



**SIGMA XI**  
THE SCIENTIFIC RESEARCH SOCIETY

**FAIRFIELD UNIVERSITY CHAPTER**

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# **13TH ANNUAL POSTER SESSION**

**Thursday | April 25, 2013**

**Barone Campus Center**

**3:00 p.m. to 5:00 p.m.**



**Fairfield**  
UNIVERSITY

Sigma Xi acknowledges additional support by the Office of Academic Engagement



Joshua Baum  
John Belden  
Robert Blaisdell  
Carly Bock '12  
Marissa Cannata  
Colleen Carty  
Justina Caushi  
Taylor Congdon  
Jesse Conklin  
Thomas S. Corona Jr.  
Jennifer Dierkens  
Frank Dileo  
Carlie Famiglietti  
Brendan Freeman  
David Giron  
Stephanie Greene  
Taylor Hoffman  
Gina Impronto  
Farheen Khan  
Gresi Kello  
Adam Kenney  
Nicole Kizielewicz  
Allison Lai  
Marilynn Lopez\*  
Audrey Longfellow  
Katherine R. Martin

Michael Mauro  
Caitlin McDonald  
Thomas McNeely  
Nick Melaragno  
Taylor Morgan  
Jillian Muhlbauer  
Umar Munshi  
Julie Passarelli  
Danielle Pepi  
Gregg Perlmutter  
Gregory Pettit  
Angela Quental  
Katherine Ritchie  
Abigail Romano  
Jeana Savage  
Chelsey Silva  
Taylor Szupiany  
Farah Themistocle  
Kathleen Tran  
Katelyn Volkar  
Taylor Walsh  
Taryn Wesoly  
Jessica Whelpley

# BIOLOGY

\*Business Management Major



## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Joshua Baum, Adam Kenney

*CLASS YEAR:* 2014, 2015

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:* Behavioral Study on Canadian Lynx

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ashley Byun, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:* Connecticut's Beardsley Zoo

### *DESCRIPTION OF WORK (Short Abstract):*

Over the course of the semester, our main focus became the behaviors of the Canadian Lynx located at the predatory animals exhibit at the Beardsley Zoo. The zoo made it clear that their goal involved the mating of the Lynx since the species is endangered. We consulted our observations with Zookeeper Steve and he would help to explain certain behaviors as we monitored and recorded any changes in behavior.

On our initial visit, we noticed that the female showed more dominance over the male; the zookeeper explained that age influenced this behavior, since the female was a year older than the male. They also did not appear to show any signs of true social activity with one another besides the occasional attempt from the male. As time progressed, more social activity between the two Lynx became evident. On a few accounts, the Lynx napped next to or near one another; the male also appeared to guard the female while she slept. More playful activity between the two also occurred such as games of tag throughout their cage. Common behavior between the two included marking their territory as well as stalking various birds and even little children.

Overall, we did notice a change in behavior. However, we do not know for sure if this change notes a mating. We will know if the Lynx mate by tests done on the fecal matter of the female; the test will indicate pregnancy by a change in hormone levels.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

STUDENT RESEARCHER(S): John Belden

CLASS YEAR: 2013

MAJOR: Biology

TITLE OF RESEARCH PROJECT: Scaling of Fast-Start Performance in Juvenile Bluegill

HOST UNIVERSITY OR INSTITUTION: Fairfield University

NAME OF FACULTY RESEARCH SUPERVISOR: Shannon Gerry, Ph.D.

DATE OF PROGRAM: Fall 2012- Spring 2013

SPONSOR: NSF

### DESCRIPTION OF WORK (Short Abstract):

One of the most important aspects of fish survival is their ability to evade predators. Fish use a fast-start mechanism to escape predators or capture prey and this has been correlated to body shape. Adult Bluegill (*Lepomis macrochirus*) show two body shapes based on their habitat: the pelagic form has a streamlined, fusiform body that is associated with steady-state swimming and faster-starts. The littoral body form is deeper and is associated with maneuverability. All juvenile bluegill hatch and develop in the littoral zone until they are large enough to evade predators in the open water. The goal of this experiment was to determine if juvenile bluegill exhibit the same variation in morphology and fast-start performance as shown by the adults. We hypothesized that older juveniles would have faster-starts, which would enable them to move into the pelagic zone. Three size classes of juveniles were collected, fast-starts recorded using high-speed video, and photographed for morphometric analysis. Principle components analysis showed a divergence in the morphology of the juveniles: younger fish had more fusiform bodies, similar to pelagic adults. This divergence in morphology is related to variation in performance. However, contrary to our hypothesis, younger juveniles showed the fastest starts and escaped the greatest distance as compared to the other two classes ( $p < 0.0001$ ). It is likely that these younger fish have increased fast-start performance because they are more susceptible to predation and older juveniles are better able to maneuver within the littoral environment.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

**STUDENT RESEARCHER(S):** Marissa Cannata, Taylor Congdon, Abigail Romano, Katelyn Volkar, and Taryn Wesoly

**CLASS YEAR:** 2014 & 2015

**MAJOR:** Biology

**TITLE OF RESEARCH PROJECT:**

Observations of the Species Interactions between Howler Monkeys (*Alouatta* sp.), Male Saki Monkey, and Introduced Female Saki (*Pithecia* sp.)

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Ashley Byun, Ph.D.

**DATE OF PROGRAM:** 2/23/2013-4/21/2013

**SPONSOR:** Connecticut's Beardsley Zoo

**DESCRIPTION OF WORK (Short Abstract):**

The Beardsley Zoo recently introduced a new female saki (*Pithecia* sp.) into an exhibit currently inhabited by a female and male howler monkey (*Alouatta* sp.) and one male saki. Over 20 hours of observations was conducted to see if all individuals were coexisting and whether both species were adapting to the new female. On the whole, it appears that the level of interaction among all exhibit members has increased. However, it seems as if the new female saki may be fearful and submissive to the female howler while the males of both species appear indifferent.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Colleen Carty

*CLASS YEAR:* 2014

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:*

Lake Lillinonah: Comparison of Trophic Status Classification Schemes

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Jen Klug, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

Trophic statuses aid in defining the status of a lake by labeling current conditions as being oligotrophic, mesotrophic, and eutrophic. These labels are important in creating consistent qualitative boundaries based on lake conditions. The purpose of this project was to compare four lake trophic status classification schemes that are based on water clarity and nutrient levels. Quantifying water clarity and nutrient concentrations is useful in determining overall water quality and can be instrumental in comparing across systems and influencing water quality management. This research compared the categories proposed by The European Water Framework directive, Nurnberg 1996, The Organization for Economic Cooperation and Development (OECD), and the CT Department of Energy and Environmental Protection (DEP) using data from Lake Lillinonah, an impoundment on the Housatonic River. According to the DEP, which is the current classification scheme used for Connecticut Lakes, Lake Lillinonah is typically characterized as a eutrophic lake. This status is based on many factors, but encompasses secchi disk depth (a measure of water clarity) and total phosphorus levels. In comparing the current standards to the other three, we were able to conclude whether or not the current way of classifying is comparable with schemes used on a national and global level. In addition, we identified trends among different sites on the lake, and over a two-year period. Ultimately, each scheme allowed each site on Lake Lillinonah to be categorized as having high, good, moderate, poor, or bad water quality. All but of one the four schemes provided consistent results. Thus, we conclude that the current scheme used in Connecticut appears to be consistent with what is being used elsewhere.



## **2012/2013 STUDENT RESEARCH IN BIOLOGY**

**STUDENT RESEARCHER(S):** Thomas S. Corona Jr.

**CLASS YEAR:** 2013

**MAJOR:** Biology

**TITLE OF RESEARCH PROJECT:**

Determination of Monk Parakeet Nesting Site Preference on Utility Poles in Southern Connecticut

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Brian Walker, Ph.D.  
Kevin Burgio, UConn Ph.D. Candidate

**DATE OF PROGRAM:** August 2012- continuing

**SPONSOR:**

**DESCRIPTION OF WORK (Short Abstract):**

Monk parakeets, *Myiopsitta monachus*, are native to South America, ranging from central Bolivia to south Brazil, Uruguay and southern and central Argentina. However, these parrots have become established in urban areas around the world. In the Monk parakeet's brief history in Connecticut, they have proven to be a controversial public safety problem. Monk Parakeets often build their large nesting sites on utility poles. Their nests frequently short out power lines, often causing transformer fires. Attempts to control their populations via nest removals and euthanasia programs have thus far been unsuccessful, and generate intense opposition from members of the public concerned about animal welfare. The goal of this research is to identify and quantify critical aspects of the Monk Parakeet's nest construction process on utility poles, to indicate any preference of nesting sites based on the characteristics of utility poles that have been recorded as a nesting site between 2004-2009. This information can be used to inform the concept and design of a nesting exclusion device for Utility poles. If a method successfully excludes them from power poles, utility companies from Connecticut to Florida will be able to reduce the incidence of power outages and fires attributed to Monk Parakeet nests, as well as the associated costs of repeated nest removals, without euthanasia or chemical sterilization programs.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

*STUDENT RESEARCHER(S):* Carlie Famiglietti

*CLASS YEAR:* 2013

*MAJOR:* Biology, Music

*TITLE OF RESEARCH PROJECT:*

Music Cognition in *Leontopithecus rosalia* : Difference in musical perceptions between humans and non-human primates

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Laura Nash, Ph.D.

*DATE OF PROGRAM:* Spring 2013

*SPONSOR:* Connecticut's Beardsley Zoo

*DESCRIPTION OF WORK (Short Abstract):*

The main goal of this study was to examine music cognition in *Leontopithecus rosalia*, as it relates to humans. A widespread literature review of the topic concluded that prior studies, although well designed, did not offer a clear reason for choosing certain musical selections. Music is based on the principles of physics and math, where the timing of music and its organization were first established well before the 19<sup>th</sup> century. Historically, meter and rhythm were first created, then melodic phrasing, and lastly harmony. Music created prior to the 19<sup>th</sup> century focuses heavily on these elements, whereas musicians in the 19<sup>th</sup> century pushed creative limits, and manipulated the tonal system in expressive ways. Thus, a family of Golden Lion Tamarins (*L. rosalia*) at the Beardsley Zoo was observed while instrumental music from both pre-19<sup>th</sup> century and post-19<sup>th</sup> century musicians was played. Music that relied heavily on rhythmic components, melodic components, or harmonic components was chosen, along with music that contained elements similar to the tamarin voice. This research indicates that *L. rosalia* respond to music that is based on the pre-19<sup>th</sup> century model of music as a science, where the structure of the tonal system is most evident. Non-human primates and humans have similar brain structures, which could be the reason both react to such structured music. This study contributed to the new and growing fields of music cognition and the neuroscience of music by incorporating the use of music in a scholarly way.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

***NAME:*** David Giron

***CLASS:*** 2014

***MAJOR:*** Economics

***TOPIC OF RESEARCH PROJECT:***

Water Resources Stress: Efficiency in Water Treatment in Campos dos Goytacazes

***HOST UNIVERSITY OR INSTITUTION:*** UENF

***NAME OF SUPERVISOR/SEMINAR LEADER:*** Carlos Rezende

***DATE OF PROGRAM:*** Fall, 2012

***SPONSOR:***

***DESCRIPTION OF WORK (Short Abstract):***

The purpose of the survey was to discover how clean is the water the residents of the area are consuming.. The survey was conducted by asking a series of questions to the residents for them to respond. The first part of the questionnaire dealt with background information of the resident. The second section was concerned with water storage, price, and maintenance. From the results, we can determine if the water treatment is efficient and reliable before being consumed by the populations. It will also tell us if the population trusts the purity of the water or if they rather use other methods of acquiring clean water.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

**STUDENT RESEARCHER(S):** Stephanie Greene, Audrey Longfellow, Kathleen Tran, and Jessica Whelpley

**CLASS YEAR:** 2013

**MAJOR:** Biology

**TITLE OF RESEARCH PROJECT:**

Comparison of Size Specific Fecundity between Native *Panopues herbstii* and Invasive *Hemigrapsus sanguineus*

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Diane Brousseau, Ph.D.

**DATE OF PROGRAM:**

**SPONSOR:**

**DESCRIPTION OF WORK (Short Abstract):**

Predicting which species are potential invaders is an important goal of researchers studying invasion ecology. Of particular interest is whether certain life history traits exist that predispose a species to become a successful invader. Among those commonly cited are fast growth, high reproductive potential, tolerance of a wide range of environmental conditions and high dispersal ability. In this study, we compared the reproductive behavior (size-specific fecundity and duration of egg-laying) of two marine crabs, the non-invasive native mud crab, *Panopeus herbstii* and the nonindigenous Asian shore crab, *Hemigrapsus sanguineus*. Both species occupy the same ecological niche and co-occur in rocky intertidal habitats of Long Island Sound. During 2012, we collected mud and Asian crabs from Black Rock Harbor, Bridgeport, CT. Crabs were counted and categorized by species and sex. Size-specific fecundity was determined for berried mud and Asian females by removing the egg mass, separating eggs manually and counting photographed eggs. Berried mud crabs were present from only June to August while egg-laying Asian crabs were found from April to September. In addition, size-specific fecundity rates for both species show greater egg production in Asian crabs than in mud crabs of comparable carapace width. The extended reproductive season and higher fecundity rates of the Asian crab support the hypothesis that an identifiable relationship exists between success in invasion transitions and high reproductive potential.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

**STUDENT RESEARCHER(S):** Stephanie Greene, Audrey Longfellow, Kathleen Tran, and Jessica Whelpley

**CLASS YEAR:** 2013

**MAJOR:** Biology

**TITLE OF RESEARCH PROJECT:**

Update on the Biology and Population Dynamics of the Green Crab (*Carcinus maenas*) in Milford Harbor (Connecticut USA)

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Diane Brousseau, Ph.D.

**DATE OF PROGRAM:** 12/2008 to present

**DESCRIPTION OF WORK (Short Abstract):**

It has been suggested that resource competition from the Asian crab (*Hemigrapsus sanguineus*) would result in population declines of the European green crab (*Carcinus maenas*) along the east coast of North America. From September 2008 to December 2012 we studied a green crab population in Milford Harbor, CT to determine abundance and population structure. Seasonal CPUE (crabs per trap per day) estimates ranged from 0.09 to 1.39. Male crabs were larger than female crabs, and approximately twice as many males as females were caught during the study period. Results showed that numbers trapped remained constant from fall 2008 through summer 2010. In 2010-2011 there was a sudden decline in the number of crabs caught, reducing the annual crab totals by half. We hypothesized that the low numbers of crabs found in traps was due to fluctuations in water temperature affecting crab movement. However, the above-average mean winter temperature observed in 2012 (5.08°C) was not accompanied by an increase in numbers of crabs caught, suggesting that crab movement is not closely regulated by temperature changes. More data is needed to determine if the decrease in number of crabs caught during winter 2010 through winter 2012 is due to population decline or crab migration from the area. Ventral carapace color varied between green and orange red, with an overall higher proportion of red morphotype crabs. Red coloration has been associated with prolonged intermolt periods and is thought to confer an advantage when mating since red phase individuals have thicker carapaces and more robust chela (Kaiser et al. 1990). Females carrying eggs were most often caught during the winter and spring months. Seasonal totals ranged from 0 to 17 females captured. The largest percentage of berried females were collected in Spring 2011 when over half of the females caught were carrying eggs (55.5%). Field data generated here is part of a long-term study of the population dynamics of *Carcinus maenas* in Long Island Sound.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Taylor Hoffman, Nicole Kizielewicz, Chelsey Silva, and Frank Dileo

*CLASS YEAR:* 2013 (TH), 2014 (NK, FD), 2015 (CS)

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:*

Observation & Analysis of Courtship/Breeding in the Keel Billed Toucan

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ashley Byun, Ph.D.

*DATE OF PROGRAM:* Spring 2013 Semester (Vertebrate Zoology)

*SPONSOR:* Connecticut's Beardsley Zoo

*DESCRIPTION OF WORK (Short Abstract):*

The purpose of our research was to analyze a male and a female toucan to see if any courtship for breeding was occurring between them. From over 20 hours of observations, we came to the conclusion that although the female is ready to copulate, the male is not receptive. We think the reason for this may be due to his leg injury. We frequently observed the female approaching the male, however, the male immediately went to a different space in the enclosure - paying no attention to her but preferring the attention of the human visitors. Our observations suggest that the male is not currently engaging in courtship behaviors.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

***STUDENT RESEARCHER(S):*** Gina Impronto, Gresi Kello, Jesse Conklin

***CLASS YEAR:*** 2014, 2015

***MAJOR:*** Biology

***TITLE OF RESEARCH PROJECT:***

The Effect of Aquifer Water Quality on Deciduous Tree Biodiversity

***HOST UNIVERSITY OR INSTITUTION:*** Fairfield University

***NAME OF FACULTY RESEARCH SUPERVISOR:*** James Biardi, Ph.D.

***DATE OF PROGRAM:***

***SPONSOR:***

***DESCRIPTION OF WORK (Short Abstract):***

This study examined the effect of surface water quality on local deciduous tree biodiversity. Tree biodiversity and water quality was determined at two upstream locations and two downstream locations relative to the Long Island Sound. We predicted that the average tree biodiversity would be greater at upstream locations compared to downstream locations. Diversity, calculated via the Shannon-Wiener index, varied with various measures of water quality including dissolved oxygen level, nitrogen level, phosphorous level, and salinity. We conclude that surface water quality had a significant effect on tree biodiversity in local temperate deciduous forests.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Farheen Khan, Tom McNeely, and Bobby Blaisdell  
*CLASS YEAR:* 2015

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:* Effect of Prey Color on Bird Feeding Preferences

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* James Biardi, Ph.D.

*DATE OF PROGRAM:* Spring 2013

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

Studies have shown that the color of prey is a significant determinant in the feeding habits of many different types of insectivorous bird species. This experiment tested whether or not color of prey has an effect on the feeding habits of insectivorous birds around the campus of Fairfield University. Four feeding trays were placed within close proximity in a small patch of woody terrain within the campus of Fairfield University. Each tray contained twenty-five dough-modeled "insects" which serve to mimic the living prey of the bird species. The dough was composed of flour, lard, and food coloring. Equal numbers of red, blue, green, yellow, and brown "insects" were arranged on feeding trays in a Latin Square orientation to maintain randomness within the sampling. The trays were set up four days a week from approximately 9 am to 6 pm every day. Our data have shown that the brown and yellow "insects" make up the majority of food items consumed and blue-colored insects the fewest.



## 2012/2013 STUDENT RESEARCH IN BIOLOGY

STUDENT RESEARCHER(S): Allison Lai '13, Carly Bock '12

CLASS YEAR: 2013, 2012

MAJOR: Biology

TITLE OF RESEARCH PROJECT:

Functional Dissection of the MEL-28 Protein in the Nematode Worm *Caenorhabditis elegans*

HOST UNIVERSITY OR INSTITUTION: Fairfield University

NAME OF FACULTY RESEARCH SUPERVISOR: Anita Fernandez, Ph.D.

DATE OF PROGRAM:

SPONSOR:

DESCRIPTION OF WORK (Short Abstract):

MEL-28 is a large protein that is essential for early embryogenesis in all metazoans, including humans. The MEL-28 protein shuttles between the nuclear envelope and the kinetochore during cell division and is required both for the integrity of the nuclear envelope during interphase and for chromosome segregation during mitosis. Other than the AT-Hook domains, which are implicated in binding to DNA, and coiled-coil domains, which are involved in protein-protein interactions, MEL-28 has very few domains that are well characterized. To determine which parts of the MEL-28 protein are required for its function, we generated mutated versions of the *mel-28* gene that encode MEL-28 proteins that have various deletions. We made transgenic animals expressing these mutated versions fused to the *gfp* gene and observed MEL-28 localization dynamics in live embryos. We found that deletion of the conserved AT Hooks had no effect in MEL-28 localization although it did abolish MEL-28 function. Removal of N-terminal domains of the MEL-28 protein disrupted its localization to the kinetochore but not its localization to chromatin or the nuclear envelope. Lastly, internal deletions of amino acids 823-1628 prevented all specific subcellular localization of the MEL-28 protein. We are currently performing rescue assays to see whether these GFP fusions can rescue the *mel-28* mutant phenotype. This way we can gain further insight into what aspects of the structure of this protein are required for its function.

**2012/2013 STUDENT RESEARCH IN BUSINESS MANAGEMENT AND  
BIOLOGY MINOR**

*STUDENT RESEARCHER(S):* Marilyn Lopez

*CLASS YEAR:* 2014

*MAJOR:* Business Management

*TITLE OF RESEARCH PROJECT:*  
IUCN and Wildlife Re-introduction Programs in Brazil and Latin America

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Carlos Ruiz-Miranda

*DATE OF PROGRAM:* Fall 2012

*SPONSOR:* Universidade Estadual do Norte Fluminense

*DESCRIPTION OF WORK (Short Abstract):*

The purpose of this project is to figure out to what extent the guidelines for wildlife re-introduction programs are being followed by the re-introduction programs located throughout Brazil and Latin America. The principle aim of a re-introduction program is to establish a viable, free-ranging population in the wild within the species former natural habitat and range when possible, according to the IUCN. These guidelines are created and updated by the International Union for Conservation of Nature (IUCN) in hope of helping these programs achieve their intended conservation benefit and not cause the adverse side effect's of greater impact. In order to figure this out a questionnaire was created and can be found in three different languages based on preference: Portuguese, Spanish or English. These questionnaires have been sent to re-introduction programs located within Brazil and Latin America in order to find out: the species that are involved within the programs, the extent to which these program's are following the guidelines, the Red List Category under which the species fall, and the success rate of their wildlife re-introduction programs.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

***STUDENT RESEARCHER(S):*** Katherine R. Martin

***CLASS YEAR:*** 2014

***MAJOR:*** Biology

***TITLE OF RESEARCH PROJECT:***

Protein Subcellular Relocalization: An Important Mechanism in the Evolution and Functional Diversification of New Genes

***HOST UNIVERSITY OR INSTITUTION:*** Fairfield University

***NAME OF FACULTY RESEARCH SUPERVISOR:*** Ashley Byun, Ph.D.

***DATE OF PROGRAM:*** Fall 2012-Spring 2013

***SPONSOR:*** Science Institute Fairfield University College of Arts and Sciences

***DESCRIPTION OF WORK (Short Abstract):***

Gene duplication is considered to be the most important process by which novel genes are created. While gene duplication can occur through a variety of genomic events, including whole chromosome or whole genome duplication, it is the process by which these genes gain such a diverse set of functions that is especially intriguing. Proposed mechanisms include classic neofunctionalization, partial or chimeric duplications, and more recently, protein subcellular relocalization (PSR). PSR proposes that the products of gene duplication can accrue new functions and ultimately evolve into new genes if there is an alteration in their subcellular localization. Specifically, the N-terminus target peptide (NTP), a 13-36 amino acid region, helps direct proteins to their proper location in the cell. Any alteration in the NTP, whether through a duplication error in the gene that affects the NTP sequence, or through point mutations within the NTP sequence itself, can cause proteins to miss their subcellular target and may lead to functional diversification of genes. The focus of our research is to determine whether PSR plays an important role in the evolution of new genes by examining the evolutionary patterns of duplicate genes from 66 completely sequenced eukaryotic genomes. From our analysis of over 800,000 pairs of duplicate genes, we have found: a) that the NTP is under positive selection (suggesting that changes in this region are adaptive) and b) duplicate genes that have protein products that exhibit subcellular relocalization have significantly higher survivorship than duplicates with no relocalization. These data suggest that PSR may be an important evolutionary mechanism by which eukaryotic genomes gain new genes and new gene functions.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Caitlin McDonald

*CLASS YEAR:* 2013

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:*

Function and Regulation of Peroxiredoxin Proteins in Doxorubicin-treated  
MCF-7 Breast Cancer Cells

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shelley Phelan, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

The Peroxiredoxin (Prdx) family of genes encodes thiol-specific antioxidant proteins that protect cells from oxidative stress. Mammalian cells express six different Prdx proteins, and these proteins play a role in cell signaling, proliferation and apoptosis. Recent studies have shown that Prdx levels are elevated in many cancers, suggesting that Prdx upregulation may be an advantageous adaptation to the cancerous state. In the present study, the expression and function of different Prdx proteins in untreated and doxorubicin-treated MCF-7 breast cancer cells, as well as noncancerous MCF-10A cells, was investigated. Previous data using real-time PCR and western blotting showed that five out of the six peroxiredoxins are overexpressed in MCF-7 cells at the mRNA and protein levels. The effect of doxorubicin treatment on both the MCF-7 and MCF-10A cells was then determined. This revealed that MCF-7 cells are significantly more resistant to cell death induced by doxorubicin as compared to the MCF-10A cells. Transient transfection of the MCF-7 cells using siRNA was then used to suppress the expression of the Prdxs. Treatment of the suppressed cells with doxorubicin led to reduced cell proliferation and increased susceptibility to doxorubicin-induced death in the MCF-7 cells. The results of these experiments suggest that overexpression of Prdxs in MCF-7 cells may be a protective mechanism employed by the cancerous cells and that Prdxs may contribute to doxorubicin-resistance in MCF-7 and other breast cancer cells.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Jillian Muhlbauer

*CLASS YEAR:* 2014

*MAJOR:* Biology, Molecular Concentration

*TITLE OF RESEARCH PROJECT:*

Regulation of Peroxiredoxin Proteins by Nrf2 in MCF-7 Breast Cancer Cells

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shelley Phelan, Ph.D.

*DATE OF PROGRAM:* April 25, 2013

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

The Peroxiredoxin (Prdx) family of genes encodes thiol-specific antioxidant proteins that protect cells from oxidative stress. Mammalian cells express six different Prdx proteins, and these proteins play a role in cell signaling, proliferation and apoptosis. Recent studies have shown that Prdx levels are elevated in many cancers, suggesting that Prdx upregulation may be an advantageous adaptation to the cancerous state. Nuclear factor (erythroid-derived 2)-like 2 (Nrf2) is a basic leucine zipper transcription factor known to bind to the antioxidant response element (ARE) and promote transcription of many antioxidant genes. In the present study, we investigated the expression of Nrf2 in MCF-7 breast cancer cells, as well as noncancerous MCF-10A cells. We used western blotting to confirm the overexpression of Nrf2 in the MCF-7 cells compared to the MCF-10A. Transient transfection of MCF-7 cells with Nrf2 siRNA are currently underway to implicate the role of Nrf2 in Prdx expression. Other studies to assay cell death induced by the chemotherapy agent doxorubicin have also been completed to distinguish cell death by necrosis or apoptosis using fluorescent microscopy.

## 2012/2013 STUDENT RESEARCH IN MOLECULAR BIOLOGY

NAME: Umar Munshi and Justina Caushi

CLASS: 2013

MAJOR: Molecular Biology

TOPIC OF RESEARCH PROJECT: *Phragmites australis*

HOST UNIVERSITY OR INSTITUTION: Fairfield University

NAME OF SUPERVISOR/SEMINAR LEADER: Ashley Byun, Ph.D.

DATE OF PROGRAM:

SPONSOR:

### DESCRIPTION OF WORK (Short Abstract):

Phragmites, or the common reed, is found in wetlands throughout the world. In America, there is a particular species called *Phragmites australis*, which is divided up into two major groups; introduced and native. The introduced haplotype M, of *P. australis*, is invasive. There are 11 native haplotypes, or non-invasive *P. australis*, and they are relatively easier to control. Haplotype M tends to overpower and permanently displace the native haplotypes of *P. australis*. The methods of controlling haplotype M are far too costly and destructive. Furthermore, after removal, the invasive species reappears after a given time. We speculate that one of the reasons as to why these invasive haplotypes are able to out-compete the native ones is because of their efficient ability to uptake nitrogen from the environment. Studies have shown that invasive *P. australis* uptake on average more nitrogen than native haplotypes. This study seeks to identify and compare the different types of bacteria that are responsible for nitrogen uptake in both native and invasive *P. australis*. We are currently comparing the different endophytic bacteria associated in the roots of *P. australis*, is isolating and sequencing the bacteria.

## **2012/2013 STUDENT RESEARCH IN BIOLOGY**

*STUDENT RESEARCHER(S):* Julie Passarelli

*CLASS YEAR:* 2013

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:*

Function and Regulation of Peroxiredoxin Proteins in Doxorubicin-Treated MCF-7 Breast Cancer Cells

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shelley Phelan, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

The Peroxiredoxin (Prdx) family of genes encodes thiol-specific antioxidant proteins that protect cells from oxidative stress. Mammalian cells express six different Prdx proteins, and these proteins play a role in cell signaling, proliferation and apoptosis. Recent studies have shown that Prdx levels are elevated in many cancers, suggesting that Prdx upregulation may be an advantageous adaptation to the cancerous state. Previously, we demonstrated that Prdx is overexpressed in MCF-7 breast cancer cells compared to MCF-10A non-cancerous breast epithelial cells. In the present study, we examined the levels of reactive oxygen species (ROS) in untreated and doxorubicin-treated MCF-7 cells compared to MCF-10A cells using 2',7'-dichlorofluorescein-diacetate (DCFH-DA), a compound that reacts with intracellular H<sub>2</sub>O<sub>2</sub> to produce the highly fluorescent 2',7'-dichlorofluorescein (DCF). Our results show that untreated and doxorubicin-treated MCF-7 cells produce significantly greater levels of ROS compared to MCF-10A cells. Our findings suggest that Prdx overexpression in MCF-7 breast cancer cells in response to increased ROS may be cytoprotective and play a role in doxorubicin-resistance.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Danielle Pepi and Gregory Pettit

*CLASS YEAR:* 2015

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:* The Behavioral Study of Peacocks

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ashley Byun, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:* Connecticut's Beardsley Zoo

### *DESCRIPTION OF WORK (Short Abstract):*

This study was done in order to get more information about the various behaviors of the peacocks at the Connecticut's Beardsley Zoo in Bridgeport, Connecticut. The zoo is home to 7 male peacocks ranging from juveniles to adults. The research was done using an ethogram to understand the peacocks base behaviors and various other behaviors were noted as they appeared. The study was conducted during mating season so mating and aggressive behaviors were noted in the Peacocks. This involved the peacocks raising its tail feathers and turning in order to attract females. The Peacocks were seen to vocalize in response to inorganic and organic cues due to the resemblance of the sounds to their own calls. These cues could range from other peacocks to a fire truck siren. The majority of the peacocks were observed to stay within a defined area of the zoo, which was within a radius of the carousel and playground due to the amount of food dropped there.



## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

*STUDENT RESEARCHER(S):* Gregg Perlmutter

*CLASS YEAR:* 2014

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:*

Peroxiredoxin Expression in Normal and Cancerous Mammalian Breast Epithelial Cells

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shelley Phelan, Ph.D.

*DATE OF PROGRAM:* Summer 2012 and Spring 2013

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

Peroxiredoxins are a family of proteins expressed in all cell types that are used by the cell to eliminate reactive oxygen species are produced as a byproduct of normal metabolism. All cells express different amounts and different types of these proteins. These proteins function by donating electrons to ROS to detoxify them. Cancerous cells have developed strategies to upregulate peroxiredoxins that neutralize the excessive amounts of ROS they create through metabolism, thus avoiding apoptosis and continuing to proliferate. Chemotherapy drugs such as doxorubicin induce oxidative damage to cells, and are used to kill cancer cells and prevent their growth. We hypothesized that MCF7 breast cancer cells upregulate peroxiredoxins in response to doxorubicin, in order to increase cell survival. Western blotting was used to view the levels of peroxiredoxins in cell treatments of different concentrations of doxorubicin. MTT assays were done in order to test cell viability when exposed to different concentrations of doxorubicin as well. We found that MCF7 breast epithelial cells show increased resistance to doxorubicin when compared to MCF10A normal breast epithelial cells. Doxorubicin treatments of MCF7 cells show that some peroxiredoxins are upregulated in response to the treatments at different concentrations. We conclude that doxorubicin and possibly other chemotherapy agents may lead to increased antioxidant expression in breast cancer cells, protecting these cells from death.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

*STUDENT RESEARCHER:* Angela Quental

*CLASS YEAR:* 2014

*MAJOR:* English Literature and Cultural Studies and Biology

*TITLE OF RESEARCH PROJECT:*

Use of Playbacks for the Luring and Catching of Bird Species  
in Brazil for Morphometric Studies

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Brian Walker, Ph.D.

*DATE OF PROGRAM:* January 6-18, 2013

*SPONSOR:*

*DESCRIPTION OF WORK:*

In order to lure birds to a particular location, ornithologists employ the use of playbacks, which are recordings of a bird's song that, when played in a bird's territory, attract it due to the challenging nature of a rival's song. In this study, playbacks of the bird species Social Flycatcher (*Myiozetetes similis*), Great Kiskadee (*Pitangus sulphuratus*), and Boat-billed Flycatcher (*Megarynchus pitangua*) were used throughout various locations on the Reserva Biológica União in order to lure these birds for behavioral studies and potential capture. Measurement data was obtained of captured birds in order to draw conclusions regarding health condition and fitness. Through the use of mist nets, individuals of the species Southern Rough-winged Swallow (*Stelgidopteryx ruficollis*) were caught on two different days in order to obtain data for morphometric analysis. It was determined through independent samples T-tests that there were no significant differences in size between swallows caught on different days and, through regression analysis, that there exist correlations between different body measurements.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

*STUDENT RESEARCHER(S):* Angela Quental and Michael Mauro

*CLASS YEAR:* 2014; 2015

*MAJOR:* English Literature and Cultural Studies & Biology; Biology

*TITLE OF RESEARCH PROJECT:*

*mel-28; npp-5 and mel-28; dnc-1 double mutants produce novel phenotypes in the nematode worm Caenorhabditis elegans*

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Anita Fernandez, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

In eukaryotic cells, the function of the nuclear envelope is to protect genetic material that is contained within the nucleus. In *C. elegans*, *mel-28* encodes a component of the nuclear pore, a complex that controls the entry and exit of materials from the nucleus. *mel-28* is a maternal-effect lethal gene, which means that mother organisms that are homozygous for a null mutation in this gene, despite appearing phenotypically normal, produce inviable embryos. In order to identify other genes that may potentially work in conjunction with *mel-28*, RNA interference (RNAi) screening was performed in *mel-28* and wild-type animals. Genes were sought that caused novel phenotypes in *mel-28* animals. Two genes that were found in the RNAi screen were *npp-5* and *dnc-1*. *npp-5* encodes Nup107, a component of the nuclear pore. *dnc-1* encodes a subunit of the dynactin complex that is implicated in pronuclear migration and spindle alignment during early embryogenesis. In order to better study these genetic interactions, double mutant animals that were homozygous for null mutations in *npp-5* and *mel-28* as well as double mutant animals that were homozygous for null mutations in *dnc-1* and *mel-28* were generated. These double mutants exhibited various defects, such as sterility and reduced fertility.

## 2012/2013 STUDENT RESEARCH IN BIOLOGY

STUDENT RESEARCHER(S): Katherine Ritchie

CLASS YEAR: 2013

MAJOR: Biology

TITLE OF RESEARCH PROJECT:

Vocalizations of the Whistling Frog and Documentation of a Possible New Call

HOST UNIVERSITY OR INSTITUTION: Fairfield University

NAME OF FACULTY RESEARCH SUPERVISOR: Ashley Byun, Ph.D.

DATE OF PROGRAM: Spring 2013

SPONSOR: União Biological Reserve in Brazil, UENF

DESCRIPTION OF WORK (Short Abstract):

*Leptodactylus fuscus* are neotropical frogs best known for their distinctive “whistling” advertisement call related to mating behavior and courtship. To investigate the calling behavior of *L. fuscus*, playbacks were used in the field to examine the frequency and duration of response whistles from male frogs at the União Biological Reserve in Brazil. As predicted, playbacks of comparable volume to the male chorus elicited several response whistles. The volume of the playback recording was increased (~100db) to mimic a large frog competitor in order to observe how frogs in the chorus would respond. Surprisingly, the response was not a whistle but rather a series of quiet chirps. Using sonogram software, the second call or chirp was analyzed and determined to be of lower frequency and volume compared to the average “whistle.” The pattern of chirp vocalizations does not match documentation of other known *L. fuscus* advertisement or distress calls. It is possible that this lower pitch, more guttural vocalization is a submissive call, which has not yet been documented in the literature.

## **2012/2013 STUDENT RESEARCH IN BIOLOGY**

**STUDENT RESEARCHER(S):** Taylor Szupiany and Jennifer Dierkens

**CLASS YEAR:** 2013

**MAJOR:** Biology

**TITLE OF RESEARCH PROJECT:** Captive Maned Wolves: Aggression among Siblings

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Ashley Byun, Ph.D.

**DATE OF PROGRAM:** Spring 2013

**SPONSOR:** Connecticut's Beardsley Zoo

### **DESCRIPTION OF WORK (Short Abstract):**

The Beardsley Zoo has expressed recent concern that captive Maned Wolves, *Chrysocyon brachyurus*, are aggressive toward pack-mates. Currently, the zoo is home to two female Maned Wolves who are siblings. To document their behavior, an ethogram was developed, focusing on aggressive interactions and behavior between the wolves. Aggressive behaviors were recorded based on specific body part movements, excretion patterns, locomotion, contact with one another, sound production, and static poses. The data were collected between January and April, and a total of 20 hours were spent watching the interactions between the Maned Wolves. From the observations and analyzed results, a dominance relationship appears to exist between the two siblings, in which the smaller wolf acts and behaves in accordance with her larger sister. During each visit, the smaller wolf attempted to play with the larger wolf, but was rejected and often ran away shortly after being growled at or after the larger sister initiated a pounce stance. The larger sister has proven to be extremely territorial—she continuously walks in a counterclockwise path, and urinates and defecates in the same location outside of the path. Aside from these aggressive behaviors, there were no observed malicious acts of violence.

## **2012/2013 STUDENT RESEARCH IN BIOLOGY**

*STUDENT RESEARCHER(S):* Farah Themistocle and Jeana Savage

*CLASS YEAR:* 2013

*MAJOR:* Biology (FT); Psychology (JS)

*TITLE OF RESEARCH PROJECT:*

Beardsley Zoo Visitor Interactive Patterns and Bird Reactions at the Eagle Exhibit

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ashley Byun, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:* Connecticut's Beardsley Zoo

*DESCRIPTION OF WORK (Short Abstract):*

The Beardsley Zoo research project sought to identify the visitor interactive patterns at the eagle exhibit. Visitor's group dynamics—age and gender—were estimated, foot traffic patterns and learning patterns were observed. The ethogram conducted revealed that a majority of the visitors were groups with small children. It was also revealed that small children and group size had impact on whether or not the group learned from the graphics displayed; but overall the percentage of groups that interacted with the exhibits other than just looking, were quite low. The workers situated at the exhibit were found to make a real difference to the visitor's learning. In addition, the ethogram revealed that the birds, although appearing to be wary of people, were not all that interested at the open end of the enclosure. Their interest lay at the road on the side of open enclosure—where passing visitors, vehicles, and tigers were constantly present.

## ***2012/2013 STUDENT RESEARCH IN BIOLOGY***

***STUDENT RESEARCHERS:*** Taylor Walsh, Taylor Morgan, Nick Melaragno, and  
Brendan Freeman

***CLASS YEAR:*** 2015

***MAJOR:*** Biology

***TITLE OF RESEARCH PROJECT:***  
Niche Partitioning Among Bird Species Based on Food Type

***HOST UNIVERSITY OR INSTITUTION:*** Fairfield University

***NAME OF FACULTY RESEARCH SUPERVISOR:*** James Biardi, Ph.D.

***DATE OF PROGRAM:*** Spring 2013

***SPONSOR:***

***DESCRIPTION OF WORK (Short Abstract):***

The objective of this study was to determine if there is niche partitioning based on food type in southern Connecticut birds found on the Fairfield University campus. The experiment was carried out in wooded areas on the Fairfield University campus. Six identical bird feeders, three at each location, were set up equidistant from each other at the two designated sites. At each station the three different food types were distributed into three different feeders, in equal quantities. The feeders were monitored once daily alternating between dawn and dusk for eighteen days. A chi squared statistical analysis was performed to see if there is a significant correlation between species and feed type. The results show that there is niche partitioning based on food type, with local birds preferring sunflower seeds and the mixed medley feed to cracked corn feed.

## **2012/2013 STUDENT RESEARCH IN BIOLOGY**

*STUDENT RESEARCHER(S):* Jessica Whelpley, Abigail Romano, Carlie Famiglietti

*CLASS YEAR:* 2013 (JW, CF); 2014 (AR)

*MAJOR:* Biology

*TITLE OF RESEARCH PROJECT:*  
Loggerhead Hatchling Orientation & the Effect of Artificial Light on Sea Finding

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ashley Byun, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

The purpose of this study was to observe the effects of artificial lights on loggerhead sea turtle (*Caretta caretta*) hatchlings at Farol de Sao Thome, Brazil. Sea turtle hatchlings use natural light cues to navigate towards the ocean. Unfortunately artificial lights along heavily developed coastlines may have a detrimental effect on sea finding in these hatchlings as they are attracted to beachside buildings and street lights. Together with Project TAMAR, we developed a method to assess the influence that artificial lights have on hatchling orientation in both heavily and moderately developed areas. We found that even moderate artificial light levels significantly interfere with hatchling orientation ( $\chi^2 = 295.88, p < 0.05$ ). This is a serious concern given that the density of loggerhead turtle nests is extremely high along this coast and some of the highest densities are found in a stretch of beach which is currently undergoing rapid urbanization.



Bayan Abunar  
Kerry A. Archer  
Elizabeth E. Butrick  
Elizabeth Garvey  
Molly Graffam  
Timothy Jacisin  
Elise Lemons  
Julia K. Spridigliozzi  
Erin N. Sullivan  
Christine Villa  
Timothy Zeko

**CHEMISTRY &  
BIOCHEMISTRY**



## ***2012/2013 STUDENT RESEARCH IN CHEMISTRY***

***STUDENT RESEARCHER(S):*** Kerry A. Archer, Elizabeth E. Butrick, Elise G. Lemons, and Christine E. Villa

***CLASS YEAR:*** 2013 (KAA, EEB, EGL); 2014 (CEV)

***MAJOR:*** Chemistry (KAA, EGL); Biochemistry (EEB, CEV)

***TITLE OF RESEARCH PROJECT:***

Syntheses, X-Ray Crystallographic, Spectroscopic and Electrochemical Characterizations of Three and Five Coordinate SNS Copper Complexes: Effect of Pincer Ligand on Coordination Geometry

***HOST UNIVERSITY OR INSTITUTION:*** Fairfield University

***NAME OF FACULTY RESEARCH SUPERVISOR:*** John R. Miecznikowski, Ph.D.

***DATE OF PROGRAM:*** June 4, 2012 to present

***SPONSOR:*** Fairfield University Kuck Fund and Department of Chemistry and Biochemistry

***DESCRIPTION OF WORK (Short Abstract):***

Recently, we have developed and synthesized a series of tridentate pincer ligands, each possessing two sulfur- and one nitrogen-donor functionalities (SNS), based on bis-imidazole or bis-triazole precursors. The tridentate SNS ligands incorporate thione-substituted imidazole or triazole functionalities. We have prepared somewhat rigid ligand systems through the use of 2,6-dibromopyridine as a ligand precursor. In addition, we have prepared more flexible ligand systems by employing the starting material 2,6-(dibromomethyl)pyridine to introduce a methylene linker into the pincer ligand. We have metallated these ligand precursors to form zinc(II) complexes containing these tridentate ligands. In an effort to learn about the reactivity of the ligand precursors with other metal salts, we have metallated these ligand precursors to form copper(I) or copper(II) complexes. A detailed description of the syntheses, and characterization (X-ray diffraction, electrochemistry, UV-Vis, and EPR spectroscopy) of the SNS copper complexes will be presented.

## 2012/2013 STUDENT RESEARCH IN CHEMISTRY/BIOCHEMISTRY

*STUDENT RESEARCHERS:* Elizabeth E. Butrick, Elise G. Lemons,  
Julia K. Spridigliozi

*CLASS YEAR:* 2013 (EEB, EGL); 2014 (JKS)

*MAJOR:* Biochemistry (EEB); Chemistry (EGL, JKS)

*TITLE OF RESEARCH PROJECT:*

The Quantification of Taurine and Caffeine In Selected Energy Drinks Through  
High-Performance Liquid Chromatography (HPLC)

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Matt Kubasik, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:* Fairfield University Department of Chemistry and Biochemistry

*DESCRIPTION OF WORK (Short Abstract):*

Recently, we have quantified, through High Performance Liquid Chromatography, the amounts of caffeine and taurine in energy drinks such as: Red Bull, AMP, and 5-hour Energy. The chromatography is performed on a reverse phase column at 25°C, with a mobile phase of phosphate buffer (ph 5.57)-acetonitrile (80:20, v/v). The flow rate is 0.5mL/min, and detection is by UV-visible at 273nm and 360nm. Over the past few years, energy drink consumption has become increasingly popular among adolescents and young adults. With the consumption of energy drinks on the rise, the NCAA banned over 15µg/mL within an athlete's urine during a competitive athletic event. For our research, the amount of caffeine present in each energy drink was compared to the amount of caffeine required for a lethal dose and the amount of caffeine banned by the NCAA. The amount of taurine in each drink was also compared to the suggested amount consumed in a person's diet. All of the energy drinks were compared to determine which elicits the greatest concern out of all samples.

## **2012/2013 STUDENT RESEARCH IN CHEMISTRY**

*STUDENT RESEARCHER(S):* Elizabeth Garvey

*CLASS YEAR:* 2013

*MAJOR:* Chemistry

*TITLE OF RESEARCH PROJECT:*

Exploring synthetic strategies for encapsulating myoglobin into aerogels for chemical sensing applications.

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Amanda S. Harper-Leatherman, Ph.D.

*DATE OF PROGRAM:* Spring 2013

*SPONSORS:* Fairfield University College of Arts and Sciences, Department of Chemistry and Biochemistry, Honors Program Senior Project, Magis Scholars Grant

*DESCRIPTION OF WORK (Short Abstract):*

Aerogels are highly porous, sol-gel derived materials, which contain very high surface areas characterized by pore-solid three-dimensional, nanoscale mesh networks. The technique of supercritical solvent extraction is used to remove the liquid from the pores of a sol-gel to create an aerogel allowing for minimal pore collapse and an enormous surface area ideal for surface reactions. Many proteins and enzymes have been successfully encapsulated into sol-gels for various applications such as gas-phase biosensing and enzyme catalysis where encapsulation makes biological devices more efficient and easier to handle. Comprehensive studies have been conducted regarding the spectroscopic properties and chemical functions of heme proteins such as cytochrome *c*, hemoglobin, and myoglobