machinery. It is also used to find buried objects, such as unmarked graves in cemeteries. The two methods used with GPR were reflection and common midpoint (CMP). Reflection was used to identify subsurface materials by surveying long spans of ground, most commonly with a sled, while CMP was used to determine the exact velocity of the radar waves through a certain portion of the ground. The data collected by the GPR using these methods were analyzed using a program called ReflexW version 5.6 from Sandmeier Scientific Software. Through the use of these methods, a better understanding of the workings of GPR was acquired to better the research team in future projects. Manipulations of the ReflexW program were also used to better understand the uses and the abilities of the GPR data. By surveying the graveyard and the LSC snow-covered quad, the research team was able to gain an understanding of the quality of data in different weather conditions and manipulating data to form a 3D interpretation. The research that has been conducted this semester will help with future studies using the GPR

66.

WATER'S ROLE IN THE ROCK CYCLE

DL McDonald '13

Faculty Sponsors: Jonathan Gourley, Christoph Geiss

The understanding of the rock cycle is well known by geologists, but when the public learns about the rock cycle, few realize how much of an impact water has. Non-geologists probably ask how it is that such a thing like water can impact rocks. By implementing a STELLA model of the rock cycle people can easily realize how such an occurrence is possible. By adding the existence of water as a reservoir to the model, it will be possible to compare how much of an impact water actually has on the rock cycle. Some of the most obvious water driven processes are weathering and erosion. Another intriguing effect by water in the form of precipitation, acidic soil, and groundwater is dissolving minerals and rocks, particularly those that are unstable. Running water also carries sediments in rivers to oceans allowing them to amass and form back into rock. David Bice successfully includes the major impacts on the rock cycle, but if all the various effects of water are taken into account, the rock cycle could be greatly altered. Such as, if the flow of rivers were decreased, less sediment would be transported, and the formation of rock from it would be effected. Without water, the rock cycle could not exist and that is why it is important for the general population to know that this is the case.

67.

ANTROPOGENIC EFFECTS ON THE NITROGEN CYCLE

Renee Murray '12

Faculty Sponsor: Jonathan Gourley

Nitrogen is essential for life because it is a component of DNA, RNA, and proteins. The earth's atmosphere is comprised of 78% nitrogen gas. The nitrogen (N_2) in the atmosphere is stable and because of this it must be converted into a useable form. The nitrogen cycle describes the processes through which nitrogen moves through the atmosphere, biosphere, and geosphere. Nitrogen fixation occurs when N_2 is converted to ammonium (NH_4) mostly through nitrogen fixing bacteria. Nitrogen uptake is when NH_4 is absorbed into proteins and other organic nitrogen compounds (i.e. DNA and RNA). Nitrogen mineralization occurs when the organic nitrogen compounds convert into inorganic nitrogen using during the decomposition of organic matter. Nitrification occurs when NH_4 is converted into nitrate (NO_3). Denitrification happens when NO_3 and nitrite (NO_2) are converted to dinitrogen (N_2). Through the burning of fossil fuels and the use of fertilizers have increased the amount of nitrogen. Humans adding more nitrogen to the system than the system can process leading to environmental problems such as soil acidification, smog (air pollution), and the contamination of ground and surface water. I will use Stella, a modeling software to show various aspects of the nitrogen cycle and how those aspects will affect the cycle and the environment as a whole.

68.

MODELING THE TROUT BROOK SUB-BASIN OF THE PARK RIVER WATERSHED

Kate H. Pool '12

Faculty Sponsor: Jonathan Gourley

The Southern part of the Park River Watershed, which includes the city of Hartford, has undergone many changes as urban development has spread. The Park River has been redirected into man-made channels underneath Hartford, eventually draining into the Connecticut River, which has already dramatically changed the watershed. As the watershed becomes more developed, natural areas that buffer non-point sources of pollution disappear and the river and watershed become overly polluted. Using the modeling program STELLA, the Trout Brook sub-basin of the Park River Watershed is modeled using data that has been collected in the field as well as information from Geographic Information System (GIS). Modeling the sub-basins of the Park River Watershed can ultimately aid in the creation of a comprehensive management plan that improves the health of the watershed. This plan includes river restoration, infrastructure improvement, a shift to low impact development, better land use decisions, and education of the public that raises awareness of this valuable watershed.

69.

FLORIDA PANTHER POPULATION AS MODELED BY STELLA

Kelsey Semrod '12

Faculty Sponsor: Jonathan Gourley

The Florida Panther, *Puma concolor coryi*, has been on the endangered species list since the 1950's. While the species used to occupy much of the south western United States, it now only occupies a small section of south western Florida. Its population reached as low as 20, but now with further protective measures, it has reached approximately 165 as of 2010. The panther population decline can be attributed to anthropogenic means such as increased infrastructure (roads), deforestation, and road kills as well as disease and natural causes. Using population models through the STELLA program, the Panther population is modeled from the 1950's to today by integrating various factors introduced above. In addition, the population will be mapped from today to the future if the same conditions continue over the next few decades.

70.

STELLA MODELING ANALYSIS: HYDROLOGY OF NORTH BRANCH PARK RIVER WATERSHED, HARTFORD

Shuyang Zhu '13

Faculty Sponsor: Jonathan Gourley

The Park River Watershed (77.2 square miles) travels underneath Hartford into the Connecticut River. The North Branch Watershed (28 square miles) approximately accounts for 40% of the entire watershed. Its land is highly urbanized at its confluence with the South Branch Park River while it is undeveloped in portions of its headwater regions. In light of the watershed water flow model established by Professor Bice from Penn State University, this project employed STELLA modeling techniques and modeled the influences, including severity of rainstorms and variations of land covers, on the North Branch Park River Watershed. The reservoirs included in the model are surface water, rivers, soil water and ground water; precipitation, runoff, stream flow, infiltration, percolation and discharge are the primary flows. Two rainstorms in the summer and fall of 2010 are specifically studied. In addition, because it is predicted that the North Branch Watershed will be fully developed in the future, indicating that the soil layer will be more impermeable due to less vegetation coverage, the project looks into with the same amount of rainstorms how the surface water and the river level etc., differ from the undeveloped condition. Currently, for lack of accurate measurements, like the average width of the water channels and the average water discharge, most of the data are roughly but reasonably estimated. In the future,

this project will be studied even further and the model will be revised accordingly in order to make it fit better with reality.

HEALTH FELLOWS

71.

POLYETHYLENE GLYCOL 3350 WITHOUT ELECTROLYTES: A SAFE, EFFECTIVE, WELL TOLERATED ONE DAY BOWEL PREPARATION FOR COLONOSCOPY IN CHILDREN

Christopher M. Gromisch '11

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

Colonoscopy is a procedure which allows physicians to visualize the intestinal mucosa from the terminal ileum to the anal margin. Proper detection of mucosal lesions and treatment (polyp removal, cauterization of bleeding lesions, mucosal resections) requires adequate visualization of the intestinal mucosa. To improve visualization, patients receive a bowel lavage preparation, which helps remove fecal matter from the colon. However, between 20%-30% of inadequate bowel cleansings lead to incomplete colonoscopies. 1,2 Inadequate bowel cleansing can result from an ineffective preparation method, poor patient tolerance, or poor patient compliance. In order to improve colonoscopy completion and quality, it is necessary to implement a bowel preparation which is effective, tolerable, and safe.

Since the publication of a four-day PEG bowel preparation³, Connecticut Children's Medical Center has adopted a one-day PEG preparation as part of its standard of care. While anecdotal evidence suggests this bowel preparation has been successful, there has been no thorough evaluation. This study was conducted to evaluate the efficacy, tolerability, and safety of this bowel preparation on pediatric patients. An evaluation of physician and nurse evaluations indicates that when followed, this preparation allows for adequate visualization of the intestinal mucosa and completion of the procedure. Further, the patient/ parent questionnaire has indicated that this preparation is tolerable in pediatric patients.

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72.

PEDIATRIC HOSPITALIZATIONS DURING THE 2009 H1N1 INFLUENZA PANDEMIC

Gerald Hansen '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Catherine Wiley MD, Department of Primary Care, Connecticut Children's Medical Center

Objective: In 2009 the H1N1 influenza strain had a vast impact worldwide, resulting in many complications. This H1N1 virus strain is expected to remain circulating in future influenza seasons. The objective of this study is to obtain descriptive clinical data, which can be used for public health planning for future H1N1 pandemics. **Methods:** This retrospective study reviewed the electronic medical records of children hospitalized at the Connecticut Children's Medical Center. Case subjects were identified by positive RT-PCR for H1N1 influenza. The inclusion criteria included children between the ages 6 months and 17 years who were hospitalized for a respiratory illness after November 1, 2009. A clinical severity score, based on reported symptoms and clinical information, was used to assess the illness of each case subject. This severity score was modified on a scale out of 16 possible points, where a subject was evaluated as mild (0-3), moderate (4-6) or severe (7-16). **Results:** A total of 38 cases subjects were examined. The overall age distribution of the subjects was skewed towards children over five (63%). There was no significant association between severity score and age of onset. The mean degree of severity (9.6) was higher for previously health children, but the proportion of children with underlying medical conditions hospitalized was greater (68%). There were a high number of hospitalized children with gastrointestinal distress; 63 percent of all cases subjects had reported vomiting. **Conclusion:** For children with underlying conditions the greater number may reflect a low threshold for hospitalization. The age distribution was skewed towards older children, which is unusual for a typical seasonal influenza where the age distribution is normally curved towards children under two years of age.

73.

PATIENT'S ADHERENCE TO INHALED CORTICOSTEROID THERAPY – HOW WELL CAN YOU TELL?

Gabe Hayek '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Anita Bhandari, M.D., Craig Schramm, M.D., Division of Pediatric Pulmonology, Connecticut Children's Medical Center

Current literature suggests that patients are adherent to inhaled corticosteroid (ICS) therapy for asthma control only 40 – 60% of the time. The vast majority of these studies have used self-reporting as the only means to measure patient adherence. Current literature has also demonstrated that patients living with a low socioeconomic status, similar to the environment of Hartford, are even less likely to adhere to their ICS therapy, even with the fact that these patients are at a higher risk to develop asthma symptoms and acute exacerbations. Although most physicians have a sense if their patients are compliant with prescribed therapies, studies have shown that obtaining a refill history from pharmacies is more reliable than the ability of the physician to recognize a poorly compliant patient.

The goal of this study was to identify how well physicians are able to identify noncompliance to ICS therapy, as well as to identify characteristics common to patients that may help physicians identify noncompliance. In order to do this, data was extracted from the charts of all patients who qualified for the study upon undergoing an asthma follow-up appointment. At these follow-up appointments, a pulmonary function test (PFT) was obtained along with a pharmacy phone number. The pharmacy was then called to obtain a refill history. ICS refills were used as a surrogate to the patient actually taking the medication as prescribed.

The results showed that there were no characteristics that correlate to nonadherence to ICS therapy. These characteristics include: gender, age, ethnicity, BMI, maternal age, type of insurance, severity of disease, number of outpatient visits in the last 12 months, number of emergency department visits in the past 12 months, total ICS dose prescribed, dosing schedule, and if the patient uses a nebulizer. It was also found that obtaining a complete refill history from the pharmacy is unreliable, as useable information was obtained for only 130 of 200 patients (65%). Lastly, it was found that physicians were correct 100% of the time (58/58), when they thought a patient was nonadherent. However, physicians were correct only 67% of the time (58/87), when they thought a patient was adherent.

74.

THE EFFECTS OF NURSERY STAY ON BREASTFEEDING CHOICES AND WEIGHT LOSS FOR WELL NEWBORNS

Hannah Kaneck '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Margaret McLaren MD, Director of Well Newborn Services and PROkids Clinic, Hartford Hospital, Connecticut Children's Medical Center, Elizabeth Brinkley RNC, MSN, Nurse Manager for Bliss Unit 6 and Maternity, Hartford Hospital.

Background Rooming in is defined as care by mothers to their newborns in room, rather than in nursery, during hospitalization. Rooming in is the seventh step designated by UNICEF and the WHO in the ten steps to being a Baby-Friendly Hospital and is a specific and quantifiable step towards ensuring mother/infant dyad exclusive breastfeeding. It has recently been observed that rates of rooming in care at Hartford Hospital, a Baby-Friendly institution, have been declining. A study of the overall time spent by each newborn in the nursery was initiated to collect baseline data for eventual quality improvement assessment.

Method Baseline temporal data and sub-group designation was collected via log sheets administered by nursing staff to each well newborn admitted to Bliss Unit 6 at Hartford Hospital from February 7th, 2011 until April 4th, 2011 (n=117). Exclusion criteria included newborns with incomplete log sheets and those being treated extensively for neonatal abstinence syndrome.

