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TWENTY-FIFTH ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

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BIOLOGY

1.

BIRD STRIKES IN URBAN HARTFORD, CT

Shawna Altdorf '12

Faculty Sponsor: Joan Morrison

Collisions with windows account for approximately one billion bird deaths per year in the United States alone. Previous studies in New York City have shown that buildings with high glass coverage and a small distance to vegetation have increased bird strikes. This study observed bird strikes in urban Hartford, CT area in two collection periods. The first collection period covered fall migration (September – November 2011) and the second covered spring migration (March 2012 – present). Bird fatalities due to window strikes were recorded at six buildings in downtown Hartford, the Two Rivers Magnet School in East Hartford and Trinity College. During fall collection period 29 fatalities were collected of which 22 were migrants (10 long distance and 12 short distance) and two were resident species. Bird counts in parks along the Connecticut River conducted in fall 2001 to 2004 were comprised of mostly short distance migrants and residents. Fall window strike fatalities in Hartford were mostly comprised of long distance and short distance migrants suggesting that migrant birds are not as accustomed to urban environments as are resident birds. Spring counts in the two parks show a similar pattern and spring fatalities already found are short distance migrants suggesting that future spring fatalities are likely to be migrants. Therefore, migrants are of more conservation concern because they seem to be more susceptible to window strikes. Results for the spring migration data will be presented at the symposium.

2.

PHENOLOGIC SHIFT: ARE HAWKS ON THE EAST COAST ADAPTING THEIR MIGRATORY PATTERNS TO CLIMATE CHANGE?

Jason Baird '14

Faculty Sponsor: Joan Morrison

Hawks and many other species migrate up and down the east coast. Climate change, however, has begun to affect this movement in many cases, delaying fall migration, as species can safely stay in northern nesting areas for longer periods. The trigger for migration is still up for debate, however; for some species it appears to be hard-coded, unaffected by a temperature shift, while others easily shift their phenology back and forth to match the current temperatures. Hawks have been shown to migrate along the east coast; can they shift the timing of their migration to make up for the climate shift? I investigated mean and median passage dates of four hawk species at three hawk count sites in Pennsylvania and Connecticut, over a forty- to eighty-year period. This study did not show a significant shift in median or mean arrival date among any of five hawk species at the Hawk Mountain count site in Pennsylvania, but suggested a delay in red-tail fall passage date at both the Quaker Ridge and Lighthouse Point sites in Connecticut. Due to the high degree of variability in passage date and northern breeding grounds, it is difficult to determine the causes of a delay, if any - age differences, local weather patterns, weather and conditions at nesting sites, and prey population shifts could all account for any trends noted here.

3.

PHROM DIRT TO DNA: ARCHERS7 PRODUCES A SEA (C₁) OF INFORMATION

Arjun Bedi '15, William Blaine '15, James Curlin '15, Tiffany Damiani '12, Amy Kivela '12, Yuwan Lam '15, Varun Ram '15, Cole Sylvester '15, Abigail Whalen '15

Faculty Sponsors: Kathleen Archer, Robert Fleming, Trinity Genomics Research Program, Howard Hughes Medical Institute SEA Program

In conjunction with the Science Education Alliance (SEA) of the Howard Hughes Medical Institute, Trinity College welcomed a new scientific program this year – the Genomics Research Program. Seven first year students undertook the task of individually isolating a unique bacteriophage from soil samples taken from around their homes or on the Trinity campus. The soil samples were enriched with *Mycobacterium smegmatis* to propagate, and eventually isolate through plating and titring, any bacteriophage that invade this close cousin of *Mycobacterium tuberculosis*. Once successfully isolated, all seven isolated phages were viewed under a transmission electron microscope to study their morphological and phenotypic attributes. Phage were characterized by plaque morphology, electron microscopy and restriction digests of purified phage DNA. Individual experiments to determine phage properties included testing for requirements of calcium or magnesium for growth, temperature requirements and determination of lytic properties.

To choose phage for more complete analyses, students participated in a “Phage Olympics” where they presented their characterizations of the phage in the hopes of having the most unique and worthy phage for further analyses. From this event two phage, ArcherS7 and Whabigail7, were selected and sent to the University of Pittsburgh for DNA sequencing.

ArcherS7 was sequenced and chosen for annotation during the spring semester. This phage belongs to the C₁ cluster of mycobacteriophage and is characterized by an unusually large head and very short tail. It produces small, clear plaques and has a hexagonal capsid that contains 156,558 base pairs of DNA in its genome. Using several gene prediction algorithms – Aragorn, DNA master, Glimmer, GeneMark, BLAST, HHPred, and Phamerator - we annotated each gene in the sequence finding approximately 230 genes and 31 tRNAs.

4.

IS HELMINTHOCLADIA IN THE WESTERN ATLANTIC REALLY THE SAME AS *H. CALVADOSII* FROM EUROPE?

Tayoot Chengsupanimit '14

Faculty Sponsors: Craig W. Schneider, Thea R. Popolizio, Thomas A. Shamp, Christopher E. Lane, Department of Biological Sciences, University of Rhode Island, Kingston, RI, 02881, U.S.A.

Western Atlantic specimens of *Helminthocladia* were initially identified as *Helminthora divaricata* J. Agardh when it was first collected and reported from the Florida Keys by Harvey in 1853 and from Bermuda by A.F. Kemp in 1857. When later workers studied these western Atlantic specimens [fide Phycotheca Boreali-Americana no. 2035 (1915)], they found them to be better identified as a second European species, *Helminthocladia calvadosii* (J.V. Lamour. ex Duby) Setch. (type locality: Calvados, France), thus even changing the original generic placement. Since the initial collections in the western Atlantic during the mid-1800s, *H. calvadosii* has also been found in the Caribbean Sea and as far south as northern Brazil. Recent

winter collections of *H. calvadosii* from Spanish Point in Bermuda have provided good comparative anatomical material and yielded COI-5P sequences for genetic barcoding and *rbcL* sequences for phylogenetic comparison. These specimens have gross morphologies that are somewhat reminiscent of eastern Atlantic plants of *H. calvadosii* and demonstrate anatomical features that greatly overlap European specimens. Our molecular results will begin to elucidate the relationships of the Bermuda isolates with *H. calvadosii* from near the type locality and their generic placement within the Liagoraceae.

5.

MORPHOGENESIS OF THE PLACENTAE OF THE GARTER SNAKE *THAMNOPHIS ORDINOIDES*

Jessica Chin '12

Faculty Sponsor: Daniel Blackburn

Although about 80% of lizards and snakes species lay eggs, the other 20% of squamates give birth to live young, which is known as viviparity. These viviparous species have placentae that change throughout gestation and function in supplying the embryo with oxygen and nutrients. My research focuses on the viviparous garter snake, *Thamnophis ordinoides*. I use light microscopy techniques to analyze and record the morphogenesis of the garter snake placentae. I have been able to view the three distinct placentae in the series and can discuss the key morphological differences. The first placenta to develop (choriovitelline placenta) is formed by the vascularized yolk sac in apposition to the uterine lining. This placenta presumably accomplishes gas exchange early in development. It is soon replaced by an omphaloplacenta, formed out of the avascular yolk sac. It contains absorptive cells that are thought to take up maternal secretions. During the last half of gestation, the chorioalloantoic placenta gradually replaces the yolk sac placenta. As a result, by late gestation, the developing embryo is entirely surrounded by a vascular membrane that functions in gas exchange. In the future, we hope to quantify the characteristics that I currently am able to describe qualitatively.

6.

THE EFFECTS OF SMOKING ON BACTERIAL COMMUNITIES OF THE UPPER RESPIRATORY TRACT

Tiffany Damiani '12

Faculty Sponsor: Lisa-Anne Foster

Bacterial communities and their hosts are associated in a complex symbiotic relationship. The normal flora of the human body colonize various sites, coating mucosal membranes and external surfaces of the host. Colonization with these organisms has been shown to aid in some functions of the host and may reduce the host's susceptibility to disease through a variety of protective factors. The normal flora, more specifically, α -hemolytic strains of Streptococci, are known to block attachment sites of pathogenic bacteria, compete with pathogens for resources, and produce antimicrobial peptides such as bacteriocin. It is hypothesized that an inverse relationship exists between systemic disease and populations of normal flora. Behaviors such as smoking and alcohol consumption in addition to health conditions such as asthma may cause disruptions in the normal flora. This alteration of the microbiota may adversely affect the host, allowing pathogens to gain access to and colonize host tissues. This preliminary study investigates the effects of smoking on the composition of the bacterial communities of the upper

respiratory tract. Terminal restriction fragment length polymorphism (tRFLP) was employed after PCR amplification of the 16s rRNA gene to examine the composition of the bacterial population in oropharyngeal samples. Upon sample collection from student volunteers at Trinity College, a basic health status survey was completed. The surveys were examined to illuminate any health factors that may affect bacterial composition. The tRFLP profiles of smokers had significantly fewer peaks than those of non-smokers, correlating to the presence of fewer bacterial species in smokers than in non-smokers. These data indicate that smoking limits the microbial diversity in the upper respiratory tract. A database of tRFLP profiles produced by known pathogens and known normal flora was constructed to use as a means of identifying bacteria of interest within an unknown oropharyngeal sample in future studies.

7.

EXAMINATION OF TOTAL MERCURY IN TERRESTRIAL WILDLIFE SPECIES IN HARTFORD, CT

Gina Dinallo '12

Faculty Sponsor: Joan Morrison

Mercury contamination is a global issue affecting both wildlife and humans. Mercury has traditionally been studied in various aquatic species because human pollution from numerous sources causes mercury to leach into adjacent bodies of water. In this study, the total mercury levels in terrestrial vertebrate and invertebrate samples from urban Hartford, Connecticut were analyzed using a DMA-80 instrument. Red-tailed hawks were expected to have the highest average total mercury concentrations due to bioaccumulation; however, among all vertebrate samples, the hawks had lower than expected mercury concentrations. This may be because the hawks primary prey item is squirrels, which had even lower concentrations. Common Yellowthroats had the highest average total mercury concentration of all songbird species sampled, measuring 1.5 ppm. Values obtained from various invertebrate orders indicate that the predatory Araneae (spiders) and Diptera (flies) had relatively high total mercury concentrations compared to other invertebrates sampled. The high mercury levels in insectivorous species such as Common Yellowthroat further supports diet as the source of mercury. Given that adverse effects are known to occur in avian species with mercury concentrations as low as 0.5 ppm, the data obtained suggest Hartford terrestrial wildlife species may be at risk for negative effects from mercury accumulation.

8.

WILDLIFE APPEARANCES AT COMPOST PILES: DO KITCHEN SCRAPS AFFECT WINTER/SPRING VISITORS?

Stephanie Fisher '12, Billy Watts '13, Pierre Plath '13, Bridget Tevnan '14

Faculty Sponsor: Scott Smedley

Composting by households has become very popular in recent years. There has been a long untested claim that adding animal scraps to a compost pile would increase scavenger visitation. To test this claim, we used three different compost piles: one with only vegetable scraps, another with a mix of vegetable and animal products and a control pile. Each pile had heat-in-motion sensitive cameras to capture images of visitors. Comparing three winter/spring replicates from our overall experiment, we tested the hypothesis that there will be more animal visitors at the mix pile compared to the other two, but more at the vegetable pile than the control. We found that an overall trend of more visitors at the mix pile, suggesting that the combination of animal

and vegetable products attracted more visitors during winter/spring months. Throughout these three replicates, crows, opossums, grey squirrels, and grey fox, were frequent visitors, which at the species level reflected the overall preference for mix pile.

9.

CONSTRUCTING A DATABASE OF KNOWN BACTERIAL SAMPLES FOR TRFLP PROFILE ANALYSIS OF UNKNOWN OROPHARYNGEAL BACTERIA FROM ASTHMATIC AND NON-ASTHMATIC CHILDREN

Stephanie Garcia '15, Sara Khalil '15

Faculty Sponsor: Lisa-Anne Foster

Bacteria have been stigmatized as harmful and pathogenic, yet many species are in reality necessary to the human body. The body harbors many protective bacteria, which serve as a line of defense against pathogens. Protective bacteria thrive in the upper respiratory tract, also referred to as the oropharynx. However, there are many conditions that affect the respiratory tract, such as asthma. In this project, a database of known bacteria will be expanded and eventually used as a reference to analyze and compare the oropharyngeal bacterial presences in asthmatic and non-asthmatic children. The bacterial species that were studied include *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Streptococcus salivarius*, *Streptococcus sanguinis*, *Staphylococcus epidermidis* and non-typeable *Haemophilus influenza*. Terminal Restriction Fragment Length Polymorphism (tRFLP) profiles, graphs that create several series of peaks unique to different species, help identify protective bacterial species and quantify populations. The presence of a gene universal to all bacteria, the 16s rRNA gene, can facilitate the analysis of and differentiation between the known bacterial species used to build the database. Through molecular techniques and tRFLP profiles, the known bacterial species can be turned into readable graphs based on their fluorescently labeled terminal fragments of their 16s rRNA gene. These tRFLP profiles can later be used for comparison with profiles of unknown bacterial samples in order to identify and quantify their population.

10.

ASSESSING THE EFFECTS OF PREDATION RISK ON ESCAPE BEHAVIOR IN THE EASTERN GRAY SQUIRREL (*SCIURUS CAROLINENSIS*) IN AN URBAN ENVIRONMENT

Lindsay Gibbons '12

Faculty Sponsor: Michael O'Donnell

Wildlife are more frequently interacting with humans because their natural habitats are being altered as a result of the increase in worldwide urbanization. In order to utilize these new environments, some animals have modified their behaviors in the presence of humans. Flight initiation distance (FID), the distance at which an organism initiates flight in response to an approaching predator, measures how the organism perceives its risk of predation established by that specific predator. This experiment investigated how the FID of foraging eastern gray squirrels (*Sciurus carolinensis*) varied based on the style of approach by human stimuli and level of human exposure in an urban environment. The FIDs were measured on dry days from early winter to spring, at eleven sites with varying levels of human exposure, on or adjacent to the Trinity College campus. The results indicated that FIDs were greatly affected by the style of approach (walking with waving of arms vs. walking with no waving of arms) and the level of

human activity, but not by the color of the stimuli. There were no differences in FIDs when the approaching human was wearing a green shirt or a red shirt. The foraging squirrels had significantly greater FIDs when the approaching human was waving her arms. We found that FIDs were the lowest in the test site with the highest amount of human exposure and the FIDs increased as the level human exposure decreased among the various test sites. The results suggest that eastern gray squirrels in the areas of frequent human exposure have developed a decrease in anti-predator behavior in response to the repeated approach by humans via habituation. Since humans do not commonly approach squirrels while waving their arms, this could explain why the FIDs were greater among the sites. Even though eastern gray squirrels in urban environments have decreased their anti-predator behavioral responses to humans, these behavioral responses can also vary among microhabitats.

11.

A MOLECULAR-ASSISTED ALPHA TAXONOMIC STUDY OF A PUTATIVE *ETHELIA* SP. (PEYSSONNELIACEAE, RHODOPHYTA) FROM BERMUDA

Amy K. Kivela '12

Faculty Sponsors: Craig W. Schneider, Thea R. Papolizio & Christopher E. Lane, Department of Biological Sciences, University of Rhode Island, Kingston, RI, 02881, U.S.A.

Knowledge of the various red algal fleshy and calcareous crusts of Bermuda is limited, owing to little research in this Atlantic archipelago in the historical past. The present study investigates a common, deep water, rock conforming, fleshy red crust identified in the recent past as *Polystrata* species. Genetic barcoding of red algae using the conserved mitochondrial COI-5P sequence has recently been shown to be an effective tool to gain quick and reasonable results for species comparisons. By coupling COI-5P data with chloroplastic *rbcL* and LSU nuclear genes, more robust phylogenetic trees can be generated. After our recent samples were barcoded and compared, and species groupings among the Peyssonneliaceae were elucidated, we discovered that the "*Polystrata*" from Bermuda did not group with the type *P. dura*. Therefore, we conducted morphological studies to find unique characteristics to support the molecular distinctions. *Polystrata* is characterized by complete calcification, except for the nemathecia, and a single inferior perithallial layer generated from the mesothallial layer. The species from Bermuda lacks calcification entirely and has unequal, multi-layered superior and inferior perithallial layers. These characteristics are reminiscent of the genus *Ethelia*, a genus at present considered a junior synonym of *Polystrata*. Our data suggest the resurrection of *Ethelia* based molecular and morphological studies, and our species putatively represents a novel species.

12.

ANALYSIS OF THE *ELYSIA CRISPATA* GENOME FOR INTEGRATION OF NUCLEAR ALGAL GENES FROM *BRYOPSIS HYPNOIDES*

Jonathan Lee '12

Faculty Sponsor: Kathleen Archer

The sea slug *Elysia crispata* has the unique ability of carrying out photosynthesis, a process most typically found in plants or algae. *Elysia crispata* is just one of multiple sacoglossans known to ingest algae and incorporate the chloroplasts into its digestive epithelium. However, the nuclear genome that normally directs the production of proteins necessary for photosynthesis in algae is not present in the sea slug. This phenomenon in which the sea slug can photosynthesize without

the presence of the algal nucleus could potentially be explained if *Elysia* has assimilated algal genes by horizontal gene transfer (HGT). PCR was used to search for an algal gene in the slug genome. Any prospective fragments found this way could then be confirmed by probing a genomic library. Primers based on the psbO sequence of *Bryopsis hypnoides*, a sequence of DNA responsible for encoding a necessary photosynthetic protein, have produced four fragments of different sizes. One of these fragments has already been sequenced and compared with the psbO sequence of *Bryopsis*. Because of the high amount of disparity, it has been determined that the fragment does not encode psbO, however, three additional PCR fragments still remain to be explored.

13.

RED-SHOULDERED HAWK VISITATION TO COMPOST PILES

Elle Lucadamo '12

Faculty Sponsor: Scott Smedley

Residential composting has increased in popularity in recent years, along with the untested claim that the addition of animal-based kitchen scraps will increase the number of scavenging wildlife visitors. This is the first experimental test of that claim. Using three compost piles consisting respectively of no kitchen scraps (CON), a mix of animal and vegetable scraps (MIX), or only vegetable scraps (VEG) that were monitored with heat-in-motion sensitive cameras, we studied the visitation pattern of attracted wildlife visitors. Of the 29 species identified thus far, I chose to focus on the red-shouldered hawk (*Buteo lineatus*), the most common raptor species, and the American crow (*Corvus brachyrhynchos*), by far the most common diurnal species. The red-shouldered hawk had a preference for the MIX pile, which was consistent with the overall trend of increased visitation to the MIX pile, and frequented the piles more often in the winter/spring season. These two avian scavengers showed a distinct association at the compost piles, which appears to be due to the red-shouldered hawk attraction by American crows, perhaps to enhance their foraging.

In addition, we noted a novel behavior of the strictly carnivorous red-shouldered hawk: ingestion of vegetable matter at the VEG pile. As an alternative explanation of this aberrant behavior, I investigated the presence of small mammals at the compost piles and a nearby location to determine whether the red-shouldered hawk was attracted to the VEG pile primarily because of these prey. I found that small mammal activity was significantly higher at the non-pile location. This coupled with related observations suggested that small mammals were not likely the primary cause of red-shouldered hawk foraging at the VEG pile.

14.

AN EXAMINATION OF BACTERIAL COMMUNITIES IN THE UPPER RESPIRATORY TRACTS OF ASTHMATICS AND NON-ASTHMATICS

Kelly O'Brien '12

Faculty Sponsor: Lisa-Anne Foster

Shortly after birth, the human body is colonized with commensal microbes that attach to the skin and mucosal membranes such as the upper respiratory and gastrointestinal tracts. These indigenous microbiota exist as a type of ecosystem that remains relatively stable once it is established. The normal flora function to protect the host as part of the innate immune response

and are able to prevent infections by blocking attachment sites and outcompeting invading pathogens for necessary nutrients. Disruption of this symbiotic balance may increase a host's susceptibility to disease. In addition, proper colonization of the normal flora has been implicated in playing a vital role in shaping the immune response. It has been hypothesized that reduced exposure to infectious microorganisms early in life can prevent the development of normal immune regulation. This "hygiene hypothesis" states that the increased prevalence of allergic diseases in developed countries can be attributed to a more hygienic, westernized lifestyle that is characterized by a decrease in microbial challenges. Therefore, the allergic disease asthma, which is characterized by a heightened inflammatory response, could be the result of disturbed microbial colonization, hindrance of immune maturation, and subsequent dysregulation of the allergic response. It would be expected that asthmatic individuals would exhibit a less diverse and less abundant population of normal flora as compared to non-asthmatic individuals. This preliminary study investigated the bacterial communities found in the upper respiratory tracts of asthmatic and non-asthmatic subjects. Terminal restriction fragment length polymorphism (tRFLP) was used to examine the composition of bacteria in oropharyngeal samples collected from student volunteers at Trinity College. The tRFLP profiles of asthmatic and non-asthmatic subjects had the same number of peaks, indicating that there is no difference in the normal flora between both populations. Future lab members will continue the study using a larger sample size and clinical samples collected from the Connecticut Children's Medical Center.

15.

DOES RELOCATION OF EGF-LIKE REPEATS 4, 5, AND 6 IN THE SERRATE LIGAND ALTER CIS-INHIBITION OF NOTCH?

Christine Reavis '15

Faculty Sponsor: Robert Fleming

Cell-to-cell communication can be mediated by the Notch signaling system in multicellular animals. This system is highly conserved and serves to mediate proper differentiation of numerous cell types. Mis-regulation of the Notch system is associated with several forms of human cancer. The Notch receptor can be activated by its ligands, Delta or Serrate, which have been shown historically to activate Notch. Notch is a transmembrane receptor that can be activated when cells adjacent to the receptor-expressing cell express the ligand. In contrast, when a single cell expresses both the ligand and the Notch receptor, the ligand acts to inhibit rather than activate the receptor. The Serrate ligand is composed of 14 epidermal growth factor (EGF)-like repeats in its extracellular domain. Three of these repeats have been shown to be responsible for the inhibition of the Notch receptor. The research reported here focuses on determining if the location of these repeats within the ligand is critical to its function. We attempted to move the repeats from their normal location (repeats 4, 5 and 6) to a position further into the molecule (between repeats 11 and 12) of Serrate. Our goal is to express this altered molecule to determine if it retains the ability to inactivate Notch within the *Drosophila* system.

16.

REGULATION OF OLIGODENDROCYTE LIPID COMPOSITION BY mTOR

Caroline Reiss '12, Christina McGuire '13, Chinwe Oparaocha '14

Faculty Sponsor: Hebe Guardiola-Diaz

In the central nervous system, oligodendrocytes produce the myelin sheath, a lipid-rich membrane that insulates neurons for more efficient impulse conduction. Oligodendrocytes must undergo a series of developmental stages before they are capable of myelination. After terminal differentiation, the PI3K/AKT/mTOR pathway largely governs the transitions between these stages. In a recent study, inhibition of mTOR by the drug rapamycin was shown to decrease galactocerebroside (GalC) levels and disrupt normal morphological development of immature oligodendrocytes. Our study focuses on the effects of mTOR inhibition on lipid production in oligodendrocytes at Days 3 and 5 after the onset of differentiation, when most cells are in the immature and mature stages, respectively. Immunofluorescence was performed at Day 3. This time point was stained using A2B5/O4/HPC7 to display the developing external processes, a mark of maturation. Western blotting was used to study the inhibitory effects of rapamycin on the two mTOR complexes, mTORC1 and mTORC2, as well as the enzymes related to GalC and sulfatide synthesis, ceramide galactosyltransferase (CGT) and cerebroside sulfotransferase (CST). Liquid chromatography/ high resolution triple quadrupole time-of-flight mass spectrometry was used to quantify lipid levels in cell extracts. Preliminary results suggest that the protein complex, mTORC1, is involved in regulating the expression of the myelin lipids sulfatide and phosphatidylinositol. Chronic rapamycin treatments show as much as an 88.6% decrease in sulfatide levels.

17.

INTERACTION OF BETA-CAROTENE, CADMIUM TOXICITY AND ACETYLCHOLINESTERASE IN THE CEREBRAL GANGLION OF THE CHINESE MUD SNAIL, *CIPANGOPALUDINA CHINENSIS*

Lisa Saa '14, James Fisher '12

Faculty Sponsor: Charles C. Swart

Antioxidants have been documented to play an important role in relieving oxidative stress in the nervous system. Recent work on a variety of antioxidants under different environmental conditions and in diverse organisms suggests that free radicals are a naturally occurring challenge in animal tissues; however, normal homeostatic mechanisms can regulate them. If the body is stressed with abnormal levels of oxidizing agents, dietary antioxidant supplementation can have a positive effect. A series of experiments were conducted which focused on acetylcholine (ACh) production and levels of beta-carotene in the nervous tissue. The Chinese Mud Snail, *Cipangopaludina chinensis*, is a fresh water animal with natural high levels of carotenoids in the nervous system. We suspect that the role of the carotenoids in the snails' brain is to protect against exposure to high levels of heavy metals in their food source (diatoms growing on the pond substrate). The snails were placed in one of four conditions for three days: water, cadmium chloride, beta-carotene, or beta-carotene and cadmium chloride. The effect of cadmium and beta-carotene on acetylcholinesterase (AChE) production and beta-carotene levels in the cerebral ganglion of the snail were examined using spectroscopic bioassays. When the snail was exposed to both high levels of cadmium (20 ppm) and pre-treatment with beta-carotene, AChE production in the cerebral ganglion increased. The snail also responded to environmental cadmium by increasing endogenous beta-carotene in the brain.

CHEMISTRY

18.

SYNTHESIS OF γ -CARBOXYGLUTAMIC ACID

Lauren Aber '13

Faculty Sponsor: Richard Prigodich

The focus of this project is to find a new method of synthesizing a modified amino acid, γ -carboxyglutamic acid. There is a published method for each reaction in which we are trying to optimize the synthesis. The first step of this synthesis is to produce Di-tert-butylallyl malonate. In order to do this different bases and solvents were used along with varying molar equivalences of reagents and bases. The goal of this synthesis is to optimize the formation of the desired product without producing a side product. The reaction was run with tetrahydrofuran (THF), Potassium tert-butoxide, di-tertbutyl malonate and allyl bromide to produce a small amount of product while Gas Chromatography-Mass Spectrometry (GC-MS) was used to identify the components in the product. The reaction was run for varying amounts of time to determine if more di-tert-butyl malonate reacted over time, with differing conditions such as stirring vigorously at room temperature and refluxing. The reaction was run using sodium hydroxide in THF then adding di-tertbutyl malonate and allyl bromide after a specified amount of time. This method was found to react a greater amount of the starting reagent and was optimized at a 1:1 mmol equivalent NaH to di-tert- butyl malonate. The reaction is monitored by GC-MS and H^1 NMR. The next step to oxidize the di-tert-butylallyl malonate to an aldehyde is being optimized with the reaction of ruthenium(III) chloride and sodium periodate.

19.

ANALYSIS OF SOIL WATER AND SLUDGE FROM BELIZE BY ICP-OES AND SPME GC-MS FOR HEAVY METAL AND POP PREVELANCE

Lauren Aber '13, Mark Chesson '13, Jonathan Handali '13, Pathik Khatri '13, David Pierce '13

Faculty Sponsor: William H. Church.

Soil, swamp, and water samples collected from a resort development area near San Pedro, Belize were analyzed for heavy metals and persistent organic pollutants (POPs). Both POPs and heavy metals present significant health issues and environmental levels are closely monitored. Concentrations of Barium, Sodium and Potassium were determined using inductively coupled plasma - optical emission spectroscopy (ICP-OES). Solid phase micro extraction gas chromatography- mass spectrometry (SPME-GC-MS) was used to identify and quantify POP levels, in particular organochlorine pesticides. Results are presented in the context of the need for further characterization of the environmental distribution of these toxins and possible identification of sources.

20.

**METHOD DEVELOPMENT AND QUANTITATIVE ANALYSIS OF
DIMETHYLTRYPTAMINE (DMT) IN ORAL FLUID BY HS-SPME/GC-MS**

Erika J. Adams '13

Faculty Sponsor: Janet F. Morrison

N,N-dimethyltryptamine (DMT) is a schedule I hallucinogen that is found in many plants, but is also produced synthetically. Historically, DMT has been used in a brew during religious ceremonies of many indigenous South American cultures; however, it has become increasingly popular among college students and young adults in recent years. In October of 2010, students at Georgetown University were arrested for operating a covert 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 which implements headspace solid-phase microextraction (HS-SPME) and gas chromatography-mass spectrometry (GC-MS) for laboratory confirmation of DMT in oral fluid (saliva), which is the sampling method of choice because it provides a quick and noninvasive way to determine whether a person was under the influence of drugs at the time the sample was collected. Test kits for oral fluid sampling based mainly on immunoassay have been developed for roadside screening of a variety of drugs. The results of these 'on-site' tests are considered preliminary and require laboratory confirmation for forensic defensibility.

Results of method optimization and validation experiments for DMT in saliva samples will be presented. It was observed that the sample matrix has a strong effect on DMT recoveries by SPME; the influence of solvent, and the presence or absence of salt and KOH will be discussed. Internal standard calibration was employed for the quantification of DMT in oral fluid samples, using 5-methoxy-dimethyltryptamine as an internal standard. Limit of detection and limit of quantification data will be presented. Derivatization (both in-vial and on-fiber) of DMT to its trimethylsilyl derivative was also investigated.

21.

FLUORESCENCE SPECTROSCOPY: A STUDY OF CAGED FLUORESCCEIN

Shawna Berk '13

Faculty Sponsor: Maria Krisch

Fluorescein gives a strong fluorescence signal that can be quenched with a cage. Certain wavelengths of light can uncage the fluorescein. Three different light sources were used to excite caged fluorescein: a 254 nm pen ray lamp, a 266 nm laser, and a 356 nm pen ray lamp. The effect of light exposure on caged fluorescein bis-(5-carboxymethoxy-2-nitrobenzyl) ether, dipotassium salt was examined using fluorescence spectroscopy. When caged fluorescein is exposed to a 356 nm light, the sample exhibits the characteristic 520 nm peak of fluorescein. When a sample is hit with a higher energy light source, it does not match the fluorescein peak, so we suspect that other chemistry is being done. These results were confirmed using UV-Vis spectroscopy. This chemical system will be used as a light probe to test out an experimental apparatus.

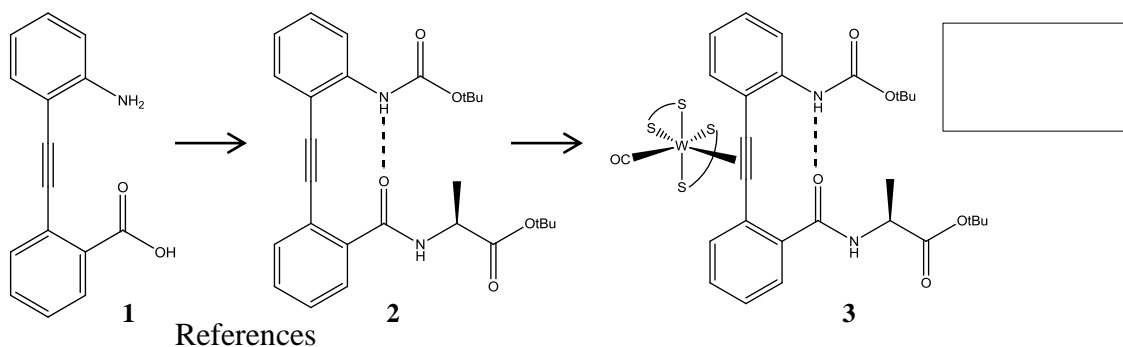
22.

SYNTHESIS OF DIPHENYLACETYLENE β -TURN MIMETICS AND THEIR COORDINATION TO TUNGSTEN: A POSSIBLE APPLICATION 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'-carboxydiphenylacetylene (**1**) and peptide derivatives incorporating **1**.^{1,2} They found that peptide derivatives of **1** adopt a β -sheet conformation. β -sheets are a major type of secondary protein structure and development of β -sheet mimetics could provide a useful means to study their structure and function. Our work has focused on exploring various synthetic routes to create peptide derivatives of **1** (e.g. **2**) and specifically, to produce derivatives of **1** having peptide substituents longer than those reported by Kemp and Li. Additionally, the Curran lab has previously explored the ability of tungsten-alkyne coordination to constrain alkynylpeptides and dialkynylpeptides to specific secondary structures.^{3,4,5} Because peptide derivatives of **1** adopt a β -sheet conformation and contain an alkyne group, we have also studied whether peptide derivatives of **1** will coordinate to tungsten (e.g. **3**) and whether coordination maintains or eliminates the β -sheet conformation. This presentation will outline our progress in developing and studying these diphenylacetylene β -sheet mimetics.



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23.

ATTEMPTED SYNTHESIS AND FLUXIONALITY ANALYSIS OF PEPTIDES DOUBLY CONSTRAINED USING FERROCENE AND TUNGSTEN

Mark Chesson '13

Faculty Sponsor: Timothy P. Curran

Previous research has shown high fluxionality in tungsten(II) bis(alkyne complexes), prompting the investigation into the potential for these types of complexes to form rigid, non-fluxional molecules. In previous work, 1,1'-ferrocenedicarboxylic acid chloride was reacted with propargylamine and subsequently cyclized in a reaction with $W(CO)_3(dmtc)_2$ yielding a stable,

non-fluxional tungsten(II) bis(alkyne) complex. In an effort to explain these findings, the chemical behavior of additional tungsten(II) bis(alkyne) complexes has been explored through the variation of the chemical identity of the alkyne, with the ultimate goal of producing new ferrocenyl dialkynes that may be ultimately crosslinked with tungsten and studied to observe their fluxionality. Initial attempts at coupling 1,1'-ferrocenedicarboxylic acid with 4-ethynylaniline using PyBOP coupling reagent proved ineffective. Instead, 1,1'-ferrocenedicarboxylic acid chloride was produced through the reaction of oxalyl chloride with 1,1'-ferrocenedicarboxylic acid, and coupling was again attempted with 4-ethynylaniline under reflux. Ultimately, synthesis and isolation of the ferrocenyl dialkyne in sufficient quantities for characterization has proven difficult, and possible reasons, in addition to future remedial steps, are suggested.

24.

METHOD DEVELOPMENT FOR ANALYSIS OF MDMA ("ECSTASY") IN ORAL FLUID; APPLICATIONS TOWARDS THE DETECTION OF EMERGING 'LEGAL HIGHS'

David M. Correll '13, Charles A. McLendon '13

Faculty Sponsor: Janet F. Morrison

Synthetic amphetamine-type stimulants (ATS) have gained immense popularity within the past few years due to their legal availability stimulatory/hallucinogenic properties. Not surprisingly they have garnered great interest by the United States government due to their addictive and dangerous side-effects.

In the past decade oral fluid has received considerable attention as an alternative biological specimen for the detection of illicit drug use in both workplace and roadside drug testing applications. Oral fluid is a convenient specimen because it can be easily and readily obtained in a non-invasive manner by non-medical personnel. Studies have shown that for many drugs, detection in saliva is highly predictive of the detection of the parent drug or its metabolites in blood, and thus provides evidence of recent use and possible impairment. A variety of immunoassay-based oral fluid test kits are commercially available for point-of-care testing; however, for forensic defensibility, results of such on-site screening tests must be subsequently confirmed in the laboratory by a different analytical technique.

The current study explores the development of an 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 oral fluid. Furthermore, this study presents applications toward the detection of emerging designer drugs marketed as 'legal highs' and not scheduled by the United States Drug Enforcement Administration. Results of method optimization experiments designed to maximize SPME recoveries of MDMA from saliva will be presented. Parameters investigated included fiber type, incubation temperature and time, extraction temperature and time, desorption time, sample pH, and salting out effects. An internal standard calibration method was developed using matrix-matched calibrators and deuterated MDMA as internal standard. Validation data including limit of detection, limit of quantification, intra- and inter-day calibration reproducibility, and accuracy and precision of quantification for spiked saliva samples will be presented. The potential for on-fiber derivatization of MDMA to its heptafluoroacyl derivative was also demonstrated. Finally, the application of this optimized method to the detection of amphetamine-type designer drugs in oral fluid will be discussed.

25.

PROFILE OF THE THERMAL BEHAVIOR OF METAL HYDRIDES

Gabriel Hayek '12

Faculty Sponsor: Ralph O. Moyer, Jr.

Differential scanning calorimetry (DSC) is a thermoanalytical technique that measures the difference in the amount of heat required to increase the temperature of a sample and reference as a function of temperature. The DSC technique is able to identify chemical behavior as either a phase change or thermal decomposition/formation by measuring the process as either exothermic or endothermic. The goal of this study was to compile a thermal profile of a number of different metal hydrides, including Ca_2RuH_6 , Ca_2RuD_6 , $\text{Ca}_2\text{RuH}_3\text{D}_3$, and Ca_2IrD_5 . The results showed that each metal hydride underwent an endothermic process at a peak in the range of 341 - 361 °C. The endothermic process for each metal hydride was similar in the range of 295-312 kJ/mol, with the exception of Ca_2IrD_5 , which had an energy value of 657 kJ/mol. However, it is thought that these complexes are only undergoing partial decomposition and further analysis is needed to justify this hypothesis. The thermogram for each metal hydride showed no reversible phase change, however, further analysis is required to explicitly determine this.

26.

SYNTHESIS AND STRUCTURE ELUCIDATION OF TERNARY MIXED CALCIUM RUTHENIUM HYDRIDES/DEUTERIDES ($\text{Ca}_2\text{RuHxD}_6\text{-x}$) THROUGH POWDER 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 $\text{Ca}_2\text{RuHxD}_6\text{-x}$ in order to elucidate the structures and possible applications of the compounds. Due to the hydrogen storage capabilities of $\text{Ca}_2\text{RuHxD}_6\text{-x}$ compounds, there are possible alternative fuel applications. The compounds were synthesized by solid state reactions of molar amounts of CaH_2 , CaD_2 , CaHD with ruthenium metal under either a hydrogen, deuterium, or deuterium hydride atmosphere at high temperatures to yield one of several combinations of $\text{Ca}_2\text{RuHxD}_6\text{-x}$ ($x = 0, 1, 2, 3, 4, 5, 6$). The ternary compounds were ascertained to be a face-centered cubic lattice of the K_2PtCl_6 structure by use of Powder X-ray crystallography and Rietveld Refinement. The composition was characterized with Infrared Spectroscopy. The mechanism of the solid state reaction established that composition was influenced by reaction gas atmosphere. With compound structure, chemical properties of the ternary compound were discovered.

27.

NMR EXPERIMENTS ON β -CYCLODEXTRIN AND FLUORESCEIN

Richard Kim '13

Faculty Sponsor: Richard 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. NMRs of different ratio combinations of β -cyclodextrin to fluorescein were studied for the analysis of chemical shift changes of the proton peaks.

28.

SYNTHESIS AND CHARACTERIZATION OF MOLYBDENUM COMPLEXES SUPPORTED BY CHELATING ORGANOPHOSPHORUS LIGANDS

Dylan Levine '13

Faculty Sponsor: Maria Parr

Organometallic complexes utilizing bidentate bisphosphine ligands have applications in industrial catalysis. In some cases, a wide P-M-P bite angle in these complexes generally leads to greater catalytic activity. Two new molybdenum complexes with the formula $[\text{Mo}(\text{CO})_4\text{L}_2]$ were synthesized by a ligand exchange reaction where a bidentate organophosphorus ligand [$\text{L}_2 = 5,5'$ -dichloro-6,6'-dimethoxy-2,2'-bis(diphenyl-phosphino)-1,1'-biphenyl and 4,12-bis(diphenylphosphino)-[2.2]-paracyclophane] displaced two piperidine (pip) ligands from the molybdenum precursor, $[\text{Mo}(\text{CO})_4(\text{pip})_2]$. The structures of the new complexes were confirmed using FTIR spectroscopy and ^1H and ^{31}P NMR spectroscopy.

29.

LIGHT-INDUCED REACTIONS IN THE BULK SOLUTION OF MOLYBDENUM HEXACARBONYL IN 1-DECENE

Christina McGuire '13

Faculty Sponsor: Maria Krisch

Photochemical reactions involve breaking and forming new bonds within a molecule as a result of light exposure. Previous research suggests that this photochemistry can be different at the liquid-vapor interface as compared to bulk solution. Molybdenum hexacarbonyl ($\text{Mo}(\text{CO})_6$) is known to demonstrate these surface effects, and so the goal of this research is to determine whether this compound could be integrated into our experimental setup. Using an ultraviolet (UV) Pen-ray lamp, 10mM $\text{Mo}(\text{CO})_6$ solution was exposed to UV light for different amounts of time. Infrared spectroscopy showed a marked decrease in the amount of $\text{Mo}(\text{CO})_6$ present in the solution. We discovered a side product from the UV exposure and are currently determining the identity of this new compound. Future research with $\text{Mo}(\text{CO})_6$ would include forming droplets on either our droplet train apparatus or using a setup that creates even smaller droplets, so as to compare the liquid-vapor interface photochemistry to that of the bulk solution.

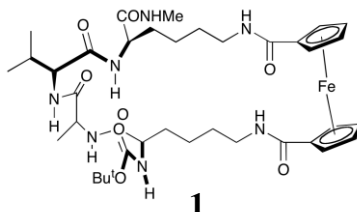
30.

FERROCENE CONSTRAINED HELICAL PEPTIDES VIA ON-RESIN CYCLIZATION

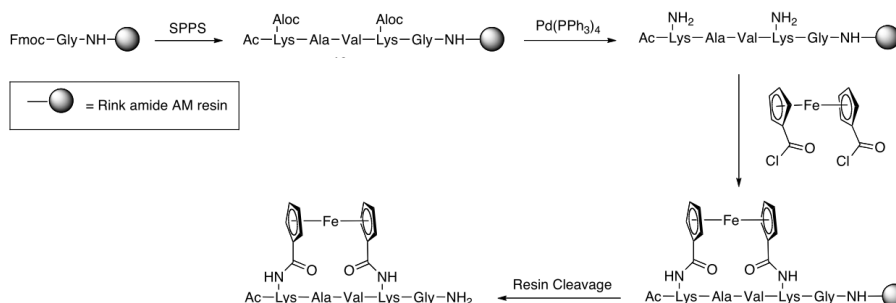
Thomas A. McTeague '12,

Faculty Sponsor: Timothy P. Curran

Previous research within the Curran group has demonstrated that ferrocene may be used as an organometallic constraint to induce the formation of α -helices in short peptides which traditionally possess undefined conformations¹. Through strategic placement of lysine residues at the i and i+3 positions within the peptide, such a constraint was accomplished (**1**) via the crosslinking of the lysine side chains to ferrocene dicarboxylic acid chloride in solution phase synthesis.



The aim of this work was to develop a method for solid phase peptide synthesis (SPPS) for the synthesis of these ferrocene-constrained helices. In particular, we seek to develop a method in which the nascent peptide can be cyclized while it is still anchored to the resin. For the synthesis, Fmoc-protected amino acids were utilized to afford the pentapeptide (Ac-Lys(Aloc)-Ala-Val-Lys(Aloc)-Gly-NH₂) (Scheme 1).

Scheme 1:

For the synthesis, Fmoc-protected amino acids and Aloc side chain protecting groups were utilized due to the mild conditions under which they are removed. This allowed the use of a Rink Amide AM resin, which is cleaved under acidic conditions. In this study it was found that on resin Pd⁰ catalyzed Aloc removal required very specific conditions and work up for efficient deprotection. Once efficient deprotection conditions were developed, the peptide was cyclized by reaction with ferrocene dicarboxylic acid chloride. Results from these studies will be presented.

¹ Curran, T., Handy, E. A 3¹⁰-helix single turn enforced by crosslinking of lysines with 1,1'-ferrocenedicarboxylic acid. *J. Organometallic Chem.*, 694, 902 (2009).

31.

SURFACE CONCENTRATION OF FORMIC ACID IN SALT/WATER SOLUTIONS

Jeff Pruyne '15

Faculty Sponsor: Maria Krisch

The concentration of organic molecules near the surface of the liquid-vapor interface is affected by the concentration of ionic salts. In atmospheric chemistry the presence of surfactants can significantly change the photochemistry of the solution. To determine the function for surface excess of formic acid, the surface tension of formic acid-salt-water solutions was measured at varying formic acid concentrations. From fitting the surface tension data to a Langmuir model, a formula for surface excess can be determined. Surface tension and surface excess values for water-formic acid solutions were compared to water-salt-formic acid solutions to determine the influence of the salt. The results from the Langmuir model will eventually be compared to results from x-ray photospectroscopy measurements of the interface. Based on early data, it seems that adding ionic salts decreases the surface excess of formic acid at a given concentration.

COMPUTER SCIENCE

32.

'A WALK DOWN MEMORY LANE'

Sheena Elveus '12

Faculty Sponsor: Madalene Spezialetti

The 'A Walk Down Memory Lane' Website allows members of Trinity community to interact with others, regardless of when time was spent here, and reminisce over memories involving the Trinity campus. Users can go through galleries of images and mark them with their recollections, big and small. They can send messages to their friends, upload photos, and just catch up with people they knew. As a computer science major and architectural studies, this project combines the technological with the visual. This website is designed to be used by all Trinity members, including students, faculty, and alumni.

33.

TRINFINDER: MOBILE EVENT IDENTIFICATION

Ben Hartung '12

Faculty Sponsor: Peter A. Yoon

Social media platforms offer a large amount of data that can be used to find and plan events, but currently, there are no applications to view all the available event data from multiple platforms. Using the Android operating system as a development platform, an application was created to allow users to view information about events occurring at and nearby Trinity College by gathering data from their social media accounts and from public event announcements. Using the Facebook API, the application draws data about events published by friends. Additional information about events is collected using RSS feeds containing details about events planned around Trinity College. Posts made with Twitter are used as another source of events and are retrieved with the Twitter API, sent to a server and stored in a database. Once stored these posts are filtered by means of a support vector machine and separated into two categories: those

that contain event data and those that do not. Any posts containing event details are sent back to the user. Details about public events are collected using the information available from the APIs of five public event announcement websites: Patch, Meetup.com, Eventful, Eventbrite, and Upcoming. Having collected this data, the application displays the events in two formats. The first format involves a series of filterable lists containing event titles which could be expanded to display details about each event. The second centers around a map interface that displays the location of events in the selected region. With the increased use of smartphones, there is a growing audience for easier mobile event identification. Further work will focus on making the application more appealing by improving the user interface and increasing the accuracy of the filtering for Twitter posts.

34.

WHAT DO YOU TWEET? AN ANALYSIS OF TWITTER USING SUPPORT VECTOR MACHINES

Richard Sung '12

Faculty Sponsor: Ralph A. Morelli

In the past few years, Twitter has become a major social networking service with over 200 million tweets made every day. With this newfound source of expanding information, can people stay up to date with what others are posting? Along with the increasing processing power of computers, is there a way computing can analyze tweets on a large scale? Moreover, can computers understand what people think based on what they post? This senior project explores this question by determining the positive or negative sentiment of twitter posts by using a machine learning algorithm called *Support Vector Machines*. Based on a labeled dataset of tweets, a parser then extracts present features in the text to create a vector. Once a collection of vectors is compiled, data is trained and tested to create a working model, which can then be evaluated to determine the effectiveness of the classifier. Based on a dataset of 359 tweets and 329 features, a model can accurately classify tweets as high as 74.84% using a linear classifier.

35.

KA-BOOM!

Gregory Vaughan '12

Faculty Sponsor: Madalene Spezialetti

In the last five years, casual gaming has exploded into the video game market. With the promise of products that have a social component, are easy to learn, and are easy to play, casual gaming attracts many who previously would have never considered playing video games. Ka-Boom! seeks to develop a browser based video game, modeled after the well known Bomberman series, that is simple and focuses on player vs. player competition. Since the goal of Ka-Boom! includes multiplayer interaction, a client-server networking model is adopted so that players can interact with the game, as well as each other, over the internet. To develop this model Java is used for the server while the client consists of Flash and Actionscript. Players visit the site hosting Ka-Boom! (turing.cs.trincoll.edu/~gvaughan/KaBoom.html), create a user account, play games against other users, and view their in-game statistics. Ka-Boom! is one of first multiplayer video games that is free, simple, and available over the web.

36.

A GPU IMPLEMENTATION OF BLOCK CHOLESKY DECOMPOSITION

Jiajia Zhao '15, Hyunsu Cho '15

Faculty Sponsor: Peter A. Yoon

Cholesky decomposition is one of the most widely used matrix factorizations to solve linear systems of the form $Ax = b$, where A is symmetric positive definite. The Cholesky decomposition is known to be numerically stable because of its diagonal dominance and requires fewer operations than conventional methods. This type of system arises in applications areas including medical imaging, radars, and sonars. In this research project, we develop an efficient parallel implementation of Cholesky decomposition using General-Purpose Graphics Processing Units (GPGPU), which has been proven effective in accelerating scientific computations in recent years. GPGPUs allow a high-level of data parallelism which is suitable for computing matrix factorizations such as Cholesky decomposition. In order to achieve peak performance, it is important to keep the data on the GPU as long as possible. To that end, we use a block version of outer-product formulation of Cholesky decomposition. Using this form, each block can be operated independent of one another. In addition, we can exploit special types of memories built into the GPUs including shared memory, constant memory and texture memory. This algorithm has been implemented using CUDA, a parallel computing platform developed by Nvidia. We present our experimental results on Nvidia's Tesla C2050 GPUs. With various input, it turned out that our program runs more than 8 times faster than the original serial, CPU version. Further work will focus on splitting the workload to multiple GPUs and using multiple threads in blocks in GPUs.

ENGINEERING

37.

FABRICATION AND CLOGGING OF MICROFLUIDIC DEVICES

Erin Barney '15

Faculty Sponsor: Emilie Dressaire

In microfluidics, liquids flow through channels that are typically as small as a human hair. These systems can be used in lab-on-a-chip technology, or for applications as common as inkjet printers. The usefulness of these microchannels is limited by clogging events: as particles pass through the channels, they build up and eventually form clogs preventing further use. This study proposes to remove or reduce the rate of formation of these clogs using ultrasound waves. The first part of the work focused on the (1) fabrication of the devices and (2) the design of a reproducible experimental method for the clogging of the microchannels. Microfluidic devices contain a series of parallel and identical channels that are fabricated in polydimethylsiloxane (PDMS). First the base and curing agent for this polymer are mixed at a 10:1 ratio and placed in a vacuum. The solution is then poured over a mold and cured in an oven for one hour. The devices are prepared so that tubing can be attached and they can be adhered to microscope slides. Once the microfluidic channels are filled with water and all air bubbles are removed, the particle solution containing 0.1% volume fraction of particles is pushed through the channels under a pressure difference of 1psi until at least half of the channels are clogged. The results are recorded using a USB camera attached to the microscope. In the future, experiments will be focused on the effects that ultrasonic waves have on clogged channels. A piezoelectric transducer will be used to generate ultrasonic waves to loosen the clogs. This will allow microfluidic devices to last longer.

38.

DESIGNING A 5mm ENDO-BABCOCK™

Sam Burck '12

Faculty Sponsors: Joseph Palladino, Christopher Evans, Development Engineer at Covidien

In the world of minimally invasive surgery, engineers often struggle to keep up with the demands doctors place on them to develop smaller and smaller surgical tools. One instrument that has proven difficult to miniaturize has been the Babcock forceps, which is used to grasp large fragile bodies of tissue. The difficulty in shrinking the Babcock forceps comes down to developing a jaw mechanism that opens wide enough and provides enough force to manipulate organs as large as the bladder or large intestine. This project required the development of a 5mm endoscopic Babcock forceps that was capable of handling tissue with the same efficacy as Covidien's twenty year old 10mm Endo-Babcock™ instrument. The 10mm Endo-Babcock™ was measured to determine proper design requirements for jaw force and maximum jaw width. Simply downsizing the jaw actuation mechanism used on the 10mm Endo-Babcock™ (as well as the majority of other minimally invasive surgical tools) would not produce the jaw force required for this tool. To develop the required jaw force, a new actuation mechanism was designed. A prototype 5mm Babcock forceps was manufactured using this mechanism.

39.

ULTRASONIC REMOVAL OF COLLOIDAL PARTICLE CLOGS IN MICROCHANNELS

Edward Donovan '12, Jay Dickenson '12

Faculty Sponsor: Emilie Dressaire

The use of ultrasonic waves as a method to unclog PDMS microchannels was studied. Soft lithography using the elastomer polydimethylsiloxane (PDMS) enables fabrication of simple and low cost complex microfluidic channel structures. When 1 μ m colloidal suspensions (latex) flow through microchannels, the transfer of particles can result in the formation of clogs. As particles move through the microchannels they can form bonds with each other resulting in bridged particle structures blocking the flow of the liquid. Acoustic waves were used to reduce or remove clogs in the channels. A 1 MHz PZT-5A shear transducer was used to induce acoustic vibrations into the microfluidic system. A Nikon Eclipse TE2000-S microscope was used to capture images at 10 fps. The images were analyzed using a customized MATLAB code that determined the number of clogs and their time of aggregation. Lastly, the times of clog formations with ultrasound off and ultrasound on were compared.

40.

DESIGN OF SHOCK TUBE TO STUDY AUTO-IGNITION OF HYDROGEN

Christian T. Firsching '15

Faculty Sponsor: John Mertens

To this date, research into the ignition of compressed and heated fuel upon release into the atmosphere has been performed on a very small scale and without taking advantage of a secondary shock wave. In order to perform tests on a larger scale and with high temperature, a new apparatus must be fabricated. It is based on a standard shock tube, but vertically oriented

and with a specially designed end cap on the driven section. This end cap is designed in such a way that it is open with an “x” shaped cutter in it. A second diaphragm will be placed in between this end cap and the flange at the end of the driven section. This diaphragm will be chosen such that it will burst after the driven gas has been heated and pressurized by the reflected shock wave, resulting in the hottest possible gas escaping into the atmosphere. Other design considerations include the use of Viton fluoroelastomer o-rings and 304L stainless steel components. These specialty o-rings are chosen to give a tight seal which will not be compromised by the properties of the gasses used in the trials. 304L stainless steel pipes and flanges are able to withstand the potentially very high gas pressures and temperatures resulting from experiments. Many components will be custom made with very small tolerances to ensure the best quality experimental apparatus.

41.

APPLICATION OF ACOUSTIC TECHNOLOGY IN OBJECT DETECTION

Tashi Genden ‘12, Rasheed Azeez ‘12

Faculty Sponsors: Lin Cheng, David J. Ahlgren

Acoustic technology forms the basis for deep-sea navigation, exploration and research studies. This project began by developing an understanding of sonar technology. The acquired information was then implemented towards the design and construction of an object detection mechanism using sound waves.

The overall purpose of the project was to gain a comprehensive understanding of acoustic (sonar) analysis principles and associated techniques. This knowledge was used to design a mechanism to detect presence of foreign targets and determine their many characteristics. It is understood that there are already triangulation devices that are used for object detection; the finished product is not meant to become a rival. The mechanism should be able to estimate and provide information about object dimensions (cross sectional area, volume, and density).

42.

GAZECONTROLLED COMPUTER USER INTERFACE

Kevin Huang ‘12, Binay Poudel ‘12, Steve Petkovsek ‘12

Faculty Sponsors: Taikang Ning, Connecticut Space Grant Consortium

The goal of the Gaze Controlled Human Computer Interface project is to design and construct a non-invasive gaze-tracking system that will determine where a user is looking on a computer screen in real time. To accomplish this, a fixed illumination source consisting of Infrared (IR) Light Emitting Diodes (LEDs) is used to produce corneal reflections on the user’s eyes. These reflections are captured with a video camera and compared to the relative location of the user’s pupils. From this comparison, a correlation matrix can be created and the approximate location of the screen that the user is looking at can be determined. The final objective is to allow the user to manipulate a cursor on the computer screen simply by looking at different boxes in a grid on the monitor. The project includes design of the hardware setup to provide a suitable environment for glint detection, image processing of the user’s eyes to determine pupil location, the implementation of a probabilistic algorithm to determine an appropriate matrix transformation, and performance analysis on various users.

43. DESIGN AND IMPLEMENTATION OF STABILIZED MAGNETIC LEVITATION TRAIN

Morris Jalloh '12

Faculty Sponsors: Emilie Dressaire, Taikang Ning

In a society that demands transportation systems to be fast, comfortable, and energy efficient, trains are one of the most effective ways to travel. For traditional trains, the friction between the rail and the train limits the traveling speed and reduces the comfort of the passenger by causing noise. A possible solution to faster and more comfortable trains is the magnetic levitation train. Magnetic levitation trains float above the rails, which allow for smooth and quiet motion regardless of speed. One of the great challenges of magnetic levitation trains is the stabilization of the motion (constants speed and fixed distance between train and rail). Result from a prototype magnetic levitation train shows that a maglev train of a given weight can floats at a fixed distance above the track and is able to move on the track smoothly with various speed controls. This study is part of a growing body of research on magnetic system. In time, this project will contribute to feature study on related topics.

44. IMPLEMENTATION OF A SIMULTANEOUS LOCALIZATION AND MAPPING ALGORITHM IN AN AUTONOMOUS ROBOT

Adam Norton '12, Anson McCook '12

Faculty Sponsor: David J. Ahlgren

This project aims to create a robot with simple mobility that is capable of implementing a Simultaneous Localization and Mapping (SLAM) algorithm. By completing this project, a thorough understanding of SLAM and its capabilities towards navigation and mapping will be realized. This includes the realization of video processing coupled with statistical analysis of the data. SLAM algorithms are extremely useful because they account for sensor error by using a probabilistic approach to state estimation. Through this approach, a map of the robot's surroundings can be created which allows for more effective path planning. This path planning becomes easier as the map becomes more complete. SLAM also allows a robot to plan for actions that will occur in the future rather than simply react to the current situation. Consequently, this project requires a robot capable of analyzing complex visual input while navigating through its environment. To solve the problem of video processing, the robot will be equipped with the Xbox Kinect. This design specification helps in fulfilling another important project goal: to create a finished product that is well documented so that it can be developed again by future undergraduate students hoping to learn SLAM and utilize its functionality on similar design projects.

45.

USE OF A BIPEDAL SYSTEM *MAXIMUS* IN ASSISTIVE ROBOTICS

Steve Petkovsek '12, Vlad Burca '14, Junius Santoso '14, Binay Poudel '12

Faculty Sponsors: David J. Ahlgren, Trinity Robot Study Team

This project's objective was to complete a fully autonomous bipedal robotic system, named MAXIMUS, to compete in the Trinity Robowaiter Competition 2012. A field of assistive robotics has emerged in which robots are designed to help humans, who may suffer from a disability. The Robowaiter competition meets that challenge by having a robot find a plate of food from a table and transport it to a waiting human. The MAXIMUS project was specifically designed to accomplish that task using bipedal motion rather than wheels, treads, etc. This was done with a Robotis Bioloid mechanical and software base. Issues involving balance, localization, motion control, intelligence, and fault recovery were addressed. Limitations regarding the number of sensors and CPU processing speed were also encountered. Proprietary sensors were avoided to reduce the overall cost of the project. Instead, custom sensors and commercial sensors were used where possible. A Havimo Vision Module was considered but not included in the final system. Wall-following and light-detection intelligence was integrated with motion control for simultaneous sensing and movement. This reduced the amount of time to complete the task. MAXIMUS was successful in walking, navigating, and finding the plate during the Robowaiter competition.

46.

NAVIGATION ALGORITHMS FOR Q, AN AUTONOMOUS GROUND VEHICLE

Steve Petkovsek '12, Adam Norton '12, Binay Poudel '12, Vlad Burca '14, Hokchhay Tann '14, Mark Yanagisawa '14

Faculty Sponsors: David Ahlgren, Trinity Robot Study Team, Travelers, PerMobil, National Instruments, Honeywell, Hemisphere, Enterprise, Lincoln Electric

This project, Q, was Trinity College Robot Study Team's (TCRST) 2011 entry in the Intelligent Ground Vehicle Competition (IGVC) held at Oakland University in Auburn Hills, Michigan. The two main challenges at the competition were the Autonomous and Navigation challenges. The Navigation challenge requires Q to navigate to six different waypoints (defined by latitude and longitude co-ordinates of specific locations) within 6 minutes. The Autonomous challenge requires the robot to complete an obstacle course circuit within 5 minutes. In both challenges the robot has to avoid barrels and fencing that have been placed at unknown locations around the course; prior mapping of the field and direct control of the robot is prohibited. To accomplish these tasks, Q's system uses a parallel software architecture with all subtasks (including motor control, data acquisition from sensors, image processing, and intelligence) running simultaneously in separate software processes using the National Instruments (NI) LabVIEW programming language. The image processing software was simplified and also pipelined to increase the image processing throughput, reducing runtime from 150ms to 75ms, and minimize the robot's reaction times. The vision software was also modified to detect differences in the texture of the ground, so that specific surfaces (such as ramps and sand pits) could be identified. In order to maintain an acceptable target heading, a path history algorithm was used to deal with local obstacle fields, and GPS waypoints were added to provide a global target heading. These modifications resulted in Q placing 5th in the autonomous challenge and 4th in the navigation challenge at IGVC, earning Trinity a \$900 prize.

Keywords: Robotics, LabVIEW, Image Processing, Parallel Software Architecture, Path History, JAUS

47.

MODELING CARDIAC MUSCLE MECHANICS

Lorenzo Sewanan '12

Faculty Sponsors: Joseph Palladino, Connecticut NASA Space Grant

As NASA advances in human exploration of space, NASA must also prepare the human explorer to travel in space by understanding the effects of such travel and by devising proper methods to support a safe human presence. NASA's Digital Astronaut Project aims to create a detailed computer model of human physiology to understand safety in space because spaceflight has a dramatic effect on systems such as the cardiovascular system which is subject to changes in fluid distribution, heart rhythm irregularities, and even diminished aerobic capacity. Aligned with NASA's strategic enterprises of human exploration and biological and physics research, this project proposes to develop a novel model of the mechanics of cardiac muscle based on an analogous generalized model of the left ventricle.

The heart is a complex electro-mechanical system which is necessary to understand for physiological and pathological purposes. As cardiac muscle tissue underlies the dynamics of the heart, models of cardiac muscle mechanics allow insights into the working of the heart at a fundamental level. Here, we propose a novel mathematical model of cardiac muscle mechanics and describe preliminary work in the developing the model based on experimental from the literature.

48.

ULTRASONIC BONE FRACTURE DETECTOR

Nay O. Shein '12, Rayan Beydoun '12

Faculty Sponsors: Taikang Ning, Lin Cheng

Without any proven health risks, ultrasound imaging, a medical imaging technique that uses sound waves, of frequencies between 2 and 18 MHz, is widely used to diagnose and visualize internal body organs. These ultrasound waves are transmitted by piezoelectric transducers towards the human body. Inside the body, they are reflected and refracted upon encountering different surfaces. The reflected waves are then received by the same transducers, which vibrate, producing electrical signals. A processor measures the latency and the intensity of the electrical signals, in order to visualize the surfaces the waves reflected from. The aim of this project is to design an inexpensive handheld ultrasound device that can scan bones to diagnose fractures using image processing techniques in place of a professional radiologist to analyze the scans. The device can be used at emergency sites, giving immediate results. The primary motivation of this project is to assist emergency medical teams in cases, such as a motor vehicle accident, where there is a risk of a closed or stress fracture, and it is advisable to check for such fractures before the person is moved. If the person does indeed have a fractured bone, the scanner will allow the emergency response team to secure the fracture area. The battery powered device primarily consists of three parts: a piezoelectric transducer array, an oscillating circuit and an ultrasonic signal receiver. The transducer-array will be used as both a transmitter and a transceiver. The oscillating circuit contains a 5MHz crystal and a microprocessor (Arduino Mega) to control voltage and frequency. The signal receiver is mainly composed of a voltage amplifier, analog filters and a peak detector which is connected to the microprocessor. An electronic relay switch is used for switching between transmitting mode and receiving mode. The

role of Arduino Mega is first to generate a 5 MHz sinusoidal signal to the transducers, and then activate the relay switch to change the connection of the transducers to receiving mode. During the receiving mode, Arduino digitizes the signal from the peak detector and performs signal processing techniques to analyze the signal and detect for cracks. The device will display whether there is a fracture in the scanned bone structure or not on a 2x16 LCD display. Preliminary research on ultrasound imaging was conducted during Fall 2012 and the majority of the hardware setup has been completed. The future work will emphasize on the design of the transducer array and the development of the algorithm.

49.

MAGNETIC LEVITATION TRAINS

Shaun Smith '15, Uzair Asad '15, Katie Starke '15

Faculty Sponsor: Taikang Ning

Magnetic Levitation (maglev) Trains are a system of transportation that uses magnetic levitation to suspend, guide and propel vehicles from magnets. The major system types of maglev are electromagnetic and electrodynamic. The goal is to create as light of a train as possible that can levitate creating a frictionless system of transportation. To achieve this, on a smaller scale, using wood for both the track and train are an effective choice. The track must provide a levitation factor and a propulsion factors. This is done by coils and magnets. The best magnets for the job are rare earth magnets which will provide the amount of necessary force easily. A prototype train has been fabricated. The design of the track is complete and ready for build. The magnets chosen and wound coils both work but have not been tested for efficiency. Through testing of design, the train will be able to levitate across a 12 inch track initially using only magnets and coils working up to a 4 foot track or even circular track. This may provide faster transportation for people and of goods.

50.

ELECTRICALLY HEATED VEGETABLE OIL CAR CONVERSION

Gary Williams '12, John Gavin '12

Faculty Sponsor: John Mertens

The goal of this project was to design and construct a system to allow a 1985 Mercedes 300SD to run on waste vegetable oil (WVO). Diesel cars, such as the 300SD, can run on vegetable oil due to the similar combustion conditions of WVO and diesel; high pressure and temperature without the use of a spark. In order to run efficiently, the WVO must be heated to a point where it has a similar viscosity to diesel. WVO at 180 F has a viscosity similar to that of diesel at 20 F; the temperature where most diesel cars begin to have trouble starting.

The system designed in this project addresses the greatest issue present in other WVO conversion kits: the need to start on diesel. The period between starting on diesel and switching over to WVO is necessary because the WVO must heat up. By incorporating electrical heating elements into the system, the car could be started on WVO, thus eliminating the need to run on diesel fuel. Eliminating the need for diesel fuel reduces sulfur and micro particle emissions released during operation, reduces cost, and WVO that would otherwise be disposed of can be harnessed for energy.

ENVIRONMENTAL SCIENCE

51.

VIEWING THE EFFECTS OF LIMITING POPULATION ON STANDARD OF LIVING USING A STELLA MODEL

Julian Brown '13

Faculty Sponsor: Jonathan Gourley

Carrying capacity is the maximum amount of people an area can support because of their limited resources. Is the United States reaching this limit? In my STELLA model, I will show where this carrying capacity is. Right now, our population is increasing every year. More people are coming into the United States through immigration and birth than leaving through death or people moving away. When creating a model, we can look at United States as the “tub” and the population as water. Unlike the tub, the US has multiple options of inflow and outflow. The factors that influence population the most are birth and death rates.

Obviously the initial population is very important when trying to create a population model. 313,188,631 people is the projected amount living in the US given by the Census bureau as of March, 15, 2012. I will also show how different our standard of living would be if we limit our population growth instead of letting it grow exponentially. To do this, I have come up with a fantasy scenario where a number of people in our population are killed off every 10 years. This scenario will obviously never happen, but for the sake of imagination I will run the model for 200 years and see measure the cost benefit by viewing two factors. The total number of deaths in those 200 years, and the standard of living defined by food per capita.

52.

PARK RIVER WATERSHED TOXIC TRACE METAL CONTAMINATION X-RAY ANALYSIS

Sam Calahan '15

Faculty Sponsors: Jonathan Gourley, Ann Lehman

As a result of industry, more and more toxic trace metals like mercury, iron, lead, cadmium, zinc, and manganese are dumped into our rivers every day. Exposure to such metals has been linked to numerous health issues, from killing the biota in waterways to brain and behavioral damage in children. Conclusions have been drawn about what sediment properties allow for best adsorption of trace metals, and the environment in which this adsorption is most likely to occur. Elemental analysis coupled with scanning electron microscopy may provide a new and powerful method to examine sediment metal contamination. It has been found that the finest particles, with the most surface area, have the greatest adsorption capacity, so sediment samples were filtered to 63µm or less. It has also been found that trace metals are more likely to be present near industrial plants, so samples were collected from the area surrounding the West Hartford Landfill waste outflow on the Park River. Samples were analyzed using the x-ray fluorescence capabilities of a scanning electron microscope, which were used to map element concentrations onto SEM micrographs. Little has been found to date, but the goal is to find distinct characteristics of the sediment particles that can be matched with their elemental composition (specifically for the trace metals of interest), which would then allow generalities to be made about the physical characteristics of the metals when bonded to the sediment. Future progress on the project will

rely on the continued observation of the sediment, as the search for the characteristics described is largely empirical. If generalizations can reasonably be made in this study, they could potentially give insight as to the sources and origins of the metals, and provide a greater understanding of how they interact with contaminated sediment.

53.

UNDEAD IN THE UNDERGROUND COFFEEHOUSE: MODELLING THE ZOMBIE APOCALYPSE FOR A SMALL LIBERAL ARTS COLLEGE

Jonathan Chu '12

Faculty Sponsor: Jonathan Gourley

Zombies have been an indelible part of the cultural consciousness ever since their inception. Perhaps it is their implacable shambling nature that attracts, or the fact that they resemble the worst diseases gone terribly wrong. In any case, the zombie myth has spurred many people on to ask themselves: How long would I survive in a zombie apocalypse? This project was designed to help answer that question. Zombies propagate by infecting humans, who are then transformed into the undead after a suitable period of time. Therefore, how would a zombie epidemic at Trinity College behave? How does hiding out affect survival? How does the presence of a vaccine affect survival? How does euthanizing infected individuals affect survival? Never mind the moral dilemmas, this is the end of the world.

54.

A STELLA MODEL OF DEFORESTATION OF THE AMAZON RAINFOREST

Kate Furgueson '15

Faculty Sponsor: Jonathan Gourley

Deforestation across the globe has become a huge problem due to the high demand for grains, paper products and livestock. I will be using a program called STELLA to show the effects of these demands on the size of the forest. My STELLA model focuses on the factors that affect deforestation specifically in the Amazon rainforest. There are two reservoirs in this model, forested land and deforested land. Large-scale agriculture, small-scale agriculture, logging and cattle ranches are the converters that affect the size of the deforested reservoir. From 2000-2005, the rainforest was being deforested at a rate of about 8,363.2 square miles a year. The main cause of this deforestation was the growing demand for cattle to be sold as meat. Cattle ranching amounts to 65-70% of deforestation to the Amazon, followed by small-scale agriculture, which contributes 20-25% of deforestation. Large-scale agriculture contributes 5-10% of deforestation, whereas logging is only 2-3%. In the model, I project when the rainforest will disappear from overexploitation by using the above data, as well as adding other contributing factors. The forest can be maintained if less of it was deforested and an ample amount of time was given for reforestation. By changing the regrowth period, we can see how the alteration affects the size of the Amazon Rainforest.

55.

DDT IN THE ENVIRONMENT: PAST TO FUTURE LEVELS

Alex Gottsch '12

Faculty Sponsor: Jonathan Gourley

DDT is a persistent organic pollutant that was widely used as an insecticide during the mid-1900's. However, by the 1970's it was outlawed within the U.S. because of its devastating impacts on wildlife and the environment. Because of its ability to bioaccumulate through the food chain and its relatively long half-life (about 20 years), DDT has caused significant damage to upper trophic levels and is still present in the environment today. This model will be used to predict present and future levels of DDT in various reservoirs in the environment. Furthermore, I will use this model to predict the effects of DDT on animals through various trophic levels.

56.

POINT SOURCE OF MERCURY (Hg) CONTAMINATION IN THE MILL POND PARK OF PARK RIVER WATERSHED

Daniel Hong '15

Faculty Sponsor: Jonathan Gourley

Mercury (Hg) is a naturally occurring element in the environment in very low concentrations. However, a recent study showed that an excess amount of mercury was present in the Piper Brook sub-basin within the Park River watershed, a sub-watershed of the Lower Connecticut watershed. Because the Park River runs across the highly populated and recently industrialized city of Hartford, the high levels of impervious cover accumulate pollutants, including mercury. Through precipitation, the deposited pollutants in the impervious cover are washed off and discharged into the Park River. However, once mercury is released and spread out in the environment through Aeolian deposition, the origin of the mercury contamination, or the point source discharge, becomes hard to determine. The Mill Pond Park in the Piper Brook sub-basin was reported to have the highest concentration of mercury. To find the sources of contamination of mercury in the Mill Pond Park, mud samples were collected and analyzed for mercury concentration using a Milestone DMA-80 Total Mercury Analyzer. The locations and distribution of the samples were plotted using GIS. The goal is to determine potential sources for mercury contamination using the concentrations and distributions of mercury.

57

PLANET VENUS: STELLA CLIMATE MODEL

Ned Hurwitch '13

Faculty Sponsor: Jonathan Gourley

This model of Venus using the STELLA program is designed to predict whether or not the planet Venus could be made habitable through the possible introduction and altering of climate parameters. This model was first designed using the parameters set by David Bice in his model of the Earth's climate system. This simple climate model monitors solar energy and carbon dioxide in the climate system, and is capable of plotting the planet's temperature graphically. Although there are many more things that are required to sustain life on another planet, this project aims to determine whether the temperature of planet Venus could be lowered to a point that humans could move to Venus (ignoring such things as oxygen content) as we assume all

vital gasses would be pumped into the colony and that temperature is the main issue to contend with.

58.

MODELLING STAND DYNAMICS RESULTING FROM SPRUCE BUDWORM IN A MIXED WOOD FOREST WITH THE STELLA PROGRAM

Samuel Ingraham '13

Faculty Sponsor: Jonathan Gourley

The Eastern Spruce Budworm, *Choristoneura fumiferana*, is one of the main disturbances in the northeastern forests of North America, specifically the caterpillar. It primarily affects balsam fir, *Abies balsamea*, and to a lesser degree white spruce, *Picea glauca*, and other spruce. The STELLA model used was constructed based on simple logistic growth models for three populations: susceptible trees, non-susceptible trees, and the spruce budworm itself. The susceptible trees were divided into immature and mature trees and from these populations is derived the spruce budworm's carrying capacity. Several experiments were performed by altering the various factors affecting both susceptible and non-susceptible tree populations in order to determine the effects on the spruce budworm population, specifically if certain forestry regimes can prevent budworm outbreaks while maintaining susceptible tree populations.

59.

EFFECTS OF SEA LEVEL RISE ON ISLAND GROUNDWATER SUSTAINABILITY EXAMINED THROUGH THE USE OF STELLA MODELING

William Martin-Black '12

Faculty Sponsor: Jonathan Gourley

Coastal areas and islands in marine environments are at an increased risk of losing both habitat and the ability to sustain terrestrial life due to rising sea levels. By observing the availability and sustainability of fresh water resources we are able to determine the health of an island system. The compilation of parameters known to exist on inhabited islands along with the current and projected rates of sea level rise allow for an accurate prediction of the long term effects of sea level rise on an island population in regards to availability of potable water. Parameters used in this model were normalized from a collection of islands located mainly in the south pacific. The hypothetical island system assumes single substrate composition as well as a uniform distribution of precipitation and sea level rise. This island system assumes no external influences other than the effects of natural disasters. Failure of the model is defined as the inability of the hypothetical island system to sustain a population due to an inadequate fresh water supply.

60.

A STELLA MODEL OF GREENLAND AND ANTARCTIC ICE SHEET MELT AND ITS EFFECTS ON MARTHA'S VINEYARD, MA

Christian Naylor '14

Faculty Sponsor: Jonathan Gourley

Interpretation of David Bice's Hydrological cycle STELLA model coupled with data of current ice sheets and proposed sea level rise have provided astonishing information of sea levels if all

major glaciers and ice sheets were to completely melt. The Greenland ice sheet covers roughly eighty percent of the entire country and Antarctica is a continent entirely made out of ice. The greenhouse effect and global warming have been slowly melting these two masses of ice. Their melt rates have been slow and gradual with periods of gain, yet in the past one hundred years, they have decreased. The amount of sea level rise by completely melting the Greenland ice sheet, West Antarctic ice sheet, and the East Antarctic ice sheet was modeled after David Bice's STELLA model of the Hydrological cycle with minor additions to account the various ice sheets. The amount the sea level rose was then able to be transposed onto the island of Martha's Vineyard, Massachusetts due to using Massachusetts' GIS 2005 elevation image data floating point values. The point values were then used in ArcGIS10.0 to illustrate the various consequences from the various melts. The West Antarctic ice sheet showed the least amount of damage to the island because it only produced 4.05 meter rise on sea level. The Greenland ice sheet showed more devastating damage due to an increased sea level of 7.2 meters, which would affect the various coastal populations on the island. The East Antarctic ice sheet raised sea levels 55.95 meters, which would essentially submerge every town on the island. If the three ice sheets were to completely melt, there could be catastrophic consequences.

61.

GROWING HUMAN POPULATION AND FISH POPULATION STELLA MODEL

Meredith Swetnick '14

Faculty Sponsor: Jonathan Gourley

Human overpopulation has increased the demand for fish worldwide and the overharvesting of fish has had a significant effect on their population numbers and what will happen if we do not lessen are demand for fish. For my project I decided to focus on the effect that human population growth has on worldwide farm and wild fish populations. I want to decrease the demand by decreasing the worldwide birth rate to 1-2 children per household how this would effect fish populations and if human population could decrease in time for fish to repopulate their numbers. My model in STELLA consists of a simple set up. With reservoirs for human population and fish population and other factors that influence these reservoirs, like human birthrate, demand for fish and fish reproduction rate, I will try to see if by the year 2050 we can save the fish populations or if decreasing human birth rate is not enough, and if so what would we need to do to save fish populations.

62.

A STELLA MODEL OF THE YELLOWSTONE FIRE OF 1988

Renee Swetz '14

Faculty Sponsor: Jonathan Gourley

Modeling forest fires is certainly not a new concept. Doing so has been attempted by many means, most of which have contributed to the model that I plan to demonstrate. By utilizing the modeling software STELLA, I have attempted to model the Yellowstone forest fire of 1988. The demonstrated model is a compilation of equations and relationships that were previously determined. Among those previously determined relationships are the equations for burn index and control rate, as well as those used for growth-rate.

A model comparable to this, in the future, may be able to accurately predict the spread of forest

fire. Furthermore, such a model can incorporate prior statistics (as done in this presentation) to determine a specific area's risk for fire and their resulting severity.

After having modeled the scenario that dictated the Yellowstone fire, this STELLA model was manipulated to then depict the different areas that vary from Yellowstone in such criteria as species richness, temperature, and rainfall.

63.

NUTRIENT ADDITION AND THE DEGRADATION OF AQUATIC ECOSYSTEMS: STELLA MODEL ILLUSTRATING PHOSPHORUS INPUTS IN A WATERSHED

Bridget Tevnan '14

Faculty Sponsor: Jonathan Gourley

Nutrient losses from land to water have increased since the Green Revolution when farmers began implementing high quantities of fertilizers in order to increase their crop yields. As humans continue to manipulate the structure of the land to suit farming practices, it is important to understand how non-point source pollutants from farm fields impact the local watersheds, upon which they ultimately depend. Phosphorus (P) is one of the predominately employed fertilizer additives utilized to increase plant productivity. STELLA was utilized to model the effect of phosphorus on a relatively simple watershed. The model demonstrates how variable additions of phosphorus interact with various watershed reservoirs, including river water, groundwater, soil water, and surface water. In those bodies of water that have become polluted with nutrient additives, major changes, including eutrophication, can impact what sensitive fish and macro-invertebrates are supported. Studying how additional nutrients, like phosphorus, flow through the watershed is important in addressing the health of an aquatic ecosystem.

64.

THE BIOACCUMULATION OF MERCURY IN MARINE TROPHIC LEVELS ILLUSTRATED THROUGH STELLA

Michael Valenti '13

Faculty Sponsor: Jonathan Gourley

Attempts to show a visual representation of the bioaccumulation of mercury in a marine environment have been illustrated by many scientists, however few have done it through the modeling techniques of STELLA. Mercury, whether occurring naturally or through anthropogenic means has always been existing in the marine environment through sediment that resides on the ocean floor, or through the more severe bio-magnification of methyl mercury in marine organisms. Recently, mercury has proven to be a major health issue in humans, due to its ability to bio-magnify through the various trophic levels of the marine environment eventually making its way all the way to the top trophic level, which is occupied by humans. The mercury is stored in the fatty tissues of fish, and upon consumption is biomagnified into that particular organism. In 2008, studies showed that high concentrations of mercury had been detected in Tuna, Swordfish, Sharks, and King Mackerel, which have been highly prized in restaurants all across the world. These high concentrations of mercury pose serious health threats such as neurological damage, birth defects, and failed pregnancies.

By using STELLA models, I will be conducting an in depth look at the bioaccumulation of mercury through the various trophic levels of the marine environment. I will start out at the origins of mercury in sediment and algae, and then make my way through the simplest of organisms such as plankton, to the largest of organisms which include tuna, dolphins, and finally humans. I will quantify mercury through ppm(parts per million) and will use a bioaccumulation formula to demonstrate my flows from each reservoir, which will be demonstrated by the different trophic levels. The formula will allow for the methylation and biotic uptake of mercury through each trophic level.

65.

FOOD CIRCULATION ON THE TRINITY COLLEGE CAMPUS

John W. Wick '13

Faculty Sponsor: Jonathan Gourley

This project explores the flow of food in and out of the Trinity College campus provided by the Chartwells dining services. Using STELLA, a computer modeling program, I mapped out the different factors that determine the amount of food that is prepared, served, consumed (or not consumed) and disposed of by Trinity College.

The model itself involves several different parts which represent the different aspects of the system (Trinity College). The first and most important part of the model is the reservoir which represents the amount of food on the Trinity College campus at any given time. The inflow is represented by the amount of food entering the campus provided by Chartwells. The outflow is represented by the amount of food waste leaving campus, whether it is uneaten or remnants from preparation. A second outflow is used to represent waste created by containers and packaging. All flows will be regulated by converters, which will control the flow of food entering and exiting the system. The values that the model is based upon were attained through interviews with the Chartwells representative on campus. When the model is activated it illustrates a consistent flow of food coming and leaving Trinity with little variation in the reservoir level. Additional work will be required to assure of the model's accuracy.

The purpose of the project is to portray the movement of food on the Trinity campus. By doing so, it may provide insight on how to make Trinity College more efficient in its consumption and disposal of food. It may also generate awareness within the student body and faculty to eat smarter and waste less food if the model can illustrate the areas that we can improve ourselves as a community.

HEALTH FELLOWS

66.

QUALITY IMPROVEMENT INITIATIVE AT HARTFORD HOSPITAL DENTAL DEPARTMENT

Lauren Aber '13

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Dr. Vernon Kwok, Hartford Hospital

Hartford Hospital's Dental Department is a comprehensive dental care facility that provides services ranging from general dentistry to oral surgery. The department sees patients on a routine and an emergency basis. The purpose of this study is twofold, first to determine the profile of new patients at Hartford Hospital Dental Clinic and second to determine specifically, emergency or routine. This is a retrospective study looking at new patients sex, payment type (50, 54, OPS), medication(s), primary language spoken and read, type of care, if the patient returned after initial visit and co-morbid diseases: diabetes, asthma, Hypertension, High Blood Pressure and High Cholesterol. The results support the hypothesis that greater than half of the patients have Medicaid. The results do not show a significant difference between the number of patients without insurance and those with private insurance. The results show that the majority of patients being seen in the dental clinic are seeking comprehensive care which was not hypothesized. It was also hypothesized that co-morbid diseases would have an effect on dental care, this has not been confirmed. This allows Hartford Hospital to understand the patients they treat, with the majority of patients being seen in the general dental clinic seeking comprehensive care and returning after their initial visit.

67.

EMOTION REGULATION PROCESSES IN THE ANXIETY DISORDERS

Erika J. Adams '13

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Gretchen J. Diefenbach, Ph.D., Laura Bragdon, Institute of Living, Anxiety Disorders Center

Emotion regulation encompasses the cognitive and behavioral processes used to manage experiences of emotion¹. Emotion regulation utilizes cognitive strategies that are associated with distress and can change and/or diminish fear in subjects, depending on the emotion regulation strategy being used by the subject (reappraisal or suppression). It has been speculated that emotion regulation deficits play a critical role in the development and perpetuation of anxiety disorders. Additionally, research suggests that as one ages, the ability to regulate emotions advances. Such advancements are thought to employ greater use of reappraisal, which is considered an adaptive strategy, in emotion regulation and fewer uses of suppression, which is a strategy associated with greater distress and pathology². To date, no research studies have explored the role of emotion regulation among older anxious adults. In the present study, participants were categorized in a 2x2 experimental design setup up, in which the two variables being tested were age and anxiety, for a total of four categories. The groups were older anxious adults, older non-anxious adults, younger anxious adults, and younger non-anxious adults. The goal of the present study is to determine how people with anxiety disorders regulate their emotions and to find out whether or not emotion regulation processes differ amongst age groups. It is hypothesized that participants with a primary diagnosis that is an anxiety disorder will have impaired emotion regulation processes as measured by 15 common mental health questionnaires

when compared to participants without an anxiety disorder diagnosis. In addition, when comparing older adults and younger adults, both without an anxiety disorder diagnosis, it is expected that the older adults will employ the reappraisal strategy while younger adults will suppress their emotions. Results of correlation analyses and t-test statistics comparing the older and younger negative control groups will be presented.

¹Campbell-Sills, L., David, H. (2007). Incorporating Emotion Regulation into Conceptualizations and Treatments of Anxiety and Mood Disorders. *Handbook of Emotion Regulation*: 542-559.

²Andreescu, C., Gross, J.G., Lenze, Eric, Edelman, K.D., Snyder, S., Tanase, C., Aizenstein, H. (2011). Altered Cerebral Blood Flow Patterns Associated With Pathologic Worry In The Elderly. *Depression and Anxiety*, 28, 202-209.

68.

EFFECTS OF FUROSEMIDE (LASIX) ON THE NEUROCOGNITIVE PERFORMANCE OF INDIVIDUALS WITH CONGESTIVE HEART FAILURE

Asiqur Anik '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Sarah Bullard, PhD, Jason Gluck, DO, Sarah Tartar, PhD, Joseph Klim, MS, Institute of Living

Congestive heart failure (CHF) is a condition in which the heart is not able to pump blood efficiently throughout the body. This condition results in the retention of liquid and salt which impedes blood circulation and reduces the blood flow. Abnormal blood flow has been associated with a decline in neurocognition. Loop diuretics such as Furosemide, commonly known as Lasix, are used to decongest the body and restore normal blood flow. This study investigates whether the administration of Lasix influences neurocognition in individuals with heart failure. Patients referred from Hartford Hospital were given a battery of cognitive tests from CogState upon admission as inpatients and then after consistent Lasix treatment. We hypothesized that the administration of Lasix would result in an increase in neurocognition. The results, however, show that the Lasix did not have a significant effect on neurocognition. This may be a result of irreversible damages due to inefficient blood flow to the brain.

69.

CLINICAL REVIEW OF PIMOZIDE ASSOCIATED EFFECTS IN CHILDHOOD TOURETTE'S SYNDROME

Matthew J. Eremita '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Dr. Francis J. DiMario, M.D., Connecticut Children's Medical Center

The use of pimozide in large cohorts of children with Tourette's syndrome has not been reported upon previously. A Cochrane review has provided the most comprehensive review of efficacy studies of pimozide in treating Tourette's (Pringsheim *et al.*, 2009). However, this review included studies whose subjects ranged from 7 to 53-years-old. The neurology department at Connecticut Children's Medical Center (CCMC) has had experience with the use of pimozide in children under 21-years-old and can provide additional insight into the drug's efficacy and potential adverse effects encountered within this group of Tourette's syndrome patients.

This study included all patients (including both new patients and follow-ups) who were seen at CCMC's neurology department for an evaluation of their Tourette's syndrome between the years 2001 and 2011. For every patient, a complete review of their medical records was conducted, and their symptoms (tics and co-morbid symptoms), treatments, and associated side effects were recorded. Of the 53 patients reviewed, ten were prescribed pimozide for management of their motor and vocal tics. The study found that every patient who was prescribed pimozide intended to continue using the drug as of their last visit within the eleven year period under review. Of these patients, 20 percent reported cardiovascular irregularities (particularly elongation of the heart's QT interval), 50 percent reported weight gain, and 10 percent reported experiencing a dystonic reaction. The results are consistent with those of the studies reviewed by Pringsheim *et al.* (2009), which reported minimal cardiovascular irregularities and extrapyramidal side effects associated with pimozide usage, with weight gain being the most commonly reported side effect. Although the results of this study, which included children only, were relatively in line with those that included adults, further studies of pimozide's efficacy in treating childhood Tourette's syndrome using larger cohorts of children still need to be conducted.

70.

ACCURACY OF PARENTAL REPORT OF H1N1 INFLUENZA VACCINATION IN CONNECTICUT CHILDREN'S MEDICAL CENTER

Richard Kim '13

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Catherine Wiley M.D., Connecticut Children's Medical Center

Influenza is a highly infectious viral illness. Children 24 months and younger are known to have similar hospitalization rates to people 65 years and older due to influenza. Two strands of influenza, seasonal influenza and the H1N1 influenza emerged in 2009. Prior studies have shown that the H1N1 strain caused the highest hospitalization rates for people less than 65 years old and may have affected children more frequently than the season influenza. Vaccines are currently available that can protect children against influenza. Thus it is important to study vaccination status of children exposed to influenza. This study looked at the accuracy of parental reports of seasonal and H1N1 vaccination of their hospitalized children compared to documentation in their physician's medical records of patients hospitalized in Connecticut Children's Medical Center. Telephone interviews were conducted with parents. By comparing parental report to actual vaccination status it is hoped to observe the validity of parental reports of vaccination status of their children in times of epidemic outbreaks.

71.

EFFECTS OF INTRAUTERINE GROWTH RESTRICTION ON 34 WEEK LATE PRETERM INFANTS

Jessica Williams '12

Faculty Sponsors: Sarah Raskin, Maryann McGuire, Shabnam Lainwala, MD-PhD, James Hagadorn, MD MS, Connecticut Children's Medical Center

Late preterm births constitute 71% of all preterm births in the United States. Premature infants are at risk for many adverse neonatal outcomes which may initiate their admittance into a neonatal intensive care unit. Some of these infants are afflicted by intrauterine growth restriction

which causes them to be small (SGA) rather than appropriate (AGA) for their gestational age. It is hypothesized that late preterm infants born within 34 weeks gestation and small for their gestational age will experience increased risks of neonatal morbidities, mortality and readmission to the hospital within the first months of life. This study compared the neonatal outcomes of infants born within 34 weeks gestation at Hartford Hospital between January 1, 2008 and December 31, 2011. The data collected were analyzed using chi square analysis for categorical variables and non-parametric Mann-Whitney test for continuous variables. It was found that although there are some neonatal outcomes SGA late preterm infants experience more than AGA infants, the instances of most of the variables considered did not significantly differ between the two groups.

MATHEMATICS

72.

CHANGE-MAKING PROBLEM: A LINEAR PROGRAMMING APPROACH

Yuhan Chi '12

Faculty Sponsor: Philip S. Brown Jr.

In making change, a cashier at a supermarket checkout wishes to become more efficient when paying amount to customers. In order to help this cashier, we present a liner programming approach to address the following the question: how can we use the minimum number of standard U.S. coins (penny, nickel, dime, quarter, and dollar) to make a given amount of money? This is a classic knapsack type problem with fixed capacity and a collection of items to maximize the total value carried subject to the requirement. Our analysis using integer programming shows that there is a general procedure to achieve this goal.

73.

OIL DEPLETION

Alyssa Cuyjet '14, Zach Freedman '14, Taylor Jordan '13

Faculty Sponsor: Philip S. Brown Jr.

In the past few decades, our consumption of oil has drastically increased due to numerous factors, some of which include population growth and technological advances. Particularly, advances in technology have increased our dependence on oil. In the past few years, many governments as well as people have begun to take part in "going green" in an effort to reduce oil consumption. We will be using a variation of the predator/prey model as well as growth and decay models to represent our use of oil and the decreasing oil stock.

74.

A MATHEMATICAL MODEL FOR WEIGHT CHANGES BASED ON CALORIC INTAKE AND ENERGY EXPENDITURE

Kyle Friedman '12, Gregory Del Giudice '12

Faculty Sponsor: Philip S. Brown Jr.

A mathematical model is an approximate representation in mathematical form of a concept, object, system, or process. We are exploring how caloric intake and energy expenditure affects an individual's weight over time. Essentially, if a person consumes more calories than they burn off, their weight will increase. By formulating a mathematical model to represent this process, we will be able to calculate the amount of time required to gain or lose a certain amount of weight. For this model, we set parameter 'K' equal to a person's bodyweight in kilograms, and set 'C' equal to the number of calories a person consumes in a given period of time. After making several assumptions about how the average human body works, the mathematical model we will evaluate is $dK/dt = 1/7700(C - 40K)$. After differentiating and interpreting that equation, we will be able to achieve our previously stated goals.

75.

**DOOMSDAY: A MATHEMATICAL MODEL
TIME LEFT TO FIND A CURE IN A ZOMBIE APOCALYPSE**

Wil Goldsholl '13

Faculty Sponsor: Philip S. Brown Jr.

Imagine a world in which a major modern day city is overrun with violent, bestial zombies. A clinical trial of a new pharmaceutical technology has gone completely off course, infecting all but one of the 30,000 original human trial subjects with a contagious, degenerative disease. The one immune subject contains the biological key to constructing a vaccine. The city has been quarantined and all the zombies will die on their own with nothing to eat, but a single bite transmits the infection, turning the victim from prey to predator. Using a set of differential equations (similar to infectious disease and predator-prey models), this model will attempt to determine how much time authorities and scientists will have between initial outbreak and total apocalypse (depletion of the non-infected population). A number of assumptions must be made for the sake of mathematical integrity:

- No births will occur (no natural growth for humans or zombies alike)
- No human deaths will occur from starvation, non-zombie-related accidents, or non-zombie-related diseases (no natural decay for humans), they may or may not occur for zombies who do not interact with humans in a designated period of time (possibility of natural decay for zombies)
- Initial zombie population is 29,999
- Humans become zombies once infected (interaction growth for zombies, interaction decay for humans)
- City is quarantined (will not spread to the outside, nobody has been evacuated)
- Zombies will not eat each other
- Humans will not be able to fend off zombie attacks

These assumptions are all made with the intention of conservative calculation of time if (when?) a zombie apocalypse should ever occur.

76.

USING THE BUFFON'S NEEDLE METHOD TO ESTIMATE π

Nyi M. Htet '13, Carlos A. Miranda Jr. '12, Stefan Timiras '15

Faculty Sponsor: Philip S. Brown Jr.

In the 18th century, Georges-Louis Leclerc, Comte de Buffon, posed the following question: If we have a floor made of parallel strips of wood, and all have the same width, and we drop a needle on the floor, what is the probability that the needle will cross a line between two strips? It was observed that if the strips had unit width and the needle had length l , the mathematical probability of the needle crossing such a line would be equal to $\frac{2l}{\pi}$. The proposed project is a computer program that uses Monte-Carlo simulation to estimate π by the Buffon's Needle method. The results from the simulation on a 32-bit and a 64-bit machine are compared and analyzed

77.

ZOMBIE APOCALYPSE: WHAT WILL HAPPEN TO MANKIND?

Leo Liyeung '13, Ryan Emberling '13, Jake Hyland '15

Faculty Sponsor: Philip S. Brown Jr.

The inevitable has arrived. We have a zombie apocalypse in our hands. Evidently, there are zombies, stupid people, and heroes. Given parallel universes with slightly different parameters, how will each world fare? Will the zombies take over? Will humans prevail? Or will they be locked in a perpetual battle until the end of time? WE WILL SEE.

P.S. A predator-prey model will be used to analyze the dynamics between the different species.

78.

HEAT TRANSFER RATES OF BEVERAGES HOUSED IN DIFFERENT MATERIALS

Anson McCook '12, Allison Friedlander '12, Erin Dorsey '12

Faculty Sponsor: Philip S. Brown Jr.

This research project looks to analyze the heat transfer of cold beverages exposed to a warm environment. Using the exponential decay model, one can determine the rates associated with the heat loss of a system. Specifically, this project aims to determine the difference in heat loss rates when using different materials to contain a beverage. For this project, water will be placed in different containers (aluminum, plastic, and Styrofoam) and data will be collected on the temperature loss over a period of time. The data found from this project can be helpful in predicting the time it takes for a beverage to reach the temperature of its surroundings.

79.

FOURIER TRANSFORM IN BRAIN WAVE ANALYSIS

Lauren Slattery '13

Faculty Sponsor: Philip S. Brown Jr.

Attention Deficit Hyperactivity Disorder has long been analyzed with Fourier transforms using EEG data. In this study, fMRI data was used from subjects considered normal, inattentive, and inattentive/hyperactive combined type. The Fourier transform technique was used to break each component into its partials, and the spectra between subjects and between components were compared. Results indicated that there were significant mathematical differences between the average spectra of each type. When the spectra were compared, it was noted that in the normal subject data, there was more power at a lower frequency than the inattentive and inattentive/hyperactive combined type. Conversely, there was more power at a higher frequency for the inattentive and inattentive/hyperactive combined type than for the normal subjects.

80.

GENERATING THE APOLLONIAN GASKET WITHOUT RECURSION

Stefan Timiras '15

Faculty Sponsor: Avraham Bourla

The Apollonian gasket is named after Apollonius of Perga, known to his contemporaries as the “Great Geometer” (Mumford et al., 2002). In his book, called “Tangencies” (Mumford et al., 2002), he proved that, for any three circles on a plane, there are at most eight circles tangent to all three (Bourke, 2006). We can use Descartes’ Theorem to generate the fractal known as the Apollonian Gasket. There are a number of ways to generate this fractal aided by computer graphics, but most of them involve recursion, which lead to very complicated computations. Our goal is to write a computer program that generates the gasket to any degree of accuracy without a recursion process. The first step is generating Ford circles corresponding to the Farey sequence of order n . A Farey sequence of order n (noted F_n) is the sequence of all irreducible fractions between 0 and 1, with denominators less than or equal to n (Burger, 2000). Ford circles are tangent to the real axis, centered at points of coordinates $(\frac{p}{q}, \frac{1}{2q^2})$ and with radius equal to $\frac{1}{2q^2}$, where p and q are natural numbers. Using the digit sequence of their continued fractions expansion for each number in the degree n Farey sequence, we can generate a collection of Ford circles without recursion. The next step is to find Möbius functions of the form $f(z) = \frac{az+b}{cz+d}$ that will map each level n -configuration of these circles correctly in the plane, assembling them into the Apollonian gasket.

81.

KNAPSACK MODEL FOR FOOD ENERGY MAXIMIZATION

Jiajia Zhao '15, Megan Chiu '14

Faculty Sponsor: Philip S. Brown Jr.

The knapsack model is one of the most studied problems in the field of combinatorial optimization. It looks for the maximum value combination of a group of objects and is subject to a certain weight limit. We consider three different types of the knapsack model: the 0-1 knapsack model, the bounded knapsack model, and the unbounded knapsack model.

The knapsack model and its variations are used in many real world applications in fields such as finance, security, cryptography, computer science, carpentry, nutriology, and many more. Based on the knapsack model, our web application seeks to maximize the energy gained from a set of foods, with the constraint of the total amount of money available.

NEUROSCIENCE

82.

MUSICAL ACTIVITY OF THE BRAIN: THE DIFFERENTIATION OF NORMAL AND ADHD BRAINS THROUGH SOUND

Elsie Arce '12

Faculty Sponsor: Dan Lloyd

Attention deficit hyperactivity disorder (ADHD) is the most commonly diagnosed behavioral disorder of childhood. There are three subtypes of ADHD: Inattentive, hyperactive/impulsive, and combined type. The inattentive type is characterized by poor organizational skills, forgetfulness, and difficulty sustaining attention. The hyperactive/impulsive type, as the name implies, is characterized by hyperactivity and impulsivity. It has been shown that the brain has musical properties and the activity within can therefore be made into sound or “music” using fMRI’s as a platform. This study reports on [#] Trinity students’ ability to differentiate between the sound of normal brains and ADHD brains of the inattentive and combined subtype. The participants first listened to sample brain files and then were presented trial files. The main results show that the participants were able to detect better than chance, which brains were which. Further analysis revealed better performance from musicians and students who have had music classes at Trinity. These results suggest that ADHD may be significantly distinguishable through the sound of brain activity. This can lead to new techniques in the diagnosis of ADHD, as well as other disorders.

83.

INVESTIGATION OF VARIANCES IN FMRI-DERIVED MUSICAL PROPERTIES OF HEALTHY AND DEMENTED SUBJECTS THROUGH ANALYSIS OF PITCH DISTRIBUTION AND MOTION

Cheryl Barber '13

Faculty Sponsor: Dan Lloyd

Alzheimer’s disease (AD) is characterized by a significant loss of neurons that results in disrupted signaling within the brain. The structural and functional differences in AD patients may generate distinct sound properties when fMRIs are converted into audible frequencies. fMRIs from young healthy, old healthy, mildly demented and moderately demented subjects were converted into frequencies which were assigned to brain regions with synchronized metabolic activity. The most intense frequencies comprised a melody that reflected the brain area with the greatest activity at a given time. To compare brain activity among the groups of subjects tested, the distribution of pitches (tessitura) and the freedom of motion (mobility) were analyzed. Healthy subjects were found to produce more continuous melodies with fewer leaps in pitch than demented subjects. The tessitura and mobility of healthy subjects tended to be more predictable

and less sporadic than in patients with dementia. The lack of continuity heard in data from demented subjects likely reflects alterations in brain connectivity caused by Alzheimer's. Further research regarding the impact of AD on the brain must still be conducted.

84.

ELIMINATING ENVIRONMENTAL VARIABLES IN TESTING FOR THE EFFECTIVENESS OF THE KETOGENIC DIET AGAINST SYMPTOMS OF AUTISM

Subrina Bisnauth '15, Sierra Slade '15

Faculty Sponsors: David Ruskin, Susan Masino

The ketogenic diet is a high-fat, low-carbohydrate diet that changes the body from metabolizing glucose to metabolizing ketone bodies. It is already known to be an effective anticonvulsant and therefore it may also alleviate symptoms of other neurological disorders, such as autism. Autism is a neurological disorder that causes impaired social and communication skills. This lab is testing the effects of the 18% ketogenic diet on BTBR mice, a mouse model for autism, by using a number of sociability tests such as the three-chamber, grooming, and social transmittance of food preference tests. The results obtained vary, and this may be attributed to variable environmental factors. These factors may include mouse genetics, noise, lighting, cage enrichment, and handling and cleaning methods. This research aims to eliminate variables in order to replicate data and determine whether the ketogenic diet is an effective therapy for symptoms of autism.

85.

A CONNECTIVITY MODEL OF NEURAL AND GENETIC CORRELATES OF IMPULSIVITY

Brian Castelluccio '12

Faculty Sponsors: Dan Lloyd, Dr. Godfrey Pearlson, Institute of Living

Impulsivity is a complex set of personality traits that underlies both adaptive and maladaptive behaviors. It is central to various psychiatric disorders as well as to normal everyday activities. Fundamental among the constellation of factors impulsivity subsumes is disinhibition, or the inability to inhibit a prepotent response. Behavioral genetics has primarily implicated genes associated with two neurotransmitter systems, serotonin and dopamine, in impulsivity phenotypes. However, there is general consensus that complicated traits are not explained by single genes or even small groups of genes, but rather networks of many genes. The purpose of this study was to uncover correlations between neural activity associated with errors of disinhibition and genetic markers. Seventy-eight subjects completed a Go/No-Go fMRI (functional Magnetic Resonance Imaging) task. In the task, subjects were instructed to respond to presentation of the letter X (Go stimulus) by pressing a button and withhold response to the letter K (No-Go stimulus). Contrast images representing blood oxygen level dependent (BOLD) response significantly associated with false alarm errors, errors in which subjects respond inappropriately to No-Go stimuli, were generated. Genetic data were also acquired from every subject using a BeadChip microarray that detects over one million single nucleotide polymorphisms (SNPs) across the genome. Of these, 4,940 SNPs from genes implicated in diseases related to impulsivity were investigated. Parallel independent component analysis (ICA) was used to identify networks of brain regions and networks of SNPs and to elucidate correlations between the two modalities. Four independent functional imaging components and

sixteen independent SNP components were identified. Two distinct functional brain networks were significantly correlated with a network of 32 genes. One of the brain networks included bilateral anterior cingulate cortex and bilateral insula regions. The other included superior parietal lobes and orbitofrontal lobes. While previous work has suggested that particular genes influence impulsive personality traits, this study proposes an alternative; shifting the focus from the level of the individual gene to networks of associated genes may provide more answers to important questions about impulsivity.

86.

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

Jessica Cote '12

Faculty Sponsor: Susan Masino

The ketogenic diet (KD) is a high-fat, low-carbohydrate regimen that has been effectively used to treat drug-resistant epilepsy. Because epilepsy and Autism Spectrum Disorders (ASD) are often comorbid disorders, recently the KD has been tested as a therapy for behavioral autistic symptoms. Adenosine is an endogenous neuromodulator of brain activity which might be involved in ASD. Adenosine's activity at the inhibitory adenosine A1 receptor in the brain has been shown to have anticonvulsant, analgesic and anxiolytic properties. Research has demonstrated an important role for adenosine in the KD and has also suggested that increased adenosine could reduce symptoms of ASD. Here we examined the responses of (1) the BTBR T+tf/J (BTBR) mouse model of autism; (2) mice lacking the adenosine A1 receptor (knockout); and (3) wild-type C57BL6 control mice to investigate the effect of the KD on autistic behavior and the role of adenosine in ASD and the KD's mechanism. Mice were observed during three tasks that tested major symptoms of autism: (a.) a social behavior task in which mice were monitored in a three-chambered apparatus for their preference for socializing and social novelty; (b.) a social transmission of food task in which mice were judged on their preference for a familiar or novel flavor based on their communication with another mouse; (c.) self-grooming to inspect repetitive behavior. Results showed that BTBR mice exhibited autistic behavior in all tests and that the KD mitigated autistic symptoms. Similarly, knockout mice showed autistic behavior in all tests except the social food task, but the KD did not lessen their autistic symptoms. Control mice did not express autistic symptoms and the KD did not affect their behavior. Taken together, these data suggest the KD could act as a dietary therapy for ASD and that adenosine might play an important role in autistic behavior and the KD's mechanism of action.

87.

EVALUATION OF STAINING METHODS TO DIFFERENTIATE BETWEEN NECROSIS AND APOPTOSIS

Jared Cotton '15

Faculty Sponsor: William H. Church

Apoptosis is the process of programmed cell death that occurs in multicellular organisms. Necrosis is the process of cell death due to acute injury such as trauma or deprivation of oxygen. The ability to differentiate between these two processes is important as each involves different biochemical and physiological pathways. This project was initiated to evaluate the ability of two popular fluorescent staining methods to distinguish between apoptotic cell death and necrotic cell death.

88.

THE APPLICATION OF THE IMPLICATION-REALIZATION THEORY OF MUSIC TO FMRI ANALYSIS OF HEALTHY AND ALZHEIMER'S PATIENTS

Ela Cross '13

Faculty Sponsor: Dan Lloyd

Brain connectivity decreases with age and is significantly diminished in Alzheimer's patients. fMRI signals were obtained from young and old healthy subjects, mildly and moderately dementia patients for analysis. fMRI signals were transposed into audible frequencies and each synchronous component of regional brain activation was assigned a frequency, resulting in a melody composed of the frequencies of the most intense components for each time. Narmour's theory of implication-realization, which measures the predictability of music based upon parameters such as pitch duration and melodic direction, was implemented to compare the groups. The brains of patients with moderate dementia produced the least consonant or musically pleasant music with more pitch jumps than healthy brains. Compared to healthy brains, dementia patient brains had greater variability in the component of greatest intensity, fewer active components, and more consistency in note duration. The differences found between healthy and dementia patient brains reflect disrupted brain connectivity, possibly caused by plaques and tangles in Alzheimer's patients. Further studies will determine the brain regions represented within each component to determine the areas most affected by aging and Alzheimer's disease.

89.

SENSITIVITY TO CORRECT SPEED OF HUMAN TREADMILL WALKING IN A POINTLIGHT DISPLAY

Yasmine L. Delgado-Jimenez '14, Venus Nunez '14

Faculty Sponsor: William Mace

Human perceivers are known to be so sensitive to human motion that a few points of light on joints can easily convey the sense of a person moving (Johansson, 1973). Such displays can be informative about many properties of the person as well as what the person is doing. We are interested in the degree to which this sensitivity includes the proper speed of display. To what extent can untrained observers tell if a display is running at proper film speed as opposed to a speeded up or slowed down version? Previous experiments at Trinity (Anik, 2011) showed evidence for such sensitivity, but did so for displays that could not be seen as biological motion as well as those that were seen as biological motion. Because these displays showed the motion as translation across the screen, it is possible that this is what observers were responding to. The studies reported here examined the same conditions as in Anik (2011), but with walking on a treadmill which could be cycled in a continuous loop and not translated across the screen. Using the psychophysical Method of Constant Stimuli, we had observers rate the speed of 10 instances each of 5 speeds of human treadmill walking shown as pointlight displays. This was done for a side view, a frontal view, upside down controls, and a two point control. The two point control showed only two points from the display and these were not seen as human motion.

90.

SEMANTIC SATIATION IN BILINGUALS

Kelsey Flynn '12

Faculty Sponsor: Nicole Dudukovic

Surprisingly little is known about the relationship between multiple languages in the human brain, and whether or not the neural representation of a second or third language coincides with that of a native language. We addressed the question of whether the bilingual brain relies on a single conceptual system for both languages by using a semantic satiation paradigm. Semantic satiation refers to a temporary decrease in the meaning of a word as a result of repetition. existed which could be improved upon in a new study to produce clearer results. We examined semantic satiation in English-Spanish bilinguals and intermediate-level Spanish students in a both an English-Spanish paradigm and a Spanish-English paradigm. First, individual words were repeated for a set amount of time (0 s, 5 s, or 60 s) in one language, and then the translated equivalents of those words were cued in a free association task in the other language. We predicted that for our bilingual participants, five seconds of repetition would facilitate priming for the meaning of that word in both languages (cross-linguistic priming), and therefore a higher incidence of accurate responses in the word association task, but 60 seconds of repetition would satiate the meaning of that word for both languages (cross-linguistic satiation) and result in a lower incidence of accurate responses. This would indicate that the two languages share semantic representations in the bilingual brain. Our findings suggested that the Spanish and English semantic systems function relatively independently for bilinguals. For the intermediate group, we observed trends towards priming that may have been significant with a larger sample size, suggesting that a second language may depend more on the first language during development.

91.

THE EFFECT OF THE KETOGENIC DIET ON FORMALIN-INDUCED NOCICEPTION IN WILDTYPE AND A1 KNOCKOUT MICE

Jessica Fortin '14

Faculty Sponsors: Susan Masino, David Ruskin

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 and on mice lacking the A1 receptor against wildtype mice. 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 a moderate 3% 10 μ L dose of formalin or vehicle (saline) solution. The injected mice were then placed in an individual clear container and the amount of time spent licking and lifting the injected hind paw was recorded. Formalin induces a biphasic pain response where phase I mimics acute pain while phase II mimics chronic pain. The two genotypes of mice tested were wildtype (normal) and A1 knockout (lacking the adenosine receptor). While the data indicate no significant diet effect that supports the expected hypoalgesia hypothesis, there is a significant difference between wildtype ketogenic and control diet-fed mice in phase II with ketogenic diet mice exhibiting increased nociception. These data conflict with previous thermal nociception experiments where ketogenic diet-fed mice exhibited significant hypoalgesia. In addition, the genotype data also indicate an expected significant hyperalgesic effect in phase II for A1

knockout mice compared to wildtype mice. Future experiments utilizing novel methods of painful stimuli will be conducted to clarify the diet effect and role of adenosine and determine the human clinical potential of the ketogenic diet as a potential therapy for pain.

92.

AN EXAMINATION OF THE ROLE OF ATTENTION IN THE TESTING EFFECT

Jackie Gottshall '13, Patricia Cavanaugh '14

Faculty Sponsor: Nicole Dudukovic

Testing has been shown to be an important tool not only in assessment, but in learning as well. Further, recent research suggests that levels of attention during retrieval can have a significant impact on the benefits of testing. The present study examined whether testing benefits are reduced in individuals with attention-deficit hyperactivity disorder (ADHD). College students with and without ADHD read short prose passages under three study conditions (control, test, and restudy). Two days later participants took a final recall test. Preliminary results show a significant interaction between study condition and level of attention. Participants without ADHD had the greatest recall as a result of testing, whereas participants with ADHD benefited the most from restudying a given passage. These findings further confirm the importance of attention in retrieval processes, and have implications for improving educational practices among individuals with ADHD.

93.

THE EFFECTS OF ALCOHOL ON COGNITIVE FUNCTIONING IN COLLEGE STUDENTS

Sarah Isaac '14

Faculty Sponsor: Sarah Raskin

The purpose of the current study is to evaluate drinking trends, memory and cognition in young adults, 18 to 25 years of age. As part of this study, 601 first year college students were tested (49% Male). Participants were categorized into one of four groups based on a self-report questionnaire: never drank, drank but never binged, binged but not in the last 30 days, and binged in the last 30 days. Binge drinking was defined by self-report as four or more drinks in a 2 hour period for women and five or more drinks in a two hour period for men. Participants were presented with a battery of computerized cognitive and memory tasks. Participants categorized as having reported binge drinking in the previous thirty days were significantly more likely to have alcohol and substance abuse disorders and mood disorders such as a depressive episode, with females more likely to be classified as binge drinkers. Furthermore, the group that reported binge drinking in the previous thirty days performed significantly worse than other participants on a test measuring declarative memory, and social drinkers showed the poorest performance on a test measuring impulsivity. These results support the hypothesis that alcohol use may impact cognitive functioning in first year college students and they highlight the need to analyze different kinds of drinking patterns separately.

94.

BEHAVIORAL AND ELECTROPHYSIOLOGICAL CORRELATES OF PROSPECTIVE MEMORY (PM) IN HEALTHY INDIVIDUALS AND TRAUMATIC BRAIN INJURY (TBI) PATIENTS

Navneet Kaur '12

Faculty Sponsor: Sarah Raskin

Prospective memory is remembering to do something in the future and involves the ability to form and later realize intentions that are delayed over time (Einstein and McDaniel, 1990). The purpose of this experiment is to examine the underlying brain activity related to prospective memory using event-related potentials (West & Ross-Munroe, 2002) and determine the relationship between these electrophysiological measures and behavioral performance, as measured by the Memory for Intentions Screening Test (MIST) (Raskin et al., 2010) in both healthy individuals and individuals with traumatic brain injury. The results of the electrophysiological component of this study will include analysis of the amplitude for the specific event-related potentials- N300, LPC, and slow wave-, accuracy time and response time for ongoing trials versus prospective memory trials. These variables will be compared with the behavioral variables from the MIST including whether the intention cue is event based or time-based and the length of delay period. The MIST also includes a recognition task and delayed recall task and error analysis. In conclusion, these data will be used to evaluate the electrophysiology of prospective memory in individuals with traumatic brain injury.

95.

THE CELL SIGNALING RESPONSE TO ER STRESS IN OLIGODENDROCYTES

John McInnis '12, Michael Acosta '13

Faculty Sponsor: Hebe Guardiola-Diaz

The elevated rates of lipid and protein synthesis required for the establishment of a functional myelin sheath make oligodendrocytes particularly sensitive to disruptions in the endoplasmic reticulum (ER). Myelin pathologies display accumulation of unfolded proteins that may arise in part from failure to adapt to ER stress. However, the cellular signaling mechanisms that mediate the adaptive response to ER stress in oligodendrocytes are not fully characterized. mTOR, a serine/threonine protein kinase that is part of the PI3K/AKT signaling pathway, controls rates of protein translation and cytoskeletal dynamics in response to growth factors and to amino acid and energy levels. We recently demonstrated that disruption of the PI3K/AKT/mTOR signaling pathway with rapamycin (an mTOR inhibitor) does not interfere with terminal differentiation of oligodendrocytes but impedes their morphological and biochemical maturation. Here we investigate the activity of AKT and mTOR signaling in response to ER stress in oligodendrocyte progenitors (OLPs) and mature oligodendrocytes (MOLs). We found that the cellular viability of OLPs but not MOLs is decreased by thapsigargin (TG), tunicamycin (TU) and dithiothreitol (DTT) in a dose-dependent manner. We analyzed the phosphorylation state of AKT and S6 ribosomal protein (S6 RP) in protein lysates from OLP cultures after three-hour exposures to TU and TG and found a decrease in levels of pAKT(T308) and pS6 RP. This suggests that the PI3K/AKT/mTOR signaling system is part of the cellular response to ER stress that regulates protein synthesis and assists the recovery of ER function in pre-myelinating oligodendrocytes.

96.

DEVELOPMENT OF PROSPECTIVE MEMORY IN CHILDREN

Ginger Mills '12

Faculty Sponsor: Sarah Raskin

This study aimed to investigate specific elements of prospective memory (PM) functioning in developing children, using a new tool, the Memory for Intentions Screening Test for Youth (MISTY). This study also aimed to investigate the effectiveness and validity of this novel tool through comparison to another PM measure, the Rivermead Behavioral Memory Test for Children (RBMT-C), and relationships to intelligence. Results revealed that as age increases, prospective memory ability increases as well, with children performing better on specific elements of PM. Overall, children performed better on event-based tasks than on time-based tasks and on two-minute time delays than on ten-minute time delays. These results were most significant in the youngest children (ages 5-6) and were not found in the oldest group studied (ages 13-15), indicating that specific aspects of PM develop at different ages. This study revealed that intelligence is related to the performance of children on the MISTY, with verbal scores, but not non-verbal, significantly correlated to the MISTY. The RBMT-C did not compare to the MISTY. Results of this study highlight the relationships between the developing pre-frontal cortex and PM development in children as well provides preliminary results for a clinical measure, the first of its kind, that can effectively measure PM in children.

97.

THE INVESTIGATION OF GLIAL-DERIVED FACTORS AFFECTING NEURONAL CELL DEATH

Alexandra Nicaise '13

Faculty Sponsors: William H. Church, Stephen Crocker

Originally astrocytes were believed to have just played a supportive role in the brain, now it has been discovered that they play very important roles, from the reuptake of neurotransmitters to the release of neurotransmitters. They might also play a role in Parkinson's disease, by either alleviating dopaminergic cell death in the substantia nigra, or by causing it. A double-blind experiment was conducted using mice astrocytes in cell culture, wildtype and a TIMP1 knockout. The cell cultures were given different concentrations of MPP+, which models the dopaminergic neuronal death caused by Parkinson's disease. The media from these experiments was collected and given to matured undifferentiated and differentiated SH-SY5Y cells in order to determine if the mice astrocytes were secreting a neuroprotective or damaging agent when treated with MPP+. SH-SY5Y cells were plated and underwent a six-day period of feeding media replacement, where half of them were differentiated using retinoic acid. The feeding media was completely replaced with the specific treatment solution and 24 hours later a live cell/dead cell assay was performed. The average percent of cell death was then calculated for each treatment solution, undifferentiated and differentiated. Initial analysis indicates that the wildtype astrocytes given no MPP+ glial media significantly increased cell death in undifferentiated SH-SY5Y cells. Present experiments have resulted in the exact same data. The different glial medias caused no significant increase or decrease of cell death in the differentiated cells. These results indicate that the glial cells could be secreting out a factor that has the ability to control neuronal cell growth by killing the undifferentiated cells.

98.

BEHAVIORAL AND ELECTROPHYSIOLOGICAL CORRELATES OF PROSPECTIVE MEMORY (PM) IN HEALTHY ADULTS AND ADULTS WITH TRAUMATIC BRIAN INJURY (TBI)

Consuelo M.A. Pedro '15, Navneet Kaur '12

Faculty Sponsor: Sarah Raskin

Prospective memory (PM) is the memory involved in remembering to do something in the future. The behavioural correlates of prospective memory have been tested previously with the Memory for Intentions Screening Test (MIST), but little is known about the electrophysiological correlates of PM in individuals with traumatic brain injury (TBI). Thus by measuring brain electrical activity when both healthy adults and persons with TBI perform PM activities, and comparing this data with the MIST; the behavioral assessment of PM, we can determine what kinds of brain activity are associated with PM. In this study we administered both the MIST and a computerized event-based measure. The computerized measure was administered while measurements of event-related potentials were recorded. Electrophysiological data was recorded using an electroencephalograph machine while the prospective memory test was administered through a computer screen and keyboard test. MIST, the paper and pencil behavioural memory test was also administered separately. These two tests were then administered to two groups of subjects, healthy adults and adults with TBI. Data was analyzed using SPSS software to find the correlation between the MIST and the EEG data. The findings of this study can lead to a better understanding of PM and design of rehabilitation techniques to help improve PM functioning in persons with TBI. Based on the outcome of this present pilot study, further work will include the design of a more comprehensive study that includes time-based cues on the EEG computer-based test, in order to investigate PM and its electrophysiological correlates more extensively.

99.

SUPPLEMENTAL INOSINE ADDITION TO SHSY5Y CELLS IN ORDER TO INCREASE URIC ACID LEVELS

Claire Prosperi '14

Faculty Sponsor: William H. Church

High plasma uric acid levels have been correlated with reduced incidence and progression of Parkinson's Disease (PD) in humans. Recently, clinical studies have been initiated to investigate the impact of increasing plasma uric acid levels in PD patients through dietary supplementation with inosine, a precursor to uric acid. In an effort to develop an *in vitro* model of this system, human neuroblastoma SHSY5Y cells were treated with inosine-supplemented culture media. Cells were incubated in low serum feeding media containing a range of inosine concentrations for 48 hours. Cells were harvested and both cell media and cell homogenate will be analyzed for a series of purine compounds, including inosine and uric acid this summer. In a separate experiment inosine-treated cells will be evaluated for enhanced resistance to the neurotoxin rotenone. These results could give insight into how scientists can supplement inosine to PD patients as well as provide information on neurochemical changes in the purinergic neurotransmitter system resulting from inosine supplementation.

100.

QUANTITATIVE ANALYSIS OF ADHD AND NON-ADHD fMRI SCANS

Renuka Shukla '13

Faculty Sponsor: Dan Lloyd

Current methods of ADHD diagnosis, which mainly utilize the *Diagnostic and Statistical Manual for Mental Disorders-IV* (DSM-IV), are not satisfactory for this childhood-onset, neurodevelopmental disorder (Thome et al., 2009). In search for a more brain-based measure of subject differentiation, the sonification of fMRI scans was found to differentiate schizophrenia and healthy patients (Lloyd, 2009). The aim of this study was to identify MATLAB functions that could significantly differentiate between combined type ADHD, inattentive type ADHD, and healthy subjects. Five different functions measuring various aspects of predictability, as well as frequency distributions, were successful in differentiating ADHD and healthy subjects. Their results suggest cortical functional differences between ADHD and healthy subjects. The frequency distribution of increased high frequency amplitude and decreased low frequency amplitude waves has been seen in several studies with electroencephalographic (EEG) measurements (Amer et al., 2010; Quintana et al., 2007; Monastera et al., 2009). Further studies will be conducted on the effect of medication on the frequency distribution of medicated and non-medicated ADHD subjects using EEG measurements.

101.

ANALYSIS OF ADHD PATIENTS USING FOURIER ANALYSIS ON fMRI SCANS

Lauren Slattery '13

Faculty Sponsor: Dan Lloyd

ADHD has long been analyzed with Fourier transforms using EEG data. In this study, fMRI data was used from subjects considered normal, inattentive, and inattentive/hyperactive combined type. The Fourier transform technique was used to break each component into its partials, and the spectra between subjects and between components were compared. Results indicated that there were significant differences between the average spectra of each type. When the spectra were compared, it was noted that in the normal subject data, there was more power at a lower frequency than the inattentive and inattentive/hyperactive combined type. Conversely, there was more power at a higher frequency for the inattentive and inattentive/hyperactive combined type than for the normal subjects.

102.

CREATING A KETOGENIC DIET-LIKE CELL MEDIA

Edgar Soto '15

Faculty Sponsor: William H. Church

The ketogenic diet has been shown to be an effective treatment for a number of neurodegenerative diseases but questions remain about the mechanisms of therapeutic effects. A cell culture model of the ketogenic diet would provide an in vitro system in which to investigate these therapeutic mechanisms. In an effort to examine whether a ketogenic-like cell media could alter the metabolic process in SH-5Y cells, d β -hydroxybutyrate was used as an alternative energy source to glucose. The effective state of ketolysis was verified via the use of nuclear magnetic resonance spectroscopy (NMR). A decrease in the production of lactose and a

consumption of d β -hydroxybutyrate, determined by NMR, was defined as the ketogenic diet-like state for the cells. Proton NMR scans were performed on the media in a solution of deuterated water. There were three different groups of cells cultures prepared, one in regular DHMeM media (24 mmol/l glucose), one with low glucose of 3 mmol/l, and one with low glucose and 10nmol/l of d β -hydroxybutyrate. The low glucose media was prepared by daily replacing half of the DMeM media with glucose-free cell media, until 3 mmol/l. This low-glucose media, as well as the use of the NMR assay, will allow for a greater understanding of the ketogenic diet and provide an experimental model for further study.

103.

THE EFFECTS OF PROSTAGLANDIN E₂ ON APOPTOSIS IN SH-SY5Y CELLS

Emily Thornton '13

Faculty Sponsor: William H. Church

The degeneration of dopaminergic neurons is a primary characteristic of Parkinson's disease. There is evidence indicating that the neurotoxin rotenone can induce apoptosis in dopaminergic neurons, leading to Parkinsonian neurodegenerative effects. Further studies have examined the possible neuroprotective molecules, such as Prostaglandin E₂ (PGE₂) to prevent the apoptosis of dopaminergic neurons. Previous work from this laboratory found that in addition to attenuating the neurotoxicity of rotenone, pre-treatment with PGE₂ for 6 hours actually lowered cell death rates to below those of controls. The experiment was designed to determine if PGE₂ alone could prevent normal apoptosis rates in undifferentiated SHSY5Y cells that had never been exposed to rotenone. Undifferentiated SH-SY5Y cells were treated with 0 nM, 5 nM, 10 nM or 25 nM solutions of PGE₂ for six hours and then treated with a low serum feeding media for twenty-four hours. Apoptosis levels in the cells were identified using the Hoechst 33342 stain. Cells were counted and the live cells/dead cell ratio was reported relative to PGE₂ pre-treatment concentration. The data from the two experiments will be evaluated relative to previous work that showed six hour exposure of PGE₂ prior to twenty-four hour exposure to rotenone decreased apoptosis levels below control.

104.

EFFECTS OF THE KETOGENIC DIET ON BEHAVIOR IN EPILEPSY AND AUTISM IN PROSPECTIVE AND RETROSPECTIVE STUDIES

Rebecca Williams '12

Faculty Sponsors: Susan Masino, David Ruskin, Julia Svedova (2011), Francis DiMario, MD, Connecticut Children's Medical Center

Autism is a pervasive developmental disorder shown to affect 1 in 88 people. Its core symptoms are impaired social interactions, delayed language development and stereotyped repetitive behaviors. There are currently no pharmacological treatments available to treat these core symptoms. The ketogenic diet is a high-fat, low-carbohydrate, adequate protein diet that forces the body to metabolize ketones instead of glucose for energy. The ketogenic diet treats seizures, and in one study a non-standard version of the diet improved symptoms typical of autism in children. The goal of this study was to determine the effects of the ketogenic diet on behavior in children with epilepsy and autism or autism. before and during or after diet treatment in a prospective study, and during or after the treatment in a retrospective study. We hypothesized that in addition to its benefits in reducing seizures, the ketogenic diet would improve aspects of

behavior in children with epilepsy, autism, and epilepsy and autism. Children who already started or are already pre-qualified and planning to start the diet were included. Parents or guardians were sent surveys to quantify clinical criteria and behavior in the children. Parents of children in the prospective study were given a set of surveys (1) prior to initiating the diet and (2) six months later. The retrospective study includes children who (1) are still on the diet or (2) have been off the diet for more than two months. Data collection is ongoing.

105.

EFFECTS OF DRINKING PATTERNS ON PROSPECTIVE EMMEORY PERFORMANCE IN COLLEGE STUDENTS

Marta Zamroziewicz '13, Michelle Royals '12, Ethiopia Kabtimer '13, Dana Estefan '13,
David Correll '13, Sarah Isaac '14

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

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 or 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

106.

CHARACTERIZATION OF ULTRAFAST ELECTRON PULSES USING FEMTOSECOND LASER PULSES

Abhishek Khanal '15, Pratistha Shakya '15

Faculty Sponsor: Brett Barwick

Processes that take place on the timescale of femtoseconds (10^{-15} s) or attoseconds (10^{-18} s) are termed ultrafast phenomena. The study of ultrafast phenomena is important in understanding the basic processes of nature and has applications in various fields including the physical and biological sciences. But given the short time duration of such phenomena, it is difficult to detect those processes. One way it is accomplished is by employing pulsed lasers whose duration is similar to or less than that of such phenomena. To use lasers for such purposes, the time duration of laser pulse needs to be known and the process of autocorrelation is commonly used to quantify them. Autocorrelation is a technique in which a laser pulse is split into two, delayed by introducing path difference and then recombined and allowed to interfere. Analyzing the resulting interference patterns give a precise measure of the laser pulse duration. This ability to measure the duration of ultra-short laser pulses is a prerequisite to utilizing them in applications such as ultrafast electron microscopy.

PSYCHOLOGY

107.

DYSFUNCTIONAL BELIEFS, ADHD SYMPTOMS, AND EARLY DEVELOPMENTAL INFLUENCES AS PREDICTORS OF SYMPTOM SEVERITY IN COMPULSIVE HOARDING AND OBSESSIVE COMPULSIVE DISORDER

Geraldine Fernandez '12

Faculty Sponsors: Laura Holt, Dina L. Anselmi

Although the DSM-IV-TR currently recognizes Compulsive Hoarding (the excessive acquisition of useless items and the inability to discard) as a subtype of Obsessive Compulsive Disorder (OCD), recent research has shown that different cognitive mechanisms may underlie each of these disorders. Specifically, research has shown relations between variables such as indecisiveness, perfectionism, and fear of uncertainty, memory deficits, and symptoms of Attention Deficit-Hyperactivity Disorder (ADHD) and the onset, maintenance and severity of the hoarding subtype of OCD, but the same relations either have not been tested or have not been clearly established for DSM-V proposed Hoarding Disorder. Moreover, empirical research has not determined: a) whether maladaptive cognitions differentially predict symptom severity in OCD and Compulsive Hoarding, b) the effect of early developmental influences on the severity of Compulsive Hoarding, and c) the relation between different dysfunctional beliefs. Each of these research questions were assessed using a clinical sample of patients with Compulsive Hoarding (n=46), OCD (non-hoarding) (n=33), and community controls (n=37). Indecisiveness was found to be related to both Hoarding and OCD severity. Alternatively, Early developmental influences, particularly uncertainty of self and others and memories of family warmth and security, and adult inattention were found to be related to Hoarding but not OCD severity. Perfectionism and the fear of uncertainty, and "Not Just Right Experiences" were related to OCD

symptom severity only. Further, although individuals with OCD and Compulsive Hoarders did not differ in the amount of reported “Not Just Right Experiences” or frequency with which these were experienced, they did differ on the levels of intensity, distress, and responsibility they produced. These findings pinpoint cognitive differences between the two disorders and challenge the current notion of hoarding as a subtype of OCD.

108.

PARENT AND PEER ATTACHMENT AS A PREDICTOR OF RESILIENCY AND YOUTH DEVELOPMENT

Adana Contreras ‘12, Geraldine Fernandez ‘12, Emily Howe ‘13, Chelsea Mello ‘12

Faculty Sponsor: Dina L. Anselmi

Theoretical frameworks of attachment have suggested that a disruption in the formation of healthy attachment can lead to emotional and psychological disturbances (Bowlby, 1973). In previous studies, attachment to parents and peers has been found to be related to self-concept, psychological adjustment, and physical health (Armsden & Greensberg, 1987). Although positive attachment has been theorized to play an important role in the development of an adolescent’s resilience, the exact nature of this relationship remains unclear. Resiliency has been identified as crucial not only in overcoming disadvantaged environments, but as a component of typical development. The present study sought to examine the relationship between parent and peer attachment and resiliency. Hearing and Deaf adolescents were assessed on a measure of parent and peer attachment (IPPA) and on the presence of protective factors and personal strengths. It was hypothesized that in comparison to hearing adolescents, deaf adolescents would possess an equal if not higher degree of resiliency and that adolescents with a stronger sense of attachment would be higher in resiliency.

109.

IMPLICIT THEORIES OF INTELLIGENCE, LEARNING STRATEGIES, AND ACADEMIC ACHIEVEMENT AMONG MIDDLE SCHOOL STUDENTS

Adana Contreras ‘12

Faculty Sponsors: Dina L. Anselmi, David Reuman, Deb Avery, Hartford Public Schools

Those that consider themselves incremental theorists believe that aptitudes are malleable and can be increased with effort; entity theorists argue that intelligence is a fixed ability that cannot be altered despite significant effort (Dweck, 1999). Previous research, has found that an incremental theory of intelligence positively influence the amount of effort one exerts on specific tasks, motivate patterns of adaptive learning strategies, self-efficacy, and positively impact academic performance. The current study was modeled after the research of Blackwell, Trzesniewski, and Dweck (2007), in which implicit theories of intelligence were evaluated in middle school students, followed by an intervention that taught the students about the aspects of effort, in an attempt to improve mathematical achievement. Using some of the intervention strategies of Blackwell et al., the present study implemented an intervention to a social studies classroom of 8th grade students. The participants were students in two separate eighth grade classes, taught by the same instructor. The experimental group received an ability belief intervention, which consisted of six, while the control group participated in early college awareness themed activities. Participants completed several self-report measures that assessed implicit theories of intelligence, effort beliefs, learning goals, and self-efficacy before and after the implementation

of the intervention. Students' course grades were also collected from the instructor at the beginning of the academic marking period, prior to the intervention, and then again after intervention, which coincided with the end of the academic marking period. The results indicated no significant effect of the intervention. There were marginally significant increases in students' theories of ability and self-efficacy; there was a decrease in effort beliefs and learning goals. Results also showed that there was no effect of the intervention on students' course grades. While the overall trends were in the predicted direction, sample size was small and the length of the intervention may have been too short, leading to the results obtained.

110.

SELF-REGULATED LEARNING: METACOGNITION, MOTIVATION AND ACADEMIC ACHIEVEMENT IN MIDDLE SCHOOL STUDENTS

Merrill M. Brady '12

Faculty Sponsors: Dina L. Anselmi, David Reuman, Deb Avery, Hartford Magnet Trinity College Academy

Research has found that students' motivation, as well as their metacognitive skills, impacts their academic and self-regulation abilities (Dignath & Buttner, 2008). Specifically, students who have an incremental theory of intelligence, higher self-efficacy, and higher levels of metacognition tend to be more academically successful and self-regulated in their learning (Ambrose et al., 2010). Although the process by which students acquire self-regulated learning is not fully known, metacognitive interventions have been found to be highly successful at enhancing students' self-regulation (Dignath & Buttner, 2008). The purpose of the current study was to investigate the effectiveness of an intervention that was designed to expose eighth grade students to a series of metacognitive strategies and encourage the use of these strategies by applying them within their current social studies curriculum. One section of an eighth grade social studies course was randomly assigned to a metacognitive intervention (N=22); another section from the same course was randomly assigned to a control section where the intervention focused on college awareness (N=19). Contrary to predictions, analyses did not show Group x Time interactions for measures of metacognition, self-efficacy and course grades, although they did show a marginally significant Group x Time effect for ability beliefs. The study shows how self-regulation interventions focusing on metacognition can be easily implemented into real-world classroom settings. Due to the complexity involved in fostering metacognition, future interventions should aim to include more sessions, more opportunities for practice and enhanced feedback; a longer and more focused intervention with a larger sample of eighth graders might provide support for how to improve students' motivation, metacognitive skills, and academic performance.

111.

THE EFFECTS OF A SCHOOL-BASED ARTS PROGRAM ON YOUTHS' SOCIAL, PERSONAL, AND ACADEMIC FUNCTIONING

Jenny Ley '12

Faculty Sponsors: Laura Holt, Dina L. Anselmi

Numerous studies have shown that the arts have the potential to positively influence the educational and social development of students. Arts-based programming is thought to positively affect student outcomes on account of the fact that it fosters skills of mindfulness and many of

Gardner's multiple intelligences. The Moving Matters program, a school-based arts program aimed at improving literacy, has been regarded as an influential part of Parkville Elementary School's curriculum since 1996, but has never been evaluated empirically. Therefore, the objective of this study was to examine possible personal, social, and academic benefits of this program. Specifically, in the current study I examined changes in writing self-efficacy and students' willingness to engage in cooperative learning, as these skills were strongly emphasized in the program's curriculum. I also examined changes in students' writing skills by evaluating their responses to a writing prompt distributed at the beginning and end of the program. One hundred nine fifth grade students at Burr Elementary and Parkville Elementary Schools in Hartford (52% female, 48% male, 65% Hispanic/Latino, 5% Black/African-American, 3% Asian/Asian-American, and 26% Other/Mixed Race) completed a pre-test prior to beginning the program and a post-test towards the end of the Moving Matters Program. Numerous students from Parkville had prior exposure to the program, while nearly all of the students at Burr Elementary were receiving the program for the first time. Analyses will examine change in writing self-efficacy, writing skills, and willingness to engage in cooperative learning following program participation. In addition, I will examine whether changes in the study variables were more/less pronounced for students with no prior experience in the program.

112.

LOVE IN DATING AND MARRIAGE: A CROSS-CULTURAL ANALYSIS

Quade Hansen '12, Julia Quattro '12, Kristen Ramsay '12, Jenny Ley '12

Faculty Sponsors: Dina L. Anselmi, David Reuman

The purpose of this study was to examine the differences between the value placed on love in marriage and love in dating across different cultures. Based on previous research, it was hypothesized that individuals from collectivist cultures would place more value on love in marriage than on love in dating as opposed to individuals from individualistic cultures. Participants were given a survey that was comprised of questions measuring whether or not they were from an individualistic or collectivistic culture, as well as questions about their views and their parents' views of love in dating and marriage. The sample consisted of 57 students at Trinity College, 34 of whom were classified as less individualistic and 23 of whom were classified as more individualistic. Although our initial research question focused on potential differences between individuals from individualistic and collectivistic cultures, due to limitations in our subject population, responses were reclassified along a scale of more to less individualistic. When individuals (whether high or low on individualism), judged the value of love in dating or marriage, no differences were found. However, when participants rated how their parents would value love in dating or marriage, a significant difference was found. According to participants, their parents were more likely to value love in marriage than in dating, regardless of their degree of individualism.

113.

COMPARING STRESS LEVELS IN COLLEGE ATHLETES: DIVISION I VERSUS DIVISION III

Leigh Howard '12

Faculty Sponsor: Randolph Lee

The investigation of how sports can have an impact on the mental psyche of participating athletes has been an area of increasing interest in the field of psychology. Collegiate athletics have been given a considerable amount of attention because of the effects that participation in sports at this level can have on a group of people who are already going through a substantial amount of stress due to the pressures of factors, such as academic responsibilities and social change. While there has been research done comparing the differences between college athletes and non-athletes, there has been little done to examine the difference that may lie among the group of athletes, depending on their level of competition. The current study sought to find such differences by looking at three areas of stress that are experienced by collegiate athletes. Three surveys were given to intercollegiate women's soccer teams at eleven schools, six from Division I and five from Division III. The questionnaires measured three main areas (1) physical stress symptoms; (2) psychological stress symptoms; and (3) social support satisfaction. I hypothesized that Division I athletes would report lower levels of physical and psychological stress than Division III athletes. I also predicted that Division III athletes would report to be more satisfied with their social support systems than Division I athletes. The results of the study suggested that there were no significant differences between the Division I and Division III athletes on any of the three measures.

114.

CULTURAL DIFFERENCES IN SPORT AS A PREDICTOR OF SELF-ESTEEM, ATHLETIC IDENTITY, AND BODY IMAGE

Leigh Howard '12, Eugene Arnold '12, Jeffrey Devereux '12, Nigel White '12

Faculty Sponsors: Dina L. Anselmi, David Reuman, Barbara Chapman

This study focused on how one aspect of sport's culture, team versus individual, affects an athlete's self-esteem, athletic identity, and body image. Past research has shown that athletes of team sports scored higher than athletes of individual sports on social self-efficacy, which is being related to self-esteem (Dinc, 2011). However, Lockhart, Black, & Vincent, (2010) found no differences between team and individual sports using different measures of self esteem. Other related past research on athletic identity indicated that children who spent more time in team rather than in individual sports reported a higher sport self-concept, which was also associated with higher self-esteem (Slutzky, & Simpkins, 2009). In a study concerning body image among different sport types, Morano, Colella, & Capranica (2010) found lower body dissatisfaction and better performance on some measures of motor performance for team sport athletes. These researchers also found that for team sports, males' body dissatisfaction was a significant mediator of the effect of BMI on perceived physical ability. The current study sampled 52 Trinity College Varsity athletes from both team (i.e., football, women's soccer) and individual (i.e., coed squash, and coed track & field) sports. Though it was hypothesized that there would be differences between team and individual sport athletes, specifically that team sport athletes would score higher on measures of self-esteem, athletic identity, and body image, no significant differences were found. One significant unrelated finding for gender did emerge; female athletes were found to display lower self-esteem than did male athletes.

115.

PAIN TOLERANCE IN MIXED MARTIAL ARTS (MMA) FIGHTERS, VARSITY ATHLETES IN NON-CONTACT SPORTS, AND NON-ATHLETES

Nigel White '12

Faculty Sponsors: Dina L. Anselmi, David Reuman

Within the last ten years acceptance-based therapy has grown into a popular therapy for managing pain, among other conditions (Hayes, 1999). The goal of acceptance-based therapy is to disconnect pain-related thoughts and feelings from literal actions. This study compared groups that were given an acceptance-based rationale, a distraction-based rationale, or no instructions for managing pain. This study also compared three groups of adult males: mixed martial arts (MMA) fighters, college varsity athletes who competed in non-contact sports, and college males who did not participate in athletics. It is through conditioning that MMA fighters are able to become capable of giving and taking pain. MMA fighters are assumed to have already had a command of acceptance given their training in their sport. Varsity athletes, who compete in non-contact sports, such as crew, must learn techniques of managing pain, given their participation and the physical demands of that sport. The final group, consisting of Trinity College students who do not participate in varsity athletics, are assumed to not possess well-developed strategies of managing pain. This study tested effects of pain management strategy and athletic group membership or self-reported measures of pain, as well as behavioral measures in a cold pressor task. Results indicated that there were no effects of pain management strategy or athletic group or any pain measures. In fact, virtually all participants (15 of 17) persisted in the cold pressor task for the maximum allowable time (5 minutes). Non-athletes judged the pain management strategies to have been more valuable in preparing for the cold pressor task than did MMA fighters. Reasons why the results of this study were so different from prior research will be discussed.

116.

DO GENDER AND RELATIONSHIP COMPOSITION AFFECT COLLEGE STUDENTS' PERCEPTIONS OF INTIMATE PARTNER VIOLENCE SEVERITY?

Jasmine Owarish-Gross '12

Faculty Sponsor: Laura Holt

Previous research has examined college students' opinions about physical abuse in heterosexual, lesbian, and gay couples. Less is known, however, about their opinions regarding the severity of psychological and sexual abuse in the context of these relationships. Given that 42 percent of intimate partner violence (IPV) victims are between the ages of 18 and 24 (Durose et al., 2005), additional research on how students react to IPV seems critical, so as to further our understanding of how students may react to and cope with IPV in their own relationships or the relationships of others.

The main aim of this study was to examine whether participant gender and relationship composition (i.e., heterosexual, lesbian, and gay couples) affected college students' opinions about the severity of physical, psychological, and sexual IPV. Other aims were to investigate if abuse in opposite-sex relationships was perceived as more severe than abuse in same-sex relationships, and if previous/current exposure to IPV was associated with lower IPV severity ratings. In order to examine these research questions, I recruited 72 Trinity undergraduates who were taking psychology classes and had them read three short vignettes that varied the gender of

the victims and perpetrators. Participants then responded to questions regarding the severity of the violence and assigned a blame rating to the victim and perpetrator. Participants also completed demographic questions, the Marlowe-Crowne Social Desirability Scale, questions about previous exposure to violence in their family, exposure to dating violence, and the Multi-Dimensional Emotional Empathy Scale (which assessed how empathic participants were).

Results were consistent with previous research, in that participants rated psychological abuse as the least severe form of abuse. Contrary to previous research, however, male participants in this study did not assign less blame to male perpetrators, nor did the participants view the violence in opposite-sex relationships as more severe than the violence in same-sex couples. Finally, previous or current exposure to IPV did not seem to have a large effect on participants' perceptions of IPV severity across all types of abuse and couple compositions.

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117.

THE EFFECT OF BILINGUALISM ON CULTURAL IDENTITY IN COLLEGE STUDENTS

Katherine Childers '13, Courtney DeVinney '12, Ashley Monter '12, Helena Zhang '12
Faculty Sponsor: Dina L. Anselmi

This study investigated how Spanish/English bilinguals identify with Hispanic and American culture, as a way of understanding which factors might contribute to an individual's sense of cultural identity. The sample consisted of 26 bilingual Trinity College students, who completed an online survey that assessed different aspects of cultural identity and linguistic competence. Results did not support the hypothesis that individuals who learned either English or Spanish first would have less sense of cultural identification than those who learned both languages simultaneously. Furthermore, while some participants felt that being bilingual greatly impacted their identity, others did not see bilingualism as a key aspect of their identity. Our research findings did demonstrate that participants believed there were positive benefits to being bilingual. For example, the majority of participants reported that they would encourage their future children in becoming bilingual. This belief is supported by research that suggests that there are positive advantages to bilingualism. Rubio-Fernández and Gluckberg (2012) found that bilingual students showed greater performance on false-belief tasks, which is linked with greater social competence.

118.

THE EFFECT OF PRIMARY AND SECONDARY CONTROL ON SOCIAL ANXIETY IN LATINO AND ASIAN AMERICAN COLLEGE STUDENTS

Helena Zhang '12

Faculty Sponsor: Janet Chang

Past research has established that appropriate, successful use of both primary and secondary control is associated with fewer symptoms of anxiety in Whites, but there has been less research

on the nature of this relationship in Latinos and Asian Americans. This study investigated how Latinos and Asian Americans differ in their use of primary and secondary control as well as how these differences are related to symptoms of social anxiety. The sample consisted of 142 Latino and 446 Asian American undergraduate students, who completed an online survey (e.g., measures assessing demographics, control, anxiety). Consistent with hypotheses, results showed that Latinos engaged in primary control to a greater extent than Asian Americans did, but Asian Americans tended to use secondary control to a greater extent than Latinos. As expected, Asian Americans scored higher on measures of social anxiety than Latinos, which may potentially be related to the importance of “face” in Asian culture. Results did not support the hypothesis that this difference in levels of social anxiety could be explained by ethnic differences in primary or secondary control. In both ethnic groups, less social anxiety was associated with higher usage of primary control, rather than secondary control. Future research should investigate the importance of primary control in lessening social anxiety as well as the influence of face loss concerns as an alternative explanatory factor.

119.

SOCIAL SUPPORT PROCESSES AND COLLECTIVIST NORMS AMONG ASIAN AMERICANS AND LATINOS

Jaclyn Arencibia ‘13, Helena Zhang ‘12, Carolyn Toner ‘14

Faculty Sponsor: Janet Chang

Seeking support from others through the disclosure of feelings or enlistment of advice is the predominant course of action in Western cultural contexts. However, limited research has focused on ethnic differences in the use and effectiveness of social support. Accordingly, the present study examined similarities and differences between Latinos and Asian Americans, exploring the role of social support in coping with stressors as well as how cultural norms impact support processes across these groups. A series of 10 separate focus groups were conducted for Latino ($n = 27$) and Asian American ($n = 31$) college students who voluntarily participated in discussions about stress and coping. Both groups overlapped in some forms of coping and relational concerns but differed in other respects. Latino and Asian American participants underscored the importance of family and respect for elders/authority, which were in line with the values of *familismo* and filial piety, respectively. Although both groups emphasized self-reliance as the primary relational concern and means of coping, self-reliance was linked with a desire to refrain from making matters worse and to preserve group harmony for Latinos, whereas for Asian Americans, it was related to saving face. Overall, the utilization of social support was avoided unless the stressor was overwhelming and unmanageable, though participants benefited to some extent from implicit support. These findings highlight the importance of understanding culturally divergent patterns even among groups with a shared emphasis on collectivism.

120.

THE ROLE OF EMOTION REGULATION IN THE PRACTICE OF FAMILIAL COPING AMONG LATINOS AND ASIAN AMERICANS

Milan Moore ‘12

Faculty Sponsor: Janet Chang

Although past research has examined cultural differences in emotion regulation, while other studies have focused on coping mechanisms, there is a paucity of research on the relation

between emotion regulation and coping strategies, namely familial coping. Given the collectivist cultural value of interdependence and connectedness among in-group members, including kin, the use of familial coping among Latinos and Asian Americans was examined in the present study. As such, the current study investigated the relationship between emotion regulation and family support among 142 Latino and 446 Asian American undergraduate students, who were administered an online survey that included measures of reappraisal, suppression, and familial coping. Partially in line with the hypotheses, results indicated no significant ethnic difference in the use of emotional reappraisal, but instead revealed significant ethnic differences in the use of both emotional suppression and family support to deal with daily stressors. Furthermore, as expected, Latinos who reported greater reappraisal of emotions were more likely to use familial coping compared to Asian Americans; reappraising their emotions may allow Latinos to rely more on family members for support because of their desires to address and change the impact of daily stressors through discourse with their kin. In short, ethnic variations in the use of family support highlight the need to use a cultural lens when promoting the use of informal support for college students.

121.

THE DEVELOPMENT OF THE VIEW OF THE “OTHER”: CORRELATION BETWEEN THE BELIEF IN STEREOTYPES BETWEEN STUDENTS’ AND CAREGIVERS

Michael Benson ‘13, Milan Moore ‘12, Michelle Okun ‘12, Amanda Shifreen ‘12
Faculty Sponsor: Dina L. Anselmi

Stereotypes are negative biases held by an individual about another group of people. One question of interest is whether stereotypes of college students are related to views of their parents. The present study measured the stereotypes of first year and senior students at Trinity College in relation to the stereotypes of their mothers in terms of race, class, homophobia, and religion. We hypothesized that there would be a positive correlation between students’ views and mothers’ views. Twenty-six participants from Trinity College and 8 caregivers participated in the current study, through the administering of an online survey to a random sample of students. Unfortunately, due to our limited sample size we did not have a reliable sample for our religious subgroup or homophobia subgroup. We correlated the remaining two subgroups, racism and classism, and found that students racial stereotypes and poor stereotypes are strongly, positively correlated. (See Table 1) Though further analysis we also found that parents were significantly less racist than students (See Table 2). Due to our limited sample size further testing still needs to be done.

SOCIOLOGY

122.

STEERING, STIGMAS, AND STEREOTYPING: RACIAL ATTITUDES IN THE HOUSING MARKET

Louise Balsmeyer '14

Faculty Sponsor: Theresa Morris

In order to understand the nature in which indirect housing barriers continue to affect the lives of residents, it is imperative to investigate the causality for the perpetual discriminatory attitudes that affect the decisions that are made in the housing market. This cross sectional study examines previously conducted interviews of residents in Hartford and its surrounding areas, in search for direct responses to the question of whether they believe housing barriers still exist. Fifty-one interviews were coded into quantitative secondary data to determine if the race of the respondent had an affect on the response given. The theory states that persisting housing barriers affect the racial attitudes of urban and suburban residents in the Hartford area. The hypothesis predicts that residents who identify as minority races would be more likely to argue that barriers still exist in the housing market. The statistical results of the chi-square analysis indicate a moderate significance between race and response to persisting housing barriers. Due to the limited amount of interviews and large number of insufficient responses, the conclusion of this study suggests that further research is necessary in order to accurately generalize the findings.

123.

ALCOHOL IN COLLEGE ATHLETICS: THE FIGHT TO RAISE AWARENESS OF BINGE DRINKING ON COLLEGE ATHLETIC TEAMS

Whitney Colbert '14

Faculty Sponsor: Theresa Morris

While there is a great amount of information on college students and binge drinking today, I wanted to focus more on the athletes perspective. This study will focus on today's generation as to why college athletes are binge drinking more now than ever before. I will be analyzing the data chosen from the Harvard School of Public Health Alcohol Study conducted in 1999, which shows the importance of alcohol in athletic teams and comparing those results to college students who are not on an athletic team. While using this secondary data I hope to draw further conclusions and develop a possible relationship as to why athletes drink more heavily than college academics, if this statement ends up being supported.

124.

WHAT AFFECTS SUCCESS? ANALYZING THE EFFECT OF SCHOOL-LEVEL RACIAL DEMOGRAPHICS ON STUDENT ACHIEVEMENT

Fionnuala J Darby-Hudgens '13

Faculty Sponsor: Theresa Morris

In an effort to better understand what affects student achievement on standardized tests, this cross sectional study analyzes quantitative secondary data to determine if school-level racial demographics affect student achievement on standardized tests. The study includes thirty-one

public schools in Hartford. The hypothesis of this study is that there is not a statistical relationship between the two variables. The statistical findings of a Pearson's correlation and regression analysis support the hypothesis. School-level achievement on standardized tests is affected by socio-economic status but not racial demographics. There are problems with the generalizability of the findings due to the limited case numbers and the lack of variation in the data. In light of the current education reform climate and Hartford's mission to better school segregation, the outcome of this study suggests that further analysis needs to be done.

125.

WHO WILL PLAY SPORTS AT TRINITY?—AN ANALYSIS OF FACTORS LEADING TO TRINITY COLLEGE SPORTS PARTICIPATION

Danyelle Doldoorian '14

Faculty Sponsor: Theresa Morris

Sports are an integral part of campus life at Trinity College. Who has not heard of Trinity's squash dynasty and what student has not been to a Trinity football game? But who ends up on the court and on the field? The aim of this study is to determine what factors lead a Trinity College student to become a Trinity student-athlete. Factors that will be examined are race, sex, and type of high school the students attended. In order to study these factors I used a data set consisting of the attributes of a recently-graduated Trinity class concerning sports participation, high-school attendance, white or nonwhite race, and sex. By using chi squared data analysis I was able to determine which of these factors lead Trinity College students to become Trinity College student-athletes and which students are most-likely to participate in athletics.

126.

EXAMINING INTERNET ACTIVITY AND SOCIAL MOBILIZATION

Booker Evans '13

Faculty Sponsor: Theresa Morris

In recent years usage of the internet has gone through the roof. Everyone is on the internet, research has shown that 3 out of 4 Americans have internet access and 41.6% of Americans have a Facebook account. However, we know little about the implications that this trend will have on society. Maybe the internet makes it possible for you to do so much that you end up stretching yourself too thin and have no focus on one thing in particular. This paper addresses whether or not usage of social networking websites effects civic engagement. Using survey data from the Pew Research Center in 2010, we will employ a logistic regression model to examine the likelihood that usage of the internet negatively effects civic engagement. Based on preliminary research, we expect to find that people who are heavily engaged in internet activity are much less active in socialization, volunteering and politics.

127.

ADOLESCENT ALCOHOL ABUSE: DO STUDENTS CONSUME MORE WHEN THEY DISLIKE SCHOOL?

Gavin Freeman '14

Faculty Sponsor: Theresa Morris

Substantial research has been done on adolescent alcohol abuse. Studies have shown how academic achievement, school commitment, gender, and parental abuse can influence alcohol intake. However, not much research has been done on how students' preferences for school affect adolescent alcohol abuse. I used a questionnaire entitled, "Health Behavior in School-Aged Children, 2001-2002 [United States]," as my main source of data. It surveys individual students. The paradigm of symbolic interactionism led me to believe that the more a student likes school, the less frequently he/she is to abuse alcohol and vice-versa. My hypothesis was supported because boys and girls alike who claimed that they liked school a lot drank a significantly less frequent amount than those who claimed they did not like school at all.

128.

DIFFERENCES IN CARE PREFERENCES OF THE EUROPEAN ELDERLY: FAMILY AND NONFAMILY SOURCES

Padmini Gopal '15

Faculty Sponsor: Theresa Morris

Despite the fact that there has been a substantial amount of research done on the treatment and care giving of the elderly, there are few studies done on what kind of assistance the elderly prefer. The following study will attempt to address the reasons and influences behind why the some elderly persons prefer formal care arrangements while other elderly persons prefer informal care arrangements. The study will focus on the elderly from Europe which will be used as the unit of analysis and the following findings are based on the analysis of the secondary data obtained from the Euro barometer, 1992. Specifically, the study will examine whether the care giving preferences of the European elderly are influenced by their gender and marital status and as well look for any socio-demographic differences with regard to Northern, Southern and Western Europe by controlling for it. I hypothesize that 1) single, divorced, widowed and separated elderly people are more likely to choose formal or non- familial sources of care arrangement for themselves than those elderly people who are married, 2) elderly brought up in North and Western Europe are more likely to choose non- familial sources of care arrangements than those elderly coming from Southern Europe. I will frame my study based on the theory of age stratification and the theory of the three worlds of welfare capitalism. After having analyzed my findings, I found that single, divorced, widowed and separated elderly people were more likely to choose non familial sources of care as compared to elderly who were married and that single elderly in Western Europe were more likely to choose formal sources of care in comparison to those coming from Southern Europe, hence confirming my hypotheses.

129.

HEALTH DISPARITIES: HEALTH STATUS AND INCOME WITHIN THE US

Emily Heneghan '14

Faculty Sponsor: Theresa Morris

Compared to other industrial nations, the United States is a country with large and growing health disparities among groups of people. Although these health disparities are most often attributed to individual health behaviors like smoking, diet, and exercise, these factors account for only a portion of these differences. This study focuses on how social factors contribute to sustain or diminish the health of groups of people by looking at the relationship between health status and various income populations. Based on the United States National Health Measurement Study 2005-2006, this study will analyze the possible casual relationship between these two variables.

130.

THE FABRICATED FACTOR OF CRIME: RACE

Taniqua Huguley '15

Faculty Sponsor: Theresa Morris

Does race contribute to neighborhood crime rates? The *strain theory* and the *social disorganization theory*, along with previous research articles guided me to analyze the relationship between the independent variable: race, and the dependent variable: neighborhood crime rates. The strain theory explains how a mismatch between opportunities structures within society and societal goals of success may cause crime; the social disorganization theory emphasizes how subcultures, particularly subcultures that emerge in disadvantaged areas, may encourage crime. Both share in common a focus on social structure and opportunities. Before I conducted my actual research I hypothesized that race is not the sole factor that contributes to crime, because society's social structures affect relationships between citizens as much as race. I used a 1996 data set titled: *National Survey of Weapon- Related Experiences, Behaviors, and Concerns of High School Youth in the United States*, to examine the relationship between race and crime. My results support my hypothesis. Based on secondary data I was able to find that race was not a sole factor that contributed to crime. The social structure of society and one's home resulted to be the significant contributing factors to crime.

131.

SCHOOL INFLUENCES: THE SIGNIFICANCE OF SCHOOL HEALTH POLICIES AND CHILDRENS' WEIGHT IN THE UNITED STATES

Michelle Johnson '13

Faculty Sponsor: Theresa Morris

Childhood obesity is often referred to as a health epidemic due to the steady increase in obesity rates in the past few decades. Because obese children suffer greater health risks as adults, health educators and policy makers have increased efforts to modify environmental factors that contribute to obesity. The purpose of this study is to analyze the impacts of stricter school health policies proposed by the Centers for Disease Control and Prevention (CDC) and by Congress aiming to regulate health food standards in schools and to increase physical education. Using secondary data from the Health Behavior in School-Aged Children (HBSC) survey, I will

analyze the relationship between children's recorded health levels and the implications of health policies in schools in the United States. Although empirical studies analyzing children's health have not concluded an individual variable that determines the obesity rates, future studies are crucial in identifying effective methods to reduce obesity rates in children.

132.

FROM THE GLASS CEILING TO THE GLASS CLIFF: DISCRIMINATION AGAINST WOMEN IN THE WORKPLACE

Sophie Katzman '14

Faculty Sponsor: Theresa Morris

There has been vast research done on discrimination in the workforce. Yet, quantitative information on the prevalence of discrimination based on certain factors is not as common. I am interested in the effect of sex because I have heard of inequalities between men and women in careers. I hypothesized that women are discriminated against in the workplace more often than men. This can be explained by feminist theory, which argues that the gender differences in the roles of women and men are the result of cultural and societal constructs, and these can further lead to inequalities. This reflects both symbolic interaction and exchange theory. To study this question, I examined secondary data from a Roper Center telephone interview conducted through a Hart-Teeter Research Company Survey in the year 2000. I used the question: "Have you experienced discrimination in the workplace" as my dependent variable and sex as my independent variable. I used SPSS statistical software to analyze the data and chi-square as my test of statistical significance. The bivariate analysis showed that women are more likely than men to face discrimination in the workplace. This relationship was statistically significant. I controlled for both race and income, and the relationship between sex and discrimination was supported in both analyses. Thus, there is a strong relationship between sex and discrimination in the workplace. For further research, I could study the reasons women get discriminated against more often than men and further analyze individuals who are discriminated against most in the workplace and the particular fields in which discrimination is most prevalent.

133.

'TO BE, OR NOT TO BE': ARTS INCENTIVES IN PUBLIC AND PRIVATE EDUCATION

Kyra Malave '13

Faculty Sponsor: Theresa Morris

In this study I propose to examine the difference in arts funding between public and private schools. While I have found little research regarding the actual financing of the arts, I believe that public institutions will have less funding, support and provision of arts education than private institutions thus reflecting the outcome of students learning capacity and achievement. The data I have examined in this study is secondary data compiled from the 1999-2000 Schools and Staffing Survey conducted by the National Center for Education Statistics of the U.S. Department of Education. I have also accumulated additional literature regarding arts education and funding for further analysis of said topic. I have found no distinct correlation between arts funding and public or private institutions until the variable of 'Urbanicity' is introduced, at which point private institutions have higher arts incentives when located in large to mid-size central cities.

134.

IN COMES DIVORCE: CAN INCOME CAUSE DIVORCE?

Priyanka Menezes '14

Faculty Sponsor: Theresa Morris

There has been a plethora of research done on the causes of divorce. However, a good amount of the research done focuses on longitudinal studies or is dated. As a result I wanted to do a cross sectional research study on divorce. This study uses data from the General Social Survey from 2010. I will be looking at the effect income, the independent variable, has on divorce, the dependent variable. I predicted that the more income a couple has, the more likely they are to get divorced. After finding that my variables are statistically significant I was able to analyze my bivariate table. Analyzing the bivariate table, I found that respondents in the middle-income and the high-income ranges were more likely to be divorced as compared to respondents in the lowest income range.

135.

GENDER AND OPINIONS ON ABORTION

Olivia Meredith '14

Faculty Sponsor: Theresa Morris

There has been a recent abundance of literature pertaining to opinions regarding abortion in the United States, a controversial topic over the past several decades. This study focuses specifically on abortion opinion and if gender influences the opinions that people hold about abortions. The population of this study includes men and women in the United States in 1989. The sample size is 588 women and 366 men, totaling 954 respondents. This study is based on secondary, quantitative data obtained from the CBS News/NY Times Abortion Poll in 1989. Using conflict theory and more specifically feminist theory, I hypothesize that women are more likely than men to support abortion because they are more directly affected by it. My hypothesis is not supported through the results of this study; however it is supported when I introduce control variables. Specifically, women in Western and Southern parts of the United States are more likely than men in those areas to support abortion. Also, women with children under the age of 18 are more likely than men with children this age to support abortion.

136.

RACE AND SELF ESTEEM: A CURIOUS DISPARITY BETWEEN THEORY AND REALITY

Jake Pullis '14

Faculty Sponsor: Theresa Morris

A commonsense approach to the study of self-esteem through the symbolic interactionism perspective of sociology would suggest that normative viewpoints held by society would affect an individual's self-esteem. Strangely, contemporary studies relating the race of respondents to their reported self-esteem have shown that despite society's racially prejudiced attitudes, blacks actually have higher self-esteem than do whites. Contemporary social researchers have attempted to explain this phenomenon in a number of ways. By analyzing a study of adolescent health, this

study attempts to recreate this unexpected racial patterning of self-esteem and help to explain the pattern.

137.

EATING DISORDERS, BODY IMAGE & ADOLESCENTS

Brigit Rioual '14

Faculty Sponsor: Theresa Morris

Today, adolescents are easily influenced through things such as media, their environments, their peers and their family. Literature looks at these factors in relation to eating disorders. Because perceptions of body image is related to and can be a cause of eating disorders, I conducted research on the effects of residence (urban, rural, suburban areas) on adolescent's perceptions of their body image. Data was difficult to find on adolescents with eating disorders; therefore I used body image as a way to measure eating disorders but I am in no way suggesting that those with a negative body image have an eating disorder. Because I focused on body image and residence, I thought that girls in urban areas would be more likely to have negative perceptions (think they are too fat) of their body but my prediction was not accurate.

138.

PUBLIC VS. PRIVATE EDUCATION

Taylor Rioux '15

Faculty Sponsor: Theresa Morris

- Does the type of high school, either public or private, affect a student's ability to properly prepare for college?
- In this research paper I hypothesize that students who attend private high schools are more likely to be better prepared to apply and enter colleges and universities than those who attend public school.
- Using educational studies and surrounding literature I attempted to surmise a definitive conclusion on the topic.
- My primary quantitative source was a data set called the National Education Longitudinal Study, 2002: Base Year. From the United States Department of Education. (National Center for Education Statistics). An extensive look into all aspects of high school education in 2002.
- Results of this study can paint a clearer picture for parents struggling with the decision between sending their kids to private or public high school.

139.

RACE AND AMERICAN NATIONAL IDENTITY: HOW DOES THEIR RELATIONSHIP AFFECT IDENTITY FORMATION?

Julia Rivera '14

Faculty Sponsor: Theresa Morris

This study examines several elements of individuals' self-identity. I analyze race, ethnicity and nationality as competing variables that determine self-identity. Using secondary data, I analyze the possible causal relationship between racial, ethnic and American self-identity. Based on the ever-present racial socialization in American society, I argue that minorities are less likely to

identify as American, and more likely to weigh race or ethnicity as important in determining their self-identity. While previous research on nationalism indicates that many factors contribute to one's national identity, I explore the degree to which racial or ethnic elements are specifically associated with identifying as American. Using the theories of incorporationism and synthesized versus confused personal identities, I address more closely the elements of race and ethnicity within the American identity, as well as the complexity of all three in identity formation. My findings confirmed that people with more complicated racial identities, in this case meaning those that self-identify as a minority, are less likely to identify as American.

140.

WHY ARE CERTAIN RACIAL GROUPS OF HIGH SCHOOL STUDENTS LESS LIKELY TO EXPECT A COLLEGE DEGREE?

Jessica Schlundt '13

Faculty Sponsor: Theresa Morris

It is commonly assumed that a lower percentage of racial/ethnic minority high school students expect a college degree as compared to white Americans. This paper adopts this assumption as a hypothesis, and will attempt to verify it and explore the reasons supporting it. The dependent variable is the expectation to obtain a college degree or beyond, while the independent variables are the influences on high school students which lead to their decision to attend or not attend college. These variables may include parents education, ability to qualify based on grades and test scores, financial ability via family resources or scholarship, and willingness of the colleges to admit these students. This report reviews the literature for previous studies, and analyses data from the Educational Longitudinal Study of 2002 showing the relationship between student expectation of a college degree and the influencing factors for that expectation. The findings show that a high percentage of high school students (and their parents) expect to achieve a college degree or higher, across all racial groups, but several influencing factors vary between these groups.

141.

ATTITUDES TOWARDS BIRTH CONTROL BY GENDER

Mia Schulman '14

Faculty Sponsor: Theresa Morris

Contraception is an important contemporary issue as well as a key part of life for many people. This study investigates how gender affects attitudes towards birth control. Using symbolic interactionist theory, I interpret data from the National Couples Survey 2005-2006. The sample consists of 1,009 heterosexual couples from five United States cities, all above 20 years old. I hypothesize that women will have more positive attitudes towards both condoms and birth control pills, the methods of contraception I focus on. Measuring attitudes through the variables, Spousal Disapproval of Birth Control Pills and Spousal Disapproval of Condoms, gender differences are observed and analyzed. After creating the bivariate graphs in SPSS, I controlled for age of respondents, length of relationship and religiosity to further understand the data. Through analyzing the responses by gender, I found that while men are more likely than women to disapprove of condoms, women are more likely than men to disapprove of birth control pills, thus refuting my initial hypothesis that women would feel less disapproval for both methods of contraception.

142.

THE EFFECT OF INCOME ON ABORTION

Alex Villa '14

Faculty Sponsor: Theresa Morris

Although women's health has increasingly been studied over the past several decades, research regarding the topic of abortion has remained limited. This study focuses on the reasoning behind women's decisions to have an abortion as a means of support for the pro-choice movement and for the procedure's future use. Given the range of explanations, specifically I focus on the economic aspect of the decision making process and whether or not total income influences a woman's decision to have an abortion. I hypothesize that there will be a causal relationship between low total income and women's decisions to have an abortion. Using secondary data from the National Survey of Family Growth, Cycle V, 1995, the study analyzes the statistical significance of this relationship. Although not a strong correlation, I conclude that there is a causal relationship between income and abortion. However, it is clear that there is more than one reason considered when deciding to have an abortion.