Results Comparisons of the amount of time each newborn spent in the nursery stratified by feeding decision, public vs. private care, and delivery mode sub-groups showed one point of statistically significant data. Newborns whose mothers had decided to exclusively breastfeed spent significantly less time in the nursery during the entirety of their hospitalization when compared to newborns whose mothers had decided to supplement formula with breast milk throughout hospitalization ($p < 0.05$). The mean number of times each newborn spent in the nursery (> 1 hour) was also stratified by sub-groups; these averages show a quantitative trend of breastfed newborns spending the smallest number of times and formula fed newborns spending the greatest number of times, with supplemented newborns falling in between. Comparisons of percent weight loss for each newborn stratified by sub-groups showed no significant trends.

Conclusions Analysis of baseline temporal data indicates that newborns whose mothers decide to exclusively breastfeed are more likely to spend significantly less time in the nursery overall and will go into the nursery fewer times (> 1 hour) than their supplemented or formula fed counterparts, over their hospitalization.

75.

THE DETERMINATION OF THE EFFECTS THE ANTICONVULSANT DRUG, GABAPENTIN, HAS IN TREATING MIGRAINE AND CHRONIC DAILY HEADACHES IN CHILDREN

Denise Lee '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Francis J. DiMario Jr., M.D, Division of Pediatric Neurology at Connecticut Children's Medical Center

Objective: Gabapentin (GABA) is an anticonvulsant drug (AED) used for prophylaxis of migraine headaches. We designed an IRB approved retrospective study based on medical records review to examine the efficacy and side effects of GABA and other anticonvulsant drugs in treating childhood non-trauma migraines.

Methods: Subjects (n=71, 38 girls, mean age 10.8 years old) were identified through chart reviews from January 2008 to December 2010 that were newly diagnosed and were prescribed anticonvulsants. We divided subjects into two groups: those that were on GABA and those that were on other AEDs in the duration of their treatment.

Results: Thirty-five subjects fell into the inclusion and exclusion criteria where 60% were functionally impaired by their migraine headaches and 66% had definite family history with migraines. Thirteen subjects were primarily prescribed GABA while 17 were primarily prescribed other AEDs besides GABA or non-AEDs. Through descriptive analysis, those who were on GABA primarily had an average dose of 384.62 mg and were on GABA for 12.4 months (mean). Three subjects had functional impairment due to their migraines while 8 did not experience functional impairment from their migraines while on GABA. Five subjects still had greater than 15 migraine headache days per month and 6 subjects had less than 15 migraine headache days per month while on GABA. Three switched from GABA to another AED but 8 did not switch from GABA. 6 subjects experienced no improvement while 5 subjects experienced full improvement in migraines while on GABA. Subjects that were on an AED other than GABA had a mean duration period of 5.4 months. Three subjects had functional impairment from their migraines while 5 did not have functional impairment from their migraines while on another AED. Three subjects had a frequency of greater than 15 migraine headache days while on another AED. Four subjects switched from their AED to GABA. Overall 2 subjects experienced full improvement in their migraines while on other AEDs while 3 had no improvement in their migraines while on other AEDs.

Conclusion: This retrospective chart review study suggested that GABA is not more effective in treating migraine headaches in children than other AEDs; this can be due to differences in tolerances children have when prescribed GABA or other AEDs.

76.

CHRONIC ILLNESS AND ITS EFFECT ON FAMILY FUNCTIONING: ORGANIZATION, CONTROL AND REPRESENTATIONS OF FAMILY CONFLICT AND COHESION

Tamar McFarlane '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Jill Popp, PhD., Department of Research, Connecticut Children's Medical Center

Objective: Previous studies show that chronic illness management has a severe impact on family functioning. This study investigated the impact of pediatric chronic illness specifically asthma and diabetes on family functioning and children's representations of family. The dimensions of family functioning analyzed were family organization (Family planning, activities, and other responsibilities) and family control (use of set rules and procedures). First, the illness group was compared to the healthy group on the dimensions of organization and control from the Family Environmental Scale (FES). Then the relationship between organization and control and children's representations of family conflict and cohesion were analyzed. **Methods:** Mothers of chronically ill children with asthma (n=14) or diabetes (n=35) completed measures of family conflict and control, by completing the Family Environmental Scale Assessments (FES). In addition, mothers of healthy children (n=30) completed similar measures. Children's representations were assessed using the MacArthur Story Stem Battery (MSSB). Two constructs previously developed from the MSSB were used, family conflict and family cohesion. Elements of family functioning (organization and control) were compared among illness groups and then analyzed in relation to the children's representation of family cohesion and family conflict. The statistical analysis was completed using the Multiple Analysis Variance Test (MANOVA) **Results:** In order to assess differences between illness group and the healthy group on the FES a Multiple Analysis of Variance (MANOVA) was run. No differences in family functioning and children's representations emerged between the asthma, diabetes and healthy groups ($p > 0.05$). To assess the relationship between organization and control and representations of family conflict and cohesion, correlation analyses were run between FES variables and MSSB variables. There were no significant correlations between study variables in the asthma, diabetes or healthy groups. However, significant correlations were present when analyzing the relationship between family control and children's representations of conflict in the combined illness group, diabetes vs. asthma ($p < 0.05$). Based on these findings, the control variable was dichotomized into high vs. low. Following this, a MANOVA was run between the combined illness group and healthy group on children's representations of conflict and cohesion. The results indicate, mothers in the illness group only, who reported high family control had children represent less frequent themes of family conflict. **Conclusions:** Family functioning is important in the management of chronic illness. Families with children who have a chronic illness should have more structure and procedure in order to have optimal disease management. High family control in this study can be viewed as a positive family characteristic that should be considered when developing family interventions.

77.

SCREENING FOR POSTPARTUM DEPRESSION AMONG PARENTS OF INFANTS IN THE NEONATAL INTENSIVE CARE UNIT

Katherine R. Sausen '11

Faculty Sponsors: Sarah Raksin, Maryann McGuire, Marilyn R. Sanders, MD, James I. Hagadorn, MD, MS, Department of Neonatology, Connecticut Children's Medical Center

Abstract: While most mothers experience a brief period of sadness in the first 7-10 days following birth, 10-20% of recently delivered mothers suffer from more intense depressive symptoms including crying, sadness, anxiety, and even suicidal thoughts. Mothers and fathers showing these symptoms are likely to be suffering from postpartum depression (PPD), which can have adverse effects on suffering parents, their newborn infants, and other family members in both the short and long-term. In the neonatal intensive care unit (NICU), parents may be at an elevated risk of developing PPD due to the increased stress from being in the NICU environment. Therefore, effective screening for PPD while parents are in the NICU is of great importance. In this pilot study, parents of infants admitted to the Connecticut Children's Medical Center (CCMC) NICU for at least four weeks were screened for PPD using the Whooley Depression Screen and the Edinburgh Postnatal Depression Scale (EPDS). Statistical analysis was performed to determine the general parental PPD prevalence rate in the CCMC NICU, the concordance between a positive screen on the Whooley Depression Screen and the EPDS, and the general consent rate of parents asked to participate in the study. The results of this pilot study will be used to guide the development of a larger definitive study of the prevalence of and risk factors for PPD among NICU parents.

78.

THE USE OF COGNITIVE PROFILES IN PROVIDING SUPERVISORY DISCHARGE RECOMMENDATIONS IN A TRAUMATIC BRAIN INJURY POPULATION

Marta Zamroziewicz '13

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Sarah Bullard, Ph.D., Sarah Tartar, Ph.D., Melina Griss, Ph.D., Kevin Young, Ph.D., Shianna Walker, Ph.D, Institute of Living

Traumatic brain injury (TBI) is a major cause of disability, morbidity, and mortality for those under the age of 45 years in the United States, and thus highlighting the need for early neuropsychological assessment for individuals with TBI. The use of neuropsychological assessments in the standardization of discharge procedures of patients with TBI is important and in this retrospective record review, the influence of scores on the Cognistat, a brief neuropsychological screening examination, on restrictive supervisory discharge recommendations was examined. The files of 60 Hartford Hospital inpatients with acute traumatic brain injury who were evaluated by the Neuropsychology Unit at the Institute of Living between January 2009 and December 2010 were examined. A stepwise forward logistic regression was used to determine the best predictors of the restrictive supervisory discharge recommendations (variables included age at testing, years of education, and Cognistat subtests). The four Cognistat subtests examined (memory, calculations, similarities, and judgment) correlated with the intermittent and 24 hour supervisory recommendation (all $p < 0.05$) while age and testing and years of education did not correlate with either supervisory recommendation (all $p > 0.05$). The logistic regression analysis revealed a three-step equation in which the best predictive variables (82.8% of cases predicted correctly) included years of education, the Cognistat similarities subtest, and the Cognistat memory subtest. These results suggest the most powerful model for standardization of the neuropsychological assessments used to determine supervisory discharge recommendations.

MATHEMATICS

79.

HOW TO WIN AT BLACKJACK: A MONTE CARLO SIMULATION

Kristen Anderson '11, Emily Guthorn '12

Faculty Sponsor: Philip Brown Jr.

The goal of our project is to use Monte Carlo simulation to determine the best strategy for winning at blackjack. The first and third cards are dealt to the player and the second and fourth cards are dealt to the dealer. There are 5 decks in a shoe, and the probability of getting any card is $1/12$; for example, the probability of getting an Ace is $1/12$. We will run a program to randomly conduct 1,000 trials and count whether or not the dealer or player wins the hand. The Dealer always hits on 16 and stays on 17. We will run three different strategies for the player: hit on 15 and stay on 16, hit on 16 and stay on 17, and hit on 17 and stay on 18. We will then compare the results of the three strategies and see which strategy is the best at beating the dealer.

80.

EPIDEMIC MODEL ANALYSIS: A CASE OF H1N1 IN TRINITY COLLEGE 2009

Eva Arango '11, Trang Luong '11, Shuyang Zhu '13

Faculty Sponsor: Philip Brown Jr.

By the start of 2010, a new strain of swine-origin H1N1 had caused about 17,000 deaths worldwide and was declared as a pandemic by the World Health Organization. Trinity College was not an exception, and we observed a number of cases with swine flu in the spring and fall of 2009. We use an epidemic model that includes infectives, susceptibles, and removeds to study the spread of swine flu within the Trinity College community during this time period. Data on the number of students who were infected, quarantined and vaccinated are retrieved from the Trinity College Health Center.

81.

MARKOV CHAIN ANALYSIS OF S&P 500 COMMODITY PRICING

Michelle Benjamin '11, Sarah Kohn '11

Faculty Sponsor: Philip Brown Jr.

A Markov Chain is a random process in which there is a sequence of moves between r states such that probability P_{ij} of changing from state i to state j in next step depends only on current state of the system and not on the history of how it reached that state. The P_{ij} 's remain constant for each step in the chain. We will examine the price change corresponding to the S&P 500 from 1993 to 1994. We will project how the price changes will appear in the long run through computations with the transition matrix. This analysis will determine whether the commodity prices of the S&P 500 will increase or decrease in future years.

82.

DISTRIBUTING POTASSIUM IODIDE TO NUCLEAR RADIATION VICTIMS: A DRUG DOSAGE MODEL

Kendra Gedney '11, David A. Patrick Jr. '11

Faculty Sponsor: Philip Brown Jr.

In response to the recent disaster at Fukushima power plant in Japan, we will develop a drug dosage model for the optimal amount of Potassium Iodide (KI) for the general public's protection from radiation exposure. After a nuclear disaster, radioactive iodine-131 is released into the air and environment. Once iodine-131 enters the body through breathing or through contaminated food and water, it is absorbed by the thyroid gland and can cause thyroid cancer. Distributing dosages of stable KI can protect the thyroid because the thyroid becomes saturated with the stable iodine preventing the radioactive iodine-131 from being absorbed. We will develop two models of the optimal amount and timing of distributing KI given the size of the Japanese disaster; one for adults and one for children. The models will be based upon an exponential decay model using the chemical properties specific to stable and radioactive iodine.

83.

MARKOV CHAIN MODEL OF TRINITY COLLEGE HOUSING

Kevin Huang '12, Binay Poudel '12

Faculty Sponsor: Philip Brown Jr.

Markov chain models are useful mathematical tools to simulate a system that undergoes transitions from various states. In this project, a user-defined transition matrix will be used to simulate the distribution of housing states of Trinity College's student body; states will include housing location and undergraduate class year. Accurate values for state-to-state transition probability are difficult to obtain and require data collection over an adequate amount of time. Thus, transition matrix values will be user-estimated parameters.

84.

MONTE CARLO SIMULATION ON "THE PRICE IS RIGHT"

Yuan Mei '12

Faculty Sponsor: Philip Brown Jr.

This project uses Monte Carlo simulation to explore possible strategies that can be used in the game show "The Price is Right". In this show, each of the three contestants will turn a wheel that is divided into twenty different prices, the maximum of which is, for example, one hundred dollars. Each person can turn the wheel twice and the contestant who gets closest to one hundred without going over is the winner. One crucial problem to the contestants thus is when should they decide to decline to spin the second time? The threshold value for the first contestant is relatively simple to find out, but its calculation would become more complicated for the second and the last contestant. I believe using Monte Carlo simulation would produce a pretty reliable numerical result.

85.

USING BATTING AVERAGES TO PREDICT THE WORLD SERIES

Tim Reichert '13, Steven Howard '13

Faculty Sponsor: Philip Brown Jr.

Baseball has had a long-standing reputation for being a “statistician’s game.” Virtually all aspects of a baseball game are converted into simple and abstract statistics that tell a story of what occurred on the diamond that night. With all of the information readily available via the Internet and databases, particularly over the last few years, there is a natural tendency to determine if these statistics have a significant impact on game outcomes.

Using a series of Monte Carlo simulations, we examine the effect of batting averages (total hits / plate appearances), on baseball games. We decided to analyze batting averages on the game’s greatest stage: the World Series. Simulating these games using a series of assumptions, we have “replayed” World Series outcomes over the last ten years, resulting in some startling information about the importance of batting averages.

86.

MONTE CARLO METHODS: SCIENTIFIC CLEROMANCY

Ryan Zukus ‘11

Faculty Sponsor: Philip Brown Jr.

Math Using probability analysis and pseudorandom number generators, computer models of systems too complex to resolve analytically can be approximated, and predictions of future states can be calculated. This has far-reaching applications to any number of fields, emphasis in this demonstration being placed on Econometrics and/or Particle Physics.

NEUROSCIENCE

87.

PREDICTORS OF COGNITIVE REHABILITATION SUCCESS ON A SIMULTANEOUS MULTIPLE ATTENTION TASK IN PEOPLE WITH SCHIZOPHRENIA

Eniana Agolli ‘11

Faculty Sponsors: Sarah Raskin, Matthew M. Kurtz, Mara Demaio, Institute of Living

Research has shown that computer assisted cognitive rehabilitation for people with schizophrenia produces significant improvement in their daily functioning. Cognitive rehabilitation (CR) tasks train attention, memory, language and/or problem solving. The goal of this research is to examine performance on a simultaneous attention task used as part of a CR training program and determine which variables predict improvement in training. Specifically, we analyzed two measures. The first is improvement, defined as the difference between the first goal set in treatment and the highest goal attained. The second measure was just the highest goal attained on the CR task. These were compared to predictor variables: symptomatology, and cognitive pre-tests (Brief Test of Attention (BTA), Penn Continuous Performance Task (PCPT), Digit Span and Trails A & B). Results show a negative correlation between the total score on the PANSS negative symptoms scale and PCPT true positives, BTA total score, and the number of errors of Trails B. Additionally, stepwise regressions were conducted to predict intensity, improvement, and highest goal based on initial cognitive tests. Results indicate that reaction time on PCPT predicts intensity, and improvement while scores on Digits raw predicts only highest goal

attained. In addition, time on Trails A predicts intensity and highest goal and the number errors on Trails A predicts both intensity and improvement. Therefore we can conclude that those with greater initial impairments on measures of attention show the ability to improve the most. We found that that less impaired individuals are able to achieve the highest goals on CR. Furthermore, those who are slower on PCPT and on Trails A will spend more time in cognitive rehabilitation and will have the most room to improve. Based on the results, it appears that specific baseline cognitive abilities measuring attention may be useful in predicting success. Therefore, we may be able to predict who will most benefit from CR.

88.

THE IMPACT OF THE AGE AT SURGERY AND TYPE OF SURGICAL INTERVENTION ON LONG-TERM NEUROPSYCHOLOGICAL OUTCOMES IN SAGITTAL CRANIOSYNOSTOSIS

Max Alderman '11

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

Approximately 35-50% of children with nonsyndromic, unilateral craniosynostosis have neurocognitive disabilities, a strikingly higher prevalence compared to the general population. The effect of either the type of cranial reconstructive surgery or the age of patients at the time of surgery on such long-term neuropsychological outcomes remains unclear. Given the paucity of scientific evidence in regards to the age and type of surgery for patients with craniosynostosis, considerable debate exists over the optimal treatment options for this craniofacial disorder.

This multi-institutional study consisted of 43 patients who were treated operatively for isolated, unilateral sagittal craniosynostosis. The subjects were subdivided by age at time of surgery: treatment prior to 6 months of age vs. after 6 months of age; as well as treatment type: strip craniectomy vs. whole vault cranioplasty (WVC). All patients underwent testing evaluating various domains of neuropsychological function using a battery of neurodevelopmental instruments.

The results indicated that infants who undergo surgical intervention before the age of 6 months will yield, on average, better long-term neuropsychological outcomes in terms of academic achievement, IQ, and behavior. Infants who receive WVC show, on average, better long-term neuropsychological outcomes in academic achievement and behavior, while infants with a strip craniectomy show better outcomes in IQ.

89.

CONTRASTING THE EFFECTS OF A KETOGENIC DIET ON ASPECTS OF INFLAMMATION AT TWO TIME POINTS

Joshua Altschuler '13

Faculty Sponsors: Susan Masino, David N. Ruskin

Inflammation is characterized by blood vessel dilation, fluid movement from across blood vessel

walls, and white blood cell infiltration. We had hypothesized that the ketogenic diet (a very-low carbohydrate diet used to treat epilepsy) would have beneficial effects on inflammation. In initial experiments, we found that the ketogenic diet reduced swelling and fluid movement in experimentally-induced inflammation in rats (Ruskin et al. 2009, PLoS One). Further experiments extended upon this previous work to examine white blood cell infiltration. This consisted of injecting two groups of rats, one on an 8% ketogenic diet, and another on a typical rat pellet diet, with CFA (an inflammatory agent) or vehicle into one hindpaw. The injected and uninjected paws were weighed, and inflamed tissue was frozen, crushed, and dispersed in buffer. This process took place two days or two hours after inflammation was induced. An enzyme assay for myeloperoxidase was performed on aliquots of this solution; myeloperoxidase is an enzyme present only in white blood cells (specifically, neutrophils). We found that CFA induction of neutrophil infiltration was very minor at 2 h compared to 48 h post-injection. Although we found a statistically significant difference in infiltration between the subjects on the control and ketogenic diets on the 2 hour time course (the same pattern as seen in previous studies), the magnitude of myeloperoxidase in both subject groups was extremely small compared to that of the subjects of the 48 hour time point. The diet seemed to have no affect on the amount of inflammation present in terms of the weights of the injected versus uninjected paws of the 48 hour time point subjects. This could be attributed to the small sample size used during testing. Regarding this same time point, however, the ketogenic diet group had higher levels of white blood cell infiltration than the control diet group. Due to the low levels of white blood cell infiltration two hours after an injection of CFA, there will need to be further testing in the future with intermediate time points. Also, we plan to test if similar effects occur with a less strict, more clinically-relevant ketogenic diet. The ultimate goal of these experiments is to completely characterize this diet's effects on inflammation, and ascertain the underlying mechanisms.

90.

ERROR MONITORING IN CURRENT AND FORMER COCAINE USERS

Brian C. Castelluccio '12, Shashwath A. Meda, Christine E. Muska, Godfrey D. Pearlson
Faculty Sponsors: Sarah Raskin, Dan Lloyd, Godfrey D. Pearlson, Institute of Living

Previous studies have demonstrated that specific regions including the anterior cingulate cortex (ACC), ventral prefrontal cortex, inferior parietal lobe (IPL) and insula are functionally associated with error processing. These regions are also identified as functionally impaired in cocaine use populations. The current study investigated error processing functionality in both former and current cocaine users together in a single statistical model. We expected to find both common and unique functional differences in the above groups in task relevant regions of an fMRI Go/No-Go task. In the present study, 29 former cocaine users (at least 6 months abstinent), 30 current cocaine users (urine positive for cocaine metabolites), and 35 screened healthy controls (age and sex matched) performed a Go/No-Go fMRI task. Scans were collected on a 3T scanner, and data were preprocessed and analyzed using SPM5. The neural responses associated with correct rejections and false alarms were analyzed. Further, an ROI based analysis was used to query specific a priori regions. Neither former cocaine users nor current cocaine users showed blood-oxygen level dependent (BOLD) differences compared to controls in neural responses to correct rejections during the Go/No-Go task. However, relative to controls, former cocaine users showed significant overactivation of BOLD patterns associated with false alarm errors in ten a priori task-relevant regions. Neural responses to false alarm errors in current cocaine users showed overactivation trending toward significance in these same regions. This study is unique

in that it examines the neural activity patterns of former as well as current cocaine users. Increased activation seen in the former users group may reflect cognitive strategies that were developed in order to achieve and maintain abstinence from cocaine use. Alternatively, some cocaine users may have underlying neural differences that allow them to discontinue use more easily than others.

91.

THE EFFECTS OF ADENOSINE AND THE KETOGENIC DIET ON AUTISTIC BEHAVIORS IN MICE

Jessica Cote '12, Julia Svedova '11

Faculty Sponsors: Susan Masino, David N. Ruskin

Adenosine is a neuromodulator of brain activity which might be involved in autism. This purine binds to several receptors, including the A1 receptor which is of extreme importance as it is widespread in the brain, has a high affinity for adenosine, and is inhibitory. In autism disorders, the behavioral aspects of the disorder (epilepsy, anxiety, disrupted sleep, repetitive behaviors) seem to improve with increased amounts of adenosine. The ketogenic diet is a low-carbohydrate diet that is used to treat epilepsy, and has begun usage in treating autism. Although the mechanism of the ketogenic diet is still unclear, research has suggested an important role for adenosine. In the current study, we examined mice lacking the A1 receptor for autistic behaviors, and the effect of the ketogenic diet on these behaviors. At three weeks of age, male mice were randomly assigned to a control or ketogenic diet group. At seven weeks, we used sociability and compulsive tests to observe the behavior of mice with and without the A1 receptor, on and off the diet. Results for sociability tests showed that while mice on the control diet showed no difference in their sociable behavior patterns with or without the A1 receptor, mice on the ketogenic diet produced significantly different patterns. Ketogenic diet mice with the A1 receptor preferred to be with another mouse over being alone, while ketogenic diet mice lacking the A1 receptor showed no preference. During compulsive behavior tests, no difference between treatment groups was observed. These preliminary data suggest that the upregulation of adenosine may be important for ameliorating autistic symptoms, and that the ketogenic diet could act as a therapy by increasing adenosine levels.

92.

THE EFFECT OF NEONATAL ISOLATION TREATMENTS ON LONG-TERM POTENTIATION IN RATS

Ela Cross '13, Georgia McAdams '14

Faculty Sponsor: J. Harry Blaise

In the brain, the basolateral amygdala (BLA) influences the formation of emotional memories and is therefore important for emotional and stress responses. The dentate gyrus (DG) is the

subfield of the hippocampus that is concerned with learning and memory. Thus, the BLA-DG pathway is significant because the BLA and DG in the hippocampus work together to link memory with stress responses and to support neuroplasticity. Neonatal isolation is known to be an early life stressor that causes changes in long-term potentiation (LTP) recorded in the BLA-DG pathway. Previous studies have only shown the results of rats isolated for 1 hour periods from days 2-9 after birth. Currently, it is being tested to determine if the results are the same when rats are isolated for 2 hour periods from days 2-5 versus 1 hour periods from days 2-9. After maturing, these rats are implanted with electrodes in the BLA and DG through stereotaxic surgery and allowed to recover for a week; they then have LTP induced. As of yet, there is no conclusive data to prove whether these two methods of isolation produce similar or different results. The future results may help to create experiments that can be completed more efficiently and quickly.

93.

COCAINE WITHDRAWAL-INDUCED ASTROCYTE ACTIVATION: ROLE OF THE CORTICOTROPIN-RELEASING FACTOR 1 RECEPTOR

Brianna Dix '11

Faculty Sponsors: William Church, Charles C. Swart, Lisa Conti, University of Connecticut Health Center

Drug abuse is a major health problem that has become an increasingly studied phenomenon affecting millions worldwide. Cocaine is just one of many substances that affects the mesolimbic dopamine pathway, and has been classified as powerfully addictive and causing withdrawal. Previous studies have indicated a significant increase in extracellular corticotropin releasing factor (CRF) in the central nucleus of the amygdala (CeA) as a result of withdrawal from all major drugs of abuse including cocaine. Also, receptors for CRF have been shown to be localized on astrocytes in this portion of the brain. Lastly, evidence indicates that CP 154,526, a selective CRF1 receptor (CRF1R) antagonist has the potential to attenuate the anxiety-like behavior associated with withdrawal by blocking these receptors. This study seeks to determine if acute and/or prolonged (2 week) withdrawal from cocaine causes astrocyte activation and/or proliferation in the amygdala of Brown Norway (BN) rats, as well as examine the effects of CP as an effective antagonist of this CRF-mediated response. In the study, the rats were given daily IP injections of cocaine (20mg/kg) for five days followed by an IP injection of CP (20mg/kg) on the sixth day. Half of the animals were tested on an elevated plus maze (EPM) and sacrificed on the sixth day. This process was repeated for the remaining rats on the twenty-first day. The results indicated that there is no effect of any of the three variables, cocaine, CP, or day, on astrocyte activation and/or proliferation in the CeA. Similarly, no effect was seen on the EPM. However, evidence from other studies indicates that these results are likely substantial to this experiment only. In the future, this study should be repeated, potentially looking at alterations in the time frame utilized for withdrawal and the brain region examined for astrocytes. If successful, results could lead to more information about potential treatments for drug addiction and withdrawal with the possibility of CRF1R antagonists as a therapy for preventing drug relapse.

94.

EFFECT OF THE KETOGENIC DIET VERSUS CONTROL DIET ON NOCICEPTION IN MICE

Jessica Fortin '14

Faculty Sponsors: David N. Ruskin, Susan Masino

The ketogenic diet is a high fat, low carbohydrate diet that adjusts the body's metabolism to use ketone bodies instead of glucose for fuel. The diet has been proven effective in raising the seizure threshold of epileptics, especially in children. The effects of the diet on pain sensitivity (nociception) are being studied in mice on the ketogenic diet against mice on a control diet. Mice were fed either a control diet or the ketogenic diet (8% protein) for three weeks. At 7-8 weeks of age the right hind paw was injected with one of three solutions: a 5% 20 μ L solution of formalin, 1.6 μ g capsaicin in saline with 7% DMSO (both of which induce a painful response), or vehicle (saline with 7% DMSO). The injected mice are then placed in an individual clear container and the amount of time spent biting and licking the injected hind paw is recorded. The data from the capsaicin trials (n=11) suggest a difference between nociception for mice on the control and ketogenic diets, with mice on the ketogenic diet having less time spent biting/licking. The data from the formalin trials are inconclusive with varying results for nociception (average time spent biting) between mice on the control (n=8) and ketogenic (n=14) diets. Further experiments will focus on adjusting the formalin concentration and volume and utilizing other injection solutions to corroborate the capsaicin results. The results of this research have a direct connection with human clinical medicine - if the ketogenic diet is effective at decreasing nociception it could prove to be a beneficial therapy for chronic pain sufferers.

95.

ALTERED DEFAULT MODE NETWORK CONNECTIVITY IS CORRELATED WITH IMPULSIVITY AND BINGE DRINKING IN COLLEGE STUDENTS

Kristina Foster '11

Faculty Sponsors: Sarah Raskin, B. Anderson, M. Ginley, H. Tennen, C. Austad, C. Fallahi, R. Wood, and G. Pearlson, Olin Neuropsychiatry Research Center, Central Connecticut State University, and Yale University School of Medicine

Current studies are investigating changes in "resting state" brain function as a means of further understanding mental disorders such as Alzheimer's disease, schizophrenia, and autism spectrum disorder. These disorders have shown altered functional connectivity in a network of brain regions identified as the default mode (DMN). These regions include the posterior parietal cortex (PCC), the inferior parietal lobule (IPL), the medial prefrontal cortex (mPFC) and precuneus. Impulsivity is a multi-faceted trait that is present in many psychopathologies and has been correlated to increased substance use disorders, therefore may correlate with altered functional connectivity in the DMN. This study was part of the Brain and Alcohol Research in College Students (BARCS) study conducted at two Connecticut colleges. Healthy undergraduate students (n=91) completed the Barratt Impulsiveness Scale (BIS-11) and the Balloon Analog Risk Task (BART) during an initial session. Monthly self-assessments of alcohol and drug use were completed via computerized surveys. In another session, participants underwent an fMRI scan. FMRI data was processed using SPM5 before utilizing independent component analysis (ICA) to determine the component most temporally correlated to an a priori default mode mask. SPM5 was used for a second-level analysis. The first-order factors of the BIS-11 correlated strongly with their respective second-order factors. BIS-11 attentional impulsiveness was correlated with increased connectivity within the precuneus. BIS-11 motor impulsiveness correlated with a decrease in connectivity in the IPL and precuneus but increased connectivity within the PCC and mPFC. BIS-11 non-planning impulsiveness correlated with decreased

connectivity in the IPL but increases in the mPFC and precuneus. The BART correlated with decreased connectivity within the mPFC. Participants who did not binge drink, in the month leading to the scan, showed stronger connectivity within the IPL and precuneus than those participants who did binge. These results suggest that the BIS-11 and BART impulsivity measures are associated with altered DMN connectivity and that altered DMN connectivity may be a risk factor for or consequence of binge drinking.

96.

PSYCHOMETRIC PROPERTIES OF THE MEMORY FOR INTENTIONS SCREENING TEST FOR YOUTH (MISTY)

Julianne Garbarino '11, Ginger Mills '12

Faculty Sponsor: Sarah Raskin

Prospective memory (PM), or remembering to do something in the future, is important in the daily lives of children and adults alike. The Memory for Intentions Screening Test for Youth (MISTY), is based on the psychometrically valid MIST (Raskin, 2009). The study of PM in children is still emerging, with an increase in research in the past ten years and the need for valid clinical measures. The MISTY is unlike previous tests in its use of two different time delays, both event-based and time-based tasks, and both action and verbal responses. The MISTY has been piloted on 113 children ages 5-14. All trials on the MISTY were significantly intercorrelated ($p < .001$) with all other trials. All trials also significantly correlated with the total score. Age was significantly correlated with MISTY total score ($r = .719$) performance but gender and ethnicity were not. There was strong interrater reliability ($r = .90$). Importantly, the MISTY was able to show stronger differences in performance of younger children than older children depending on time delay and cue type. Younger children (ages 5-10) performed significantly better on shorter delays (two minutes) than longer delays (10 minutes) and event-based cues than time-based cues, while older children did not perform differently on shorter versus longer delays or event versus time cues. Age group variation in significance on these comparisons suggests that consideration of time delay, cue type, and response type may explain some of the conflicting findings in the literature about age differences in PM ability among children.

97.

NEUROANATOMY OF THE SUPRAESOPHAGEAL GANGLIA OF THE GIANT WATERBUGS BELOSTOMATIDAE

Amy Hackett '14

Faculty Sponsor: Charles C. Swart

Outside of the behavioral and habitual knowledge of the insect, not much is known on the anatomy and physiology, particularly concerning the central and peripheral nervous system.

While the general morphology of the central nervous system has been described essentially nothing is known concerning the the nature of the tissue itself including cellular composition and physiology. Because these animals are not available in the winter I examined a number of preserved specimens with the goal of mapping the neural cell composition of the central nervous system. Using the whole mount staining with toluidine blue I have mapped cellular composition of the subesophageal ganglion and optic lobes. This basic neural map will be used in subsequent studies this summer with field caught specimens to trace the axonal tracts between various peripheral nerves and the central nervous system.

98.

THE EFFECTS OF ALCOHOL ON THE MENTAL CAPABILITIES IN COLLEGE STUDENTS

Sarah Isaac '14, Nick Caggiano '14

Faculty Sponsor: Sarah Raskin

Binge drinking is defined as a pattern of consumption that raises the blood alcohol concentration to at least 0.08%. It has been suggested to be a significant factor in causing brain and cognitive damage. This study evaluates drinking trends, memory and cognition in young adults 18 to 21 years of age. So far, 501 first year students have been tested at Trinity College. Participants were categorized into one of four groups: never drank, drank but never binged, binged but not in the last 30 days, and binged in the last 30 days. They were administered a mental health screening, M.I.N.I. (Mini International Neuropsychiatric Interview) to determine whether they were applicable for the study and to analyze any trends amongst drinking behavior. Additionally, participants were presented with a battery of cognitive and memory tasks in JANET and COGSTATE in order to assess patterns amongst drinking groups. It has been demonstrated by these tests that subjects in the group of individuals that have binged in the past thirty days are much more likely to have alcohol and substance abuse disorders and mood disorders such as a depressive episode, with females, in general, being more likely to be classified as binge drinkers. Furthermore, the group that binged in the last thirty days performed worse on a test measuring declarative memory, and social drinkers showed the poorest performance on a test measuring impulsivity. Alcohol has been shown to have a noticeable effect on mental capabilities in individuals, including aspects such as memory and impulsivity. Moreover, it was shown that it is important to determine how often an individual binged in measuring the degree of impairment of mental facilities.

99.

MEMBRANE PROTEIN BASED ENCODED LIBRARY TECHNOLOGY SELECTION DEVELOPMENT

Annie Jenney '11

Faculty Sponsors: William Church, Jean Zhang

During the semester, I spent forty hours a week interning at GlaxoSmithKline in Waltham, MA at their Molecular Discovery Research site. I assisted in the development of a method to extract

and isolate membrane proteins in their active form. This required homogenization of the cells, physical extraction of the proteins using ultra centrifugation, and finally flow cytometry and fluorescence detection to measure quantitatively for protein expression. We then used these isolated membrane proteins as targets of interest and we enriched them using a small molecule library. We also developed a membrane protein based selection protocol. Using Encoded Library Technology (ELT), the isolated membrane proteins were then subjected to a modified selection process. The development of this selection process using Membrane Protein Based Targets is an ongoing project.

100.

THE EFFECT OF THE KETOGENIC DIET ON AUTISTIC MICE

Michelle Murphy '14

Faculty Sponsors: Susan Masino, David N. Ruskin

Autism is a neurological disorder that causes impaired social and communication skills. Generally this disorder is thought of in a human context, but there is an inbred strain of mice, BTBR, that shows the same distinctive symptoms of autism in humans. A possible treatment for autism is the use of the ketogenic diet, which is a low-carbohydrate and high-fat diet. The sociability of the autistic mice on a control diet and of the autistic mice on a ketogenic diet was tested by using a three-chambered compartment experiment. In this experiment, a mouse was placed in the central chamber, which had doors to the next-door chambers, and the time that the mouse spent touching the cages in the left and right chambers that were either empty or contained other mice was determined. Three 10-minute phases were timed: the first phase only had the testing mouse, the second phase had a new mouse placed in one of the cages and the third phase had the mouse from the second phase plus another novel mouse placed in the other cage. During phase two, it was found that the autistic mice on the control diet spent less time interacting with the new mouse compared to the time that the mice on the ketogenic diet spent interacting with the new mouse. During phase three, it was found that the mice on the control diet did not spend significantly more time interacting with the novel mouse, and that the mice on the ketogenic diet did spend significantly more time interacting with the novel mouse. These data demonstrate that the social interaction of the autistic mice was improved by a ketogenic diet. Finding evidence that a ketogenic diet can alleviate symptoms of autism in mice is important because the ketogenic diet could be used to treat autism in humans.

101.

BRAIN AND ALCOHOL RESEARCH IN COLLEGE STUDENTS: COLLEGIATE ACADEMIC PERFORMANCE IN RELATION TO ALCOHOL CONSUMPTION AND COGNITIVE ABILITY

Lara Novak '11

Faculty Sponsor: Sarah Raskin, Funded by National Institute on Alcohol Abuse and Alcoholism

Research Question:

What is the relationship between drinking patterns, grade point average (GPA), and cognitive functions in first-year college students?

Hypothesis:

Increased binge drinking in college students in a two-year period will correlate with lower levels of academic performance and cognitive ability per semester.

Background: College students are at the highest risk for and engage in the highest rate of heavy episodic drinking. Excessive alcohol consumption is associated with increased mortality rates as well as functional and structural abnormalities in the brain. Binge drinking may also impact academic performance and cognitive function, but the association is uncertain. This study will examine the relationship between drinking patterns, GPA, and cognitive functions in first-year college students. Methods: Subjects were a representative sample of first year college students from Trinity College and Central Connecticut State University ranging in ages from 18-25 years old (N=200; 42.5% male). Non-cognitive assessment measures were administered including, demographic data, DSM-IV Mini International Neuropsychiatric Interview, medical history, substance use history, monthly substance use surveys, and a saliva sample. SAT/ACT and current and cumulative GPA scores were obtained from official school records. Monthly web-based substance use surveys assessed drinking patterns that were self-reported by participants over four academic semesters. Within the surveys, the subjects answered N of days they consumed any alcohol, N of days they engaged in binge drinking, and the maximum number or drinks they consumed in a 24-hour period. The category of binge drinking was classified as having a blood alcohol content (BAC) of 0.08 gram percent or above. Cognitive assessment measures included two computerized cognitive task batteries including, the Cogstate Research battery and the JAva NEuropsychological Test (JANET) battery. Results: Three linear regression models were used to predict semester GPAs based on a combination SAT scores and all previous semester GPAs. SAT/ACT scores were shown to be significant predictors of GPA for the first two college semesters. There was not a significant trend when predicting the third semester GPA and were not significant in predicting GPA for the fourth semester of college. Alcohol use was significantly correlated with lower GPAs than previously predicted by standardized test scores and previous GPA. The spring '09 semester revealed a significant negative correlation between binge drinking and academic performance ($r=-0.16$; $p=0.035$). There was also a negative trend in academic performance for the fall '08 semester in relationship between academic achievement and the number of days per semester alcohol was consumed. ($r=-0.138$; $p=0.07$). This trend was not significant in the following semester. Conclusions: Similar to findings in outside literature, SAT/ACT scores tend to predict the academic performance, specifically GPAs, in first year college students. There is a negative correlation between academic performance and alcohol consumption in the first year of college, but this association is lessened in subsequent semesters. This pattern may be explained by adjusting to college life, alcohol tolerance, or moderation of drinking patterns.

102.

DIFFERENTIATION OF SH-SY5Y CELLS BY RETINOIC ACID: PROTECTION AGAINST NEUROTOXICITY?

Lisa Pierce '11

Faculty Sponsor: William Church

The present study was carried out to investigate the impact of cell differentiation on neurodegeneration. The SH-SY5Y cells were differentiated using retinoic acid and then

differentiated and undifferentiated cells were exposed to the neurotoxins Rotenone and MPP+. Following a 24 hour exposure to neurotoxin, cell viability was determined using a fluorescent dye assay. Rotenone concentrations of 0 nM, 2.5 nM, 5 nM, and 7.5 nM and MPP+ concentrations of 0 μ M, 0.5 μ M, 1 μ M, and 2 μ M.

Retinoic acid was assessed by morphological changes in cell size and the number of processes extending out from the soma. The results showed that the toxic effect of Rotenone on the undifferentiated cells is slight, but the effect does appear to be concentration dependent. At the highest dose tested, Rotenone neurotoxicity was attenuated by Retinoic acid differentiation.

103.

COMPARTMENTALIZATION OF ASCORBIC ACID IN BODY TISSUE VS. NERVOUS TISSUE IN THE POND SNAIL, *HELISOMA TRIVOLVIS*

Lisa Saa '14

Faculty Sponsor: Charles C. Swart

Antioxidants protect against free radical damage caused by oxidation within the brain. Ascorbic acid is one antioxidant that may protect against oxidative stress, which may cause aging and age-related diseases. The pond snail *Helisoma trivolis* is shown to be very receptive to its environment; in particular, it is strongly affected by the water chemistry. Thus, these snails were used to study the effect of increased ascorbic acid treatments on the concentration of ascorbic acid within the brain. Snails were placed in one of four different treatments: 0, 50, 75, and 100 milligrams per liter. After two to three days, the snail brain was dissected and a potassium ferricyanide assay for ascorbic acid was conducted. First, the brain tissue was homogenized in 200 microliters of de-ionized water by sonication. The solution was then centrifuged for 10 minutes at 2100 rotations per minute, mixed with 100 microliters of 1 molar perchloric acid to precipitate dissolved proteins, and centrifuged again. Finally, the ascorbic acid within the brain tissue was reacted with a 0.015 M potassium ferricyanide and 0.015 M iron (III) chloride solution. A spectrophotometer was then used to determine the concentration of ascorbic acid within the brain. Ascorbic acid levels in the brains of the snails do increase stepwise with increasing environmental concentration. However, the differences did not reach the level of statistical significance. Increasing the level of antioxidants within the nervous system would be predicted to have a positive influence on neural cell longevity. Future experiments should explore which components of neurophysiology are enhanced by increased antioxidant levels.

104.

THE EFFECT OF INCREASED ASCORBIC ACID ON ACETYLCHOLINESTERASE ENZYME ACTIVITY IN VITRO AND IN THE POND SNAIL *HELISOMA TRIVOLVIS*

Nicholas J. Stewart '11

Faculty Sponsor: Charles C. Swart

Acetylcholinesterase (AChE) and its substrate acetylcholine are essential biochemicals involved in several neural systems ranging from neuromotor control to higher order cognitive processing.

Recent work has suggested important links between antioxidants and the inhibition of AChE activity. The objective of this study was to test the effects of ascorbic acid on in vivo AChE, using the pond snail *Helisoma trivolvis*, and in vitro AChE, using enzyme isolated from *Electrophorus electricus*. Common spectrophotometric bioassays were used for both the quantification of ascorbic acid and the measurement of AChE activity. The in vivo results of this study illustrate that elevated ascorbic acid levels in the aquatic environment of *Helisoma trivolvis* does not have a significant positive correlation with AChE inhibition. The in vitro assay series determined that ascorbic acid has no direct effect on AChE inhibition either in isolation or in combination with the traditional AChE inhibitor tacrine.

105.

PAIN REDUCTION VIA THE KETOGENIC DIET: INVOLVEMENT OF ADENOSINE A₁ RECEPTORS

Tracey Suter '11

Faculty Sponsors: David N. Ruskin, Susan A. Masino

Introduction: The ketogenic diet (KD) is a high fat, low carbohydrate diet that has been used to treat seizures in epileptic patients. Studies have shown that anticonvulsant medications can alleviate chronic and acute pain, thus providing a rationale that the KD could similarly reduce pain. There is a recent hypothesis that the KD increases adenosine levels in the brain and spinal cord; adenosine is well known to reduce pain via adenosine A₁ receptor (A₁R). Recently it was shown that the KD increased latency to noxious stimuli and decreased inflammatory responses, supporting our initial hypothesis that this diet can effectively treat pain. However, the mechanism remains unknown.

Objective: The aim of this current study was to determine if adenosine plays a role in pain-reducing responses of the KD. Based on previous research, pain-reducing effects of adenosine are expected via activation of the A₁ receptor (A₁R) subtype. Therefore, we expect that the KD will reduce pain responses in our models, but that mice lacking the A₁R ("knockout" mice) on the KD will experience no change in pain response.

Methods: Normal and A₁R knockout mice were placed on either a control or KD for three weeks. Right hind paws were injected with formalin or capsaicin solution. Local formalin and capsaicin injections are well-established and tested protocols for acute pain. Following the injection, pain behavior (lifting, licking, and biting) was quantified in 5 minute intervals.

Results and Discussion: The KD did not significantly reduce pain due to a capsaicin injection. A significant hypoalgesic effect, however, was observed in A₁R knockout mice on the control diet after capsaicin injection compared to A₁R knockout mice on the KD and wild-type mice on the control diet. These findings were opposite to what we were expecting, especially since A₁R knockout mice have been shown in many studies to be hyperalgesic. It could be possible that the A₁R knockout mice on the KD had an unmasked activation of P2X and adenosine 2a receptors (A₂AR) that are known to increase pain perception.

The 5% formalin injections revealed significantly increased paw lifting in A₁R knockout control diet mice during phase I, as expected, but also a unexpected slight increase in the phase I lifting in KD-fed mice. There was no difference in phase II paw lifting or in either phase of paw licking/biting after 5% formalin injection. Because there was no significant difference between

the treatment groups in paw licking/biting, which is considered a more severe pain reaction, we believe that 20ul 5% formalin is a 'ceiling dose' that was too strong for the analgesic effect of the KD. Therefore, a dose response curve was made to determine a more appropriate dosage for testing the KD's nociceptive effect. After testing 3 other concentrations/volumes, we determined that 10ul 4% formalin is likely to be useful in future work. Additional testing needs to be done with this formalin dose in order to properly determine the KD effect on this pain model.

106.

EFFECTS OF THE KETOGENIC DIET ON BEHAVIOR AND SYMPTOMS OF AUTISM: HUMAN AND RODENT STUDIES

Julia Svedova '11

Faculty Sponsors: Susan A. Masino, David N. Ruskin, Francis J. DiMario Jr. MD, Division of Pediatric Neurology, Connecticut Children's Medical Center

BACKGROUND: Autism is a pervasive developmental disorder characterized by repetitive behavior, impairments in social interactions, and deficits in communication. Recent studies suggested that the ketogenic diet (KD), a diet high in fats and low in carbohydrates and proteins used for treatment of intractable epilepsy, can cause improvements in behavior, cognition, mood, or social life. However, the number of studies investigating this phenomenon is limited. The purpose of the current study was to evaluate the effects of the KD on behavior and autistic symptoms in children with epilepsy and in a mouse model of autism (BTBR T+tf/J).

METHODS: The clinical component investigated the efficacy of the KD on behavior of children with epilepsy using two questionnaires, the Childhood Autism Rating Scale and the Child Behavior Checklist. It was divided into a retrospective and prospective phase. The goal of the retrospective phase was to evaluate the differences in behavior of children with epilepsy on the KD and children who discontinued the diet (X2 test). In the prospective part, we compared behavioral changes in three cases of children with epilepsy who underwent the modified KD for 6-9 months. The laboratory component investigated the effects of the KD on BTBR T+tf/J mice and C57BL/6J control group of mice. The battery of tests used in the laboratory component targeted two of the major symptoms of autism, i.e. deficits in sociability (the Three-chambered sociability test; t-test) and repetitive behavior (the Marble-burying test and the Self-grooming test; Mann-Whitney test).

RESULTS: The retrospective phase of the clinical component demonstrated a significantly more normal behavior of children on the KD (n=11) compared to children off the diet (n=9; $P \leq 0.05$). In addition, all three cases of children on the modified KD in the prospective phase showed marked improvements in various domains of behavior. The Three-chambered sociability test of the laboratory component revealed that the BTBR T+tf/J mice on the KD had greater sociability than the BTBR T+tf/J mice on a control diet. In fact, the social behavior of the BTBR T+tf/J mice on the KD was comparable to the behavior of C57BL/6J control animals. Furthermore, there was a strong trend suggesting a reduction of repetitive behavior in the BTBR T+tf/J mice on the KD as measured by the Self-grooming test ($P=0.057$). There was no strain or diet effect in the Marble-burying test.

CONCLUSION: The current study suggested that the KD could be used as an effective natural therapy for treatment of autism and behavioral deficits. Further studies will be necessary to confirm these findings and illuminate the mechanisms of the diet.

107.

ONTOGENY OF GENDER SPECIFIC NEURONAL NUMBER IN THE CEREBRAL AND BUCCAL GANGLIA OF THE CHINESE MUD SNAIL, *CIPANGOPALUDINA CHINENSIS*

Amelia Wattenberger '11

Faculty Sponsor: Charles C. Swart

The chinese mud snail (*Cipangopaludina chinensis*), a large gastropod mollusc which lacks giant neurons and is likely protandrous, is an ideal model organism for the study of complex nervous systems. Neuronal counts in the cerebral and buccal ganglia were compared as a function of gender and age, based on opercular ring count. Neuronal number was determined using whole mount ganglial staining with Toluidine blue and Hematoxylin and eosin stained paraffin sections as well as plastic embedded sections. This initial description of the neuroanatomy of the cerebral and buccal ganglia will facilitate future research directed at understanding snail phylogenetics, gender differences in neural development, and neurogenesis in a complex invertebrate model. Immediate future work on the Trinity campus will focus on the effects of environmental toxins on neural development and neurochemistry in this animal.

108.

EFFECTS OF DRINKING PATTERNS ON PROSPECTIVE MEMORY PERFORMANCE IN COLLEGE STUDENTS

Marta Zamroziewicz '13, Kristina Foster '11, Lara Novak '11, Ethiopia Kabtimer '13

Faculty Sponsors: Sarah Raskin, Rivkah Rosen, Howard Tennen, Carol Austad, Carolyn Fallahi, Rebecca Wood, Godfrey Pearlson, Institute of Living

Alcohol consumption in college students is of interest due to interactions between alcohol and the developing brain and this is an important age for the development of prospective memory (PM). Fifty-seven first-year college students completed the Self-Rating Effects of Alcohol (SREA), Modified Timeline Follow-back (TFLB), and Alcohol Effects Questionnaire (AEQ) and two measures of PM. The time-based measure required students to close the testing room door in exactly two minutes. The event-based measure required students to sign their name if they encountered a colored sheet of paper in the testing package. Both measures were scored as 0 if no recognition of the task was given, 1 if the task was partially completed or completed late, and 2 if the task was correct. The ongoing task was a packet of paperwork and the MINI DSM-IV-TR. Binge drinking was defined as consuming 5 or more drinks (male), or 4 or more drinks (female), in ~ 2 hours. Surprisingly, students performed better on the time-based (mean = 1.62, s.d.=0.77) than on the event-based measure (mean=0.87, s.d.= 1.00) of prospective memory. Students who had consumed alcohol in the last 30 days performed better on the event-based (mean=0.95, s.d.=1.00) and time-based (mean=1.69, s.d.=0.72) measures than teetotalers (event-based measure mean=0.67, s.d.=0.97; time-based measure mean=1.38, s.d.=0.92). Binge drinking in the last 30 days did not affect performance on the event or time-based measure; however those who drank often (on ten or more occasions in the past 30 days) did perform worse on the event-based measure (mean=0.64, s.d.=0.95) than those did not drink as often (mean=0.96, s.d.=1.00). This suggests that heavy drinking may have a specific detrimental effect on executive functions associated with PM. The findings of teetotalers were not due to religious or cultural differences and may reflect a degree of rigid thinking.

PHYSICS

109.

SELF-ORGANIZED CRITICALITY: THE COMPLEX PHYSICS OF SAND PILES

Lorenzo R. Sewanan '12

Faculty Sponsor: Mark Silverman

The theory of self-organized criticality (SOC) arose from an interesting theoretical problem of describing the dynamics of a system of coupled torsion pendulums in one and more dimensions. With the finding of Per Bak and colleagues that the system computationally entered a critical state characterized by power laws and $1/f$ fluctuations, SOC was proposed as the model for dynamics underlying the creation of ubiquitous $1/f$ signals. In addition, the spatial and time invariant nature of the SOC state was applied to many different systems, physical, biological, economic, and others. In this project, we investigate the most basic SOC model, the sandpile paradigm, through computational simulation of discrete, continuous, random, and deterministic cases. Results from the measurement of sand flow and total sand signals indicate that SOC is not a general phenomenon observable in the sandpile but rather a specific phenomenon limited to certain cases of the sandpile paradigm. Future work would include the estimation of power law coefficients for various cases and the simulation of the random neighbor model, a different case of the sandpile paradigm.

110.

CHARACTERIZATION OF ULTRAFAST ELECTRON PULSES USING FEMTOSECOND LASER PULSES

Sama Shrestha '14

Faculty Sponsor: Brett Barwick

Electrons through the De Broglie relationship can in principle have a very short wavelength enabling their use in the investigation of objects at the microscopic level. By pulsing electrons in ultrashort bursts, temporal resolution of ultrafast dynamics can be attained. These ultrafast electron pulses are created by hitting a metal tip with a femtosecond laser pulse which causes the emission of a very short pulse of electrons. The duration of the electron pulse depends directly on the duration of the laser pulse. In order to characterize the electron pulses, it is important to be able to control the entering laser pulse so that the duration between two induced electron pulses can be measured. A commonly used device to characterize ultrafast laser pulses is an autocorrelator. An autocorrelator works by splitting a single laser pulse into two and then recombining them. By varying the delay between the two pulses by a known delay, a well defined delay is induced in the output electron pulses. Thus the optical autocorrelator can be used to obtain temporal information on the ultrashort duration electron pulses. After characterizing the duration of the electron pulses, they can be used in applications such as ultrafast electron microscopy and electron diffractions.

111.

SONOLUMINESCENCE: LIGHT FROM SOUND

Ryan Zukus '11

Faculty Sponsor: Barbara Walden

By bombarding microscopic air bubbles in water with ultrasound waves, light can be emitted in the visible spectrum. The exact mechanism for this is currently one of the remaining unsolved mysteries in physics.

PSYCHOLOGY

112.

ABILITY BELIEFS, METACOGNITIVE LEARNING STRATEGIES, AND ACHIEVEMENT AMONG UNDERGRADUATES IN WRITING AND QUANTITATIVE

Samantha Alcala '11

Faculty Sponsors: Dina Anselmi, David Reuman

According to Dweck (1999), entity theorists believe their intelligence is fixed and not modifiable, while incremental theorists believe their intelligence is malleable and can be improved with effort. Metacognitive learning strategies are techniques to improve thinking and study habits. Henderson and Dweck (1990) reported that incremental theorists who use metacognitive learning strategies have more positive educational outcomes. Students tend to view writing ability as more modifiable than quantitative reasoning (QR) ability. I predicted that incremental theorists who use more metacognitive learning strategies would report higher grades. This study assessed Trinity College undergraduates' ability beliefs and use of metacognitive learning strategies in relation to their grades on a writing course and a QR course. 200 participants completed an online survey that included questions from Dweck's Ability Beliefs Scale and the Motivated Strategies for Learning Questionnaire (MSLQ), particularly their Metacognitive Self Regulation, Elaboration, Critical Thinking, Effort Regulation, and Time and Study Environment for each course. Students self-reported their grades. The results indicated that students not only viewed writing ability as more modifiable but also used more learning strategies in writing courses. Critical thinking was the least used strategy for both types of courses; fewer students reported using critical thinking in QR courses. All five MSLQ scales predicted grades in writing courses but only Metacognitive Self Regulation predicted grades in QR courses. Ability beliefs did not predict grades. These findings suggest that the use of metacognitive learning strategies may increase student achievement, but the roles of learning strategies differ in important ways in writing and QR courses.

113.

PERCEPTION OF "NATURAL" SPEED OF BIOLOGICAL MOTION

Asiqur Anik '12

Faculty Sponsor: William Mace

This project aims to see if the human visual system can determine if a certain speed of a moving figure is "natural". The term "natural" speed in this case refers to the normal expected velocity of

a movement. In order to figure out how perceived normalcy is affected, the orientation of the moving figure is altered. Studies done by Swedish researcher Gunnar Johansson at Uppsala University has shown that human visual system is very accurate in understanding motion when given minimal cues. In one of Johansson's experiment, a human figure represented by dots indicating several body joints were shown to several observers who were able to accurately determine, not only, the type of motion, but even age, gender and possible emotions of the figure. Our research attempts to further investigate human perception capacity in hopes of advancing the knowledge of the interphase process between biological input (stimulation) and psychological output (perception).

114.

ABILITY BELIEFS, METACOGNITIVE STRATEGY USE AND ACADEMIC ACHIEVEMENT IN MIDDLE SCHOOL AGED STUDENTS

Ada Avila '11

Faculty Sponsors: David Reuman, Dina Anselmi, Debra Avery, Hartford Magnet Middle School

The current study examined the relationship between beliefs about modifiability of ability, the use of metacognitive strategies and academic achievement. Dweck (1990) describes incremental theory as the belief that intelligence can grow and entity theory as the belief that intelligence is an unchangeable entity. Based on previous research, I predicted that an incremental theory of intelligence would predict higher use of metacognitive strategies and higher academic achievement than an entity theory of intelligence. I also predicted that effective use of metacognitive strategies would predict positive academic achievement. The current study also examined the effects of an intervention on beliefs of modifiability, the use of metacognitive strategies and academic achievement. Previous research by Blackwell & Dweck (2007) showed that an intervention had an effect on modifiability of ability and academic achievement; I predicted that an intervention would be effective and result in more of an incremental theory of intelligence in students, increased use of metacognitive strategies and higher academic achievement. In order to determine the effects of an intervention and the relationships amongst ability beliefs, metacognitive strategy use and academic achievement, I studied a sample of 80 eighth grade students at a local middle school. Participants completed a set of questions at the beginning of the third quarter that measured ability beliefs and components of metacognitive learning strategies, self-efficacy, intrinsic value, test anxiety, self-regulation and cognitive strategy use. Then participants were part of either an experimental or control intervention, which were done over two sessions at 45 minutes per session. After the intervention participants completed a set of questions identical to the questions they had completed prior to the intervention. The results showed that there was no significant effect of the experimental intervention when compared to the control intervention. There was a significantly greater tendency to conceive of intelligence more incrementally and an increase in self-regulation over time. Path analyses showed that self-regulation, self-efficacy and intrinsic value significantly predicted course grades. Theory of ability and self-efficacy were significantly mutually predictive. These results show that there are significant relationships among some of these measures and academic achievement.

115.

RELATIONS AMONG PARENT AND PEER ATTACHMENT, EMOTION REGULATION, SELF-ESTEEM, AND RISKY BEHAVIOR IN FIRST-YEAR COLLEGE STUDENTS

Jamie Callahan '11

Faculty Sponsors: Laura Holt, Carol Shilliday

National statistics show that there is a marked increase in risky behaviors, such as substance use and risky sex, when students enter college (National Youth Risk Behavior Survey, 2009). In order to explain this phenomenon, researchers have explored multiple individual and environmental factors that might explain why some students are at higher risk for engaging in these behaviors. The quality of one's relationship with a parent(s) has emerged as one key predictor of student adjustment (Larose, Bernier, & Tarabulsy, 2005; Larose & Boivin, 1998). Accordingly, in the current study it was hypothesized that the quality of first-year students' relationships with parents and friends (parent and peer attachment) would predict the likelihood of engaging in risky behavior. Since few studies have explored more proximal variables that might explain the relations between attachment and risky behavior, the current study explored whether emotion regulation and self-esteem also predicted engagement in risky behavior. It was hypothesized that lower parent/peer attachment would be associated with difficulties in emotion regulation and in turn, problems with emotion regulation would predict substance use. Also, based on previous research, it was expected that higher levels of attachment would be associated with greater self-esteem and that higher self-esteem would predict lower rates of risky sexual behavior.

To test these hypotheses, a sample of first-year Trinity students (N= 69) completed an online survey with questions about their relationships with parents and peers, emotion regulation strategies, self-esteem, alcohol use and related problems, and risky sexual behavior. As hypothesized, close relationships with parents and peers were associated with fewer emotion regulation problems, close relationships with parents predicted a lower intensity of heavy drinking, and higher levels of self-esteem were associated with lower levels of risky sexual behavior. Contrary to the hypotheses, neither quality of parent/peer attachment nor emotion regulation predicted alcohol-related problems, and greater attachment to peers predicted more pronounced heavy drinking and higher levels of risky sexual behavior. Future research should examine other variables besides emotion regulation that might explain the link between parent attachment and heavy drinking. Given that peer attachment was positively associated risky behavior, future research also should examine, in greater detail, how peer attachment influences college adjustment.

116.

AN fMRI INVESTIGATION OF SOURCE MEMORY RETRIEVAL

Patricia Cavanaugh '14

Faculty Sponsor: Nicole Dudukovic

The medial temporal lobe (MTL) of the brain is involved in long-term memory formation. However, it is hypothesized that the hippocampal region of the MTL is active in the retrieval of memories when recollecting episodic details about an event and that the pattern of activation differs depending on the type of details that are retrieved. To test this theory, functional magnetic resonance imaging (fMRI) was used to measure activity in the MTL and specific sub regions including the hippocampus. Participants were shown a series of colored line-drawings while responding to one of two types of questions. They were later scanned while retrieving perceptual details about the color of the drawings, conceptual details about what question they were asked, and recognition tests about whether a picture they were shown was old or new. If an area of the brain was active regardless of the type of details being retrieved, it is a domain-general activity. If it is active only during retrieval of one specific type of details, it is domain-sensitive activity. Statistical parametric mapping (SPM8) was used to process the imaging data from the retrieval tests. By comparing the activity in scans from one participant to another, the statistical significance of overlapping activity in regions will be determined. Knowing how sub regions of the MTL and the prefrontal cortex are engaged in the retrieval of conceptual and perceptual details of an event may help in the understanding of errors and pathologies that contribute to false memories and memory bind deficits that come with the onset of old age.

117.

A STUDY OF PRO-SOCIAL PROSPECTIVE MEMORY IN CHILDREN

Julianne Garbarino '11

Faculty Sponsors: Sarah Raskin, Janet Chang

Prospective memory (PM), the ability to remember to carry out intentions, is important in the daily lives of adults and children alike. Research on PM in children has increased in the past ten years but many questions—particularly concerning motivation—remain. This study looked at a type of PM that has been studied in adults but not yet in children: memory for pro-social intentions. A pro-social intention is one that if carried out, benefits another person, and is more likely to be carried out by adults than is a non-prosocial intention (Brandimonte, Ferrante, Bianco & Villini, 2010). Children ages 7-11 were given a prospective memory task (either pro-social or non-pro-social) and took a computer-based ongoing task during the time between receiving the PM instructions and the time when they were supposed to carry out the task. I hypothesized that, like adults, children would be more likely to carry out pro-social tasks. I also expected that participants who were given a PM task would perform the ongoing task faster but less accurately than those in the control condition who performed the ongoing task in the absence of prospective memory instructions. Results showed no differences in performance on the PM task depending on whether the task was pro-social. There were also no between-group differences in ongoing task performance. Based on these findings, it remains unclear at what pro-social outcomes affect prospective memory performance.

118.

THE ADVANTAGES AND DISADVANTAGES OF COMPUTER-MEDIATED SOCIAL COMMUNICATION FOR SHY AND SOCIALLY ANXIOUS INDIVIDUALS

Erica Klein '11

Faculty Sponsor: David Reuman

The current study examined the relationship between shyness and social anxiety with the use of computer-mediated social communication (CMSC)—communication through cell phones, the Internet, and other communication technologies—by looking at the advantages and disadvantages of CMSC for these individuals as well as the general population. Based on previous research, I predicted that shyness would lead to certain psychological and behavioral benefits as well as costs, and that CMSC would either mediate or moderate (interact with) the effects of shyness. Some benefits I predicted for shy individuals are that they would be able to express their emotions more easily and make more friends through CMSC. Some advantages of CMSC that I predicted shyness would not be associated with are the ease with which people can make and cancel plans. I also predicted that shyness and social anxiety would be associated with some disadvantages, such as feelings of loneliness and problem usage of CMSC. Finally, I expected that shyness would not be related to certain disadvantages of CMSC, such as the likelihood of texting while in a face-to-face conversation, the underestimation of online confidentiality, and the misinterpretation of a text message. An online survey was sent out to a random sample of 400 Trinity students of which 125 responded. The survey included questions measuring the students' shyness, social anxiety, cell phone and Internet use for social communication, and a variety of psychological and behavioral outcomes. Regression analyses were performed to test whether volume of CMSC use mediated effects of shyness and also whether volume of CMSC use interacted with shyness. Shyness predicted students' beliefs that CMSC facilitated the expression of emotions, and this positive effect was mediated by volume of CMSC. Shyness predicted having fewer friends, but this negative outcome was neither mediated nor moderated by volume of CMSC. Additionally, shyness predicted greater self-reported loneliness; this negative outcome was not mediated by volume of CMSC, but an interaction effect occurred in which greater CMSC use reduced loneliness for high-shyness students. Shyness predicted more pathological use of texting but this negative outcome was neither mediated nor moderated by volume of CMSC. Implications of these findings for how CMSC has influenced the way shy people use CMSC and how we communicate will be discussed.

119.

EMERGENT BEHAVIORAL RHYTHMS IN TWO SETTINGS AT TRINITY COLLEGE

Hannah Korsmeyer '11

Faculty Sponsor: William Mace

Neuroscientist Warren McCulloch and physicist Arthur Iberall studied brain processes purely in the context of an organism's activity cycles, from very fast to very slow. Iberall investigated the idea that, like all complex systems, humans live and behave through temporal schedules and natural cycles (Iberall 1995). He developed a theory called homeokinetics, a dynamic extension of "homeostasis", based on the concept that these natural schedules and cycles are an integral and governing aspect of human life, cognition and behavior. Environmental psychologist, Roger Barker showed that there was value in looking at behavioral characteristics of places as well as individuals. Building upon the ideas of Iberall and Barker, this research looks at the temporal characteristics of places. The present research looked at changes in the population of a location on Trinity College's campus over time to discover whether or not there were fluctuations specific to that location. Observations were made approximately three times per day for two months at the gym and library to count the number of people present in the spaces. Additionally, gate count

data from the entrances of the library spanning the years 2004-2010 were analyzed with a Fourier transform. Both sets of data were analyzed to define the natural patterns of activity within each space on campus. Preliminary results indicate distinct cyclical patterns of activity in the library, especially on a 24-hr cycle, yearly cycle and 6-month cycle. These findings indicate that, while decision-making may be a discrete cognitive process that can be attributed to specific brain locations, actual decision-making within the context of a person's life is the result of many scheduling constraints.

120.

THE PERCEPTION OF HUMAN MOTION THROUGH AIR VERSUS WATER

Ewen Kronemeyer '14

Faculty Sponsor: William Mace

Point-light displays, now commonly called “biological motion” displays, are video presentations of motion depicted through a series of moving dots. They have traditionally been created by placing dots on key areas of the human body, such as the hands, head, and feet. A human model is then filmed performing a specific action. When the motion of the dots against a blank background is shown to participants, they have consistently perceived a number of properties of the action being filmed. However, little research has been done on the perception of the medium of the motion. Two point-light display videos were created depicting an easily replicable motion; a model was told to place his elbow on a surface and to then repeatedly raise his hand and hit the ground. Dots were placed on the model's shoulder, elbow, wrist, and hand. The first point-light video filmed this motion through air, and the second point-light video filmed this motion through water. The “air” video was slowed to match the speed of the “water” video. Since the resistance of a medium is a function of the velocity of the motion through it, alleviating discrepancies in the velocities of the motions isolated the effects of the resistances. Participants will be asked to view both videos, and will then be asked to explain any visual discrepancies that they perceive between the two. Given that the viscosity of water is much different than the viscosity of air, the results of this experiment will show the importance of resistances on motion. In other words, the results of this experiment should reveal whether water alters the limb components of a basic motion, rather than solely affecting the speed of the motion.

121.

THE EFFECTS OF EXERCISE ON THE SUCCESS OF COGNITIVE REHABILITATION IN SCHIZOPHRENIA

Amelia Lewis '11

Faculty Sponsors: Sarah Raskin, Matthew M. Kurtz, Ph.D., Mara De Maio, Ph.D., Hartford Hospital, Institute of Living

Recent research has shown that computerized cognitive rehabilitation (CR) leads to significant improvements in cognitive functioning, especially in speed of information processing and reasoning/ problem solving. Additional research has indicated that exercise also helps to improve neurocognitive functioning, particularly in tasks related to executive functioning. This study examined 22 schizophrenic patients engaged in both CR training and weekly exercise. Participants were grouped and compared based on exercise frequency. Performance was measured on the Brief Test of Attention (BTA), Penn Continuous Performance Task (PCPT), Trails A & B, and the Digit Span, Symbol Search and Letter-Number Sequencing from the WAIS-III. I hypothesized that CR would produce a greater improvement when combined with exercise in schizophrenic patients. Results showed that exercise frequency was positively correlated with CR intensity. While there was no difference between exercise groups on any of the neuropsychological outcome measures, trends showed the frequent exercise group had a higher mean score on the BTA and faster reaction times on both the PCPT and the Trails B. Surprisingly, the sporadic exercise group had significantly greater improvement on both the symbol searching task and the Trails B task between pre and post-testing. The results suggest that while exercise frequency is strongly related to CR intensity it doesn't necessarily lead to any improvements in the efficacy of the CR. Additionally, we must consider the generally higher pre-test scores of the frequent exercise group and what those might indicate regarding both room for improvement and the issue of self-selection.

122.

THE USES OF EXPRESSIVE THERAPIES AS EFFECTIVE TREATMENT MODALITIES AND CREATIVE OUTLETS FOR IMPAIRED AND TYPICALLY DEVELOPING INDIVIDUALS

Kaitlyn Mazzilli '11

Faculty Sponsor: Randolph M. Lee

This project will explore the applications of expressive therapies for both impaired as well as typically developing individuals. The emerging field of expressive therapies uses arts-based interventions for psychological treatment. Of the many specializations in expressive therapies, I will consider the uses of art, music, and dance/movement therapy as treatment modalities and creative outlets. In a review of these methods, I will examine the potential benefits and opportunities for expressive therapies to promote measureable changes in individuals at all levels of physical and psychological functioning. I will also question whether more recognition and research should be dedicated to this developing field. In addition to my research, I will perform a small experiment to observe the potential of art-based projects for the reduction of stress in typically developing students at Trinity College. The aim of this study is to explore the central argument that expressive therapies provide legitimate and effective means of therapy and creative outlets for both physically and psychologically impaired, as well as typically developing individuals to better their social and emotional well being.

123.

THE EFFECTS OF PLAYING SINGLE-SEX SPORTS VERSUS COED SPORTS ON SEX-STEREOTYPING IN CHILDREN

Ashley Meilleur '11

Faculty Sponsor: Dina Anselmi

Research on gender stereotypes suggests that gender stereotypes for certain sports may influence who elects to participate and how participants are viewed by others (Alley and Hicks, 2005). The current study looked at gender stereotyping measured by an adapted version of the Children's Occupation, Activity, and Trait Scale (COAT) and stereotype consciousness measured by the stigma consciousness questionnaire (SCQ) in children who participate in single-gendered sports versus co-ed sports and their parents. Children ages 8-10 years old were studied since at this age children may still be participating in co-ed sports or have recently entered single-gendered sports participation. The study also looked at sports participation and gender stereotyping attitudes of the parents to see if there is any relationship between the sex stereotypes of parents and their children. I hypothesized that children who participate in coed sports will be less likely to engage in gender stereotyping or to experience stigma-consciousness than children who participated in single-sexed sports. In addition, I predicted that children whose parents exhibited more stigma consciousness would also exhibit more stigma consciousness and engage in gender stereotyping. Parents and children were recruited through Glastonbury Hartwell Soccer Club and Glastonbury Little League Organization. Our findings demonstrated that parent's stigma consciousness was correlated to their child's stigma consciousness. We also found that children's sports participation and sports attitudes were related to the degree of their stigma consciousness.

124.

ABILITY BELIEFS, LEARNING STRATEGIES, AND ACHIEVEMENT: A COMPARISON OF TRADITIONAL AND NON-TRADITIONAL AGED UNDERGRADUATES

Ivica Pavisic '11

Faculty Sponsors: Dina Anselmi, David Reuman

This study examined the differences in beliefs about the modifiability of abilities and the use of learning strategies for traditional aged undergraduates (TAUs) and non-traditional aged undergraduates (NTAUs). I hypothesized that, compared to TAUs, NTAUs would believe more strongly in the modifiability of general intelligence, quantitative reasoning, and writing ability. I also predicted that NTAUs would use more learning strategies in writing and quantitative reasoning courses than would TAUs. Finally, I predicted that incrementalist beliefs and the use of learning strategies would be positively correlated with grades in a writing course and a quantitative reasoning course for both TAUs and NTAUs. A random sample of 200 traditionally-aged Trinity College undergraduates and a census of all students in the Individualized Degree Program (IDP) were given an online survey consisting of a modified version of Blackwell, Trzesniewski, and Dweck's (2007) Ability Beliefs Scale, several subscales from Pintrich's (1991) Motivated Strategies for Learning Questionnaire (MSLQ) pertaining to a quantitative reasoning course and a writing course, and questions asking about overall grades received in said courses. I found that NTAUs were more incrementalist in their attitudes towards quantitative reasoning and writing ability than were TAUs, and that NTAUs used more learning strategies in both quantitative reasoning and writing courses than did TAUs. Incrementalist beliefs were not correlated with grades for either course for either group, and learning strategies were consistently only predictive of grades for TAUs. The majority of research pertaining to college students has been primarily performed on TAUs; NTAUs remain relatively unstudied. These findings suggest that there are demonstrable differences in the ways that NTAUs perceive and carry out coursework.

SOCIOLOGY

125.

POLITICAL CONFLICT IN RESOURCE RICH COUNTRIES

Erica Bertoli '14

Faculty Sponsor: Keely Stater

In her book "Global Outlaws", Carolyn Nordstrom states that "resource rich countries are four times more likely to be engaged in political conflict than more normally endowed states." (Nordstrom 12) She owes this statistic to the implications of the characterization of certain resource rich countries as "frontiers" (Nordstrom 12); that is, countries marked by "immense freedom, danger, and profit." This paper thus addresses the gap between raw data and conclusions by analyzing whether resource rich countries are at a higher risk for political conflict than normally endowed states, and if so, why (ie what factors allow this). Using raw data from Polity IV (<http://www.systemicpeace.org/inscr/inscr.htm>), by analyzing the relationship between a country's GDP and it's total level of civil and political violence we can then determine whether resource rich countries are more likely to be engaged in political conflict using regression in Stata. My independent variable is a country's GDP, while the dependent variable is a country's total level of civil and political violence. My hypothesis is that as a country's GDP increases, then it's total level of civil and political violence rises as well. Interestingly, my preliminary findings suggest that resource rich countries are actually less likely to be engaged in political conflict, which directly contradicts Nordstrom's assertion (along with my original hypothesis).

126.

PUBLIC VERSUS PRIVATE: WHICH HIGH SCHOOLS BETTER PREPARE THEIR STUDENTS TO STUDY AT TRINITY COLLEGE?

Chloe Boullier '13, Dana Shaker '13

Faculty Sponsor: Keely Stater

Trinity College, a liberal arts college in Hartford, Connecticut prides itself on the diversity of its student's backgrounds. Indeed, every year the College invests time and money towards recruiting academically gifted students from both public and private schools across the country. However, it is indisputable that the College enrolls a significant percentage of privately educated students, a higher percentage than the proportion of students nationwide that graduate from private secondary schools. While this large percentage may suggest that privately educated students are better prepared to attend a prestigious liberal arts school like Trinity, there are a multitude of reasons that could explain this matriculation pattern. In this paper, we try to understand whether privately educated students are actually better prepared than publicly educated students for the level of academic rigor at Trinity. With data from Trinity's Institutional Research Department on matriculated students from 2001-2010, we use regression analysis to examine the impact of private versus public school preparation on student's standardized test scores, three admission ratings and end of the first year grade point average. We expect to find that private school graduates ultimately have higher end of the first year grade point averages compared to public school graduates. This hypothesis, whether rejected or accepted, can help the admissions office at Trinity College as they prepare to begin the laborious recruiting process for the class of 2015.

127.

ANALYSIS OF RACE, GENDER, AND SOCIO-ECONOMIC CLASS ON ONE'S MENTAL HEALTH

Rachel Carey '11, Aymara Heath '14

Faculty Sponsor: Keely Stater

While many consider an individual's mental health to be unrelated to social status, there are differences in how race, gender, and socioeconomic status might contribute to a person's reported mental health outcomes in terms of access to treatment, education about mental illness, and the stigma attached to seeking treatment. Moreover, the majority of the current literature attempts to separate one's race, gender, and socioeconomic status from one another in their effects on mental health, completely disregarding their combined effect in influencing mental health outcomes. For example, both Linda George (2003) and Nancy Adler (1999) focus on single factors, race for George and socioeconomic status for Adler, when examining mental health.

This paper addresses this gap in the literature by examining differences in race and gender, socio-economic status and gender, and socio-economic status and race in the impact on mental health outcomes, instead of treating each as one single factor. Using data from the U.S. Department of Justice, "Gender, Mental Illness, and Crime in the United States 2004" (Thompson, 2004), we utilize regression analysis to examine differences between the combined identified factors and their relationship to on mental health outcomes. Our dependent variable, mental health, will be measured by HEALTH2 (overall health recode), DEPEPISODE (major depressive episode in a lifetime), and TXEVERDUMMY (ever received substance abuse treatment) while our independent variables race, class, and gender will be measured by SEXRACE (combined gender by race indicator) and INCOME_R (individual income). Our findings suggest that efforts should be made to increase education about mental illness and access to treatment to women of racial minorities, and women from lower socio-economic classes.

128.

EASTERN EUROPEAN DIASPORA IN HARTFORD: POINTS OF CULTURAL LOCUS, BUSINESS & PRACTICAL DEMOGRAPHICS

Janaki Challa '11

Faculty Sponsor: Keely Stater

Immigration to the United States has skyrocketed in the past ten years—both in documented and undocumented cases. This exposition aims to explore the symbiotic and symbolic relationship between organizations of particular ethnic groups and the distribution of "cultural centers" urban metropolises. Hartford's social demographics are diverse and complex. The city, as it is a classic trait of most urban metropolises in the Northeast, is involuntarily structured with large clusters of different ethnic groups depending on city zone. I am interested in looking at Hartford's Eastern European diaspora, particularly around the Franklin Ave.

The general purpose of this paper will be to examine the distribution of various Eastern European populations around the Franklin Avenue area. Preceding research showed that a large concentration of these populations hail from Albania, Bosnia, and Ukraine. What are some of the “cultural locuses” that arose from these particular populations in Hartford? Why has there been an accumulation of these particular ethnic groups around Franklin Avenue and what is the correlation between the businesses and the ethnic concentrations in the area?

Using various Census data, Social Explorer, Stata and databanks, I will assemble a set of variables (ethnic groups) against the constants (businesses, cultural/recreational centers). These variables will be measured using Regression and Multivariate Analysis.

This exploration will help me understand the dialectical relationship between population characteristics (ie. Culture, religion, ethnicity) on the institutional demographics in Hartford—from the strategic locations of cultural centers to businesses, and the general clusters of people that both create and define them.

129.

STATISTICAL ANALYSIS OF MAJOR LEAGUES BASEBALL VERSUS NATIONAL BASKETBALL ASSOCIATION SALARY CAP

John Greenough '13

Faculty Sponsor: Keely Stater

Recently many sports fans throughout the United States have become critical of the current salary system that is in place within the sport of baseball. These critics claim that by not having a salary cap it provides an unfair advantage to those teams who generate more revenue and can therefore afford better players which results in winning more. However, we know little about the statistical relationship between the winning percentages of baseball, which does not have a salary cap, in relation to the winning percentage of sports that do have salary caps in place, more specifically basketball. Studies show that there are many factors that influence how teams win, including teams salary/payroll. This study will first examine if there is a correlation between the GDP of a city and the teams winning percentage. It will then examine if there is a direct correlation between winning percentage among professional baseball teams in relation to the salaries they have and comparing the correlation to professional basketball that has issued a salary cap within the last twenty years. By analyzing data that comes from the Entertainment Sports Programming Network (ESPN) as well as previous articles written on similar topics collected through Google Scholar and data from the U.S. Bureau of Economic Analysis, a regression model can be formed which analyzes the overall relationship between the various data points. Based on prior research, this study is expected to show a direct correlation between the winning percentage, team salary, and GDP of a city in the sport of baseball, while little or no correlation of those factors in basketball.

130.

SOCIAL INEQUALITY IN THE AMERICAN CRIMINAL JUSTICE SYSTEM

Brittney Huffman '13, Adam Skaggs '13
Faculty Sponsor: Keely Stater

“For the same criminal behavior, the poor are more likely to be arrested; if arrested, they are more likely to be charged; if charged, more likely to be convicted; if convicted, more likely to be sentenced to prison; and if sentenced, more likely to be given longer prison terms than members of the middle and upper classes” (Reiman). This statement describes a very disturbing flaw in the American criminal justice system and is a clear reflection of the unequal treatment of the different socially constructed classes that are present in our society. In order to shed light on this “social class gap” in the justice system and attempt to solve the problem, we must first identify who is socially considered to be a member of the lower class and how their treatment is different from members of the upper class for the same criminal behavior. This data can be collected from statistics, interview transcripts with inmates, and articles discussing previous research on this topic. This paper addresses the social class gap in the justice system by examining the factors that determine whether a member of the poor class is more likely to be convicted and sentenced to longer jail time than a member of the upper class. Using data from the ICPSR, we use linear regression analysis to estimate the impact of class on length of jail term. We expect to find that on average, the poor are more likely to be arrested, charged, convicted, and sentenced to longer prison terms than the rich for the same criminal behavior. Our findings suggest that the social class gap in the criminal justice system is a major social problem in America that can only be fixed by altering the structure of our society.

131.

DOES BEING AN ATHLETE IMPACT ACADEMIC ACHIEVEMENT? EXAMINING THE EFFECT OF ATHLETICS ON STUDENT SUCCESS RATE

Kerry McCarthy '13, Emma Wilson '13
Faculty Sponsor: Keely Stater

Previous studies on participation in sports and academic achievement have shown that athletes at large Division I schools have been less successful than non-athletes at the same schools. However, little research examines possible differences in academic success rates across NCAA divisions or between men’s and women’s sports. This paper utilizes regression analysis to estimate the differing impact of participation in athletics on a sports team’s overall academic achievement by NCAA division and gender of the team. This information can help aid prospective students in their decision to possibly participate in a college sport. Furthermore, schools can use this data to show prospective students the benefits of participating in college athletics. Success and Progress Rate Data are collected by the NCAA each year on men’s and women’s sports teams from colleges in the U.S. The data files are collected at the institutional level, with data by gender, race, and sport at the team level for both student-athletes. Based on preliminary research, we expect to find that athletes at Division I schools have lower academic success rates than their counterparts at Division II and III schools. Furthermore, male athletes who participate in popular sports, such as basketball, football, and hockey, will have lower academic success rates than female athletes participating in the same sports. We argue that such a lower rate of achievement by gender and NCAA Division is related to a higher chance of becoming professional athlete and the possibility of having a career in professional sports. The potential financial draw reduces the benefit of receiving high grades and the level of play reduces the time athletes have available to study. Our initial findings show that female teams at a Division I level generally have a higher academic progress rate than male teams.

132.

DID CONSUMPTION BEHAVIOR OF 13-18 YEAR OLDS INCREASE AFTER MTV?

Gustavo Morales, Jr. '12, Wendy Huang '13

Faculty Sponsor: Keely Stater

MTV has become a source of information in contemporary trends for many adolescents, allowing MTV to focus most of its marketing towards that specific age group. In fact, studies have shown that 13-18 year olds, given that this is widely known as the adolescence period, generally consume more, specifically for themselves, and spend most of their leisure time using technology (i.e. watching television) (Walker, 1996). MTV has not only been an icon of the music world, it has also been an icon of the youth. Previous studies have suggested that the emergence of television watching prompted an increase in consumption behavior (Schor 2004). However, the role of MTV has been investigated very little, if any at all, in regards to teen consumption behavior. This paper examines how consumption behavior of 13-18 year olds has changed after the birth of MTV in 1981, particularly to determine whether or not it has increased. Using data sets from Monitoring the Future: A Continuing Study of the Lifestyles and Values of Youth (1976, 1980, 1985, 1995, and 2009), we used a multiple regression model to determine the relationship between various predictors (namely, television watching) and consumer behavior ([window] shopping frequency) during the years mentioned. By doing so, we were able to see changes in consumer attitudes after the emergence of MTV. Based on preliminary research, we expected to find a significant increase in consumerism among teens. Our findings suggest that increased consumer behavior in adolescents is a clear indicator of accelerated emergence of adulthood: not only has consumer behavior been changing in 13-18 year olds, consumer activity in younger age groups has changed as well, as a result of significant influence of media. Consequently, teen culture has migrated down to children, ultimately shifting the period of adolescence.

133.

**IS EXCESSIVE WORKING AFFECTING STUDENTS' ACADEMIC PERFORMANCE?
EXAMINING THE FACTORS THAT REQUIRE STUDENTS TO WORK AND THE
IMPACT OF WORK ON GPA**

Begaeta Nukic '11, Holly Rodriguez

Faculty Sponsor: Keely Stater

Part-time employment has become a common feature of full-time university students. Increasingly, the number of students turning to part-time work in addition to their full-time studies is on the rise due to rising costs of college tuition and fees, and the decrease in available funds available to see them through their educational years (Broadbridge and Swanson 2005; Ford, Bosworth, and Wilson 1995; James et al. 2007; McCartan 1988). This study examines the effects of part-time work of full-time students and asks up to what point does working become detrimental to their college careers. With data from the National Longitudinal Survey of Youth from 1997 which followed the lives of a sample of American youth born between 1980 and 1984, we employ regression analysis to assess the impact of hours worked on academic success as measured by GPA. We find that the impact of part time employment varies based on age of the student, the number of hours the student works, the place of employment, and whether it is career-related job.

Our findings illustrate that there is a clear negative relationship between students' employment and academic success. This relationship is particularly negative when students work for more than 20 hours per week. Due to this negative impact, universities may consider setting limits on the number of hours student is allowed to work. At the same time, universities may consider increasing financial aid for those students who are burdened by high cost of higher education. Decreasing the need for students to work would improve their academic performance.

134.

ADVERTISING AND CAPITALISM

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Faculty Sponsor: Keely Stater

The effects of advertisement on capitalism are something that goes beyond the consideration of most American consumers. Generally, people consume what they purchase purely based on necessity; however what people fail to reflect on is why they buy the things they do. Why do people spend extra money on brand names, or luxuries that they do not need, when more affordable alternatives are available? Advertisement has expanded to virtually every media outlet the nation has, and as a result consumers flock to consume the products that they are told to every minute of every day. Through extensive research and data analysis provided by the 2000 census as well as the ICPSR, my partner and I have examined the effects of advertising on consumption, specifically in the fashion industry. Are fashion products that are advertised heavily more consumed on a national scale, and to what extent are the two related? My partner and I used a bivariate analysis, with the direct variable being consumption of fashion products (particularly brand name clothing) and the indirect variable being advertisement. With our findings, fashion and clothing companies will have a better understanding of how advertisement can affect the production and consumption of their products as well as other competing products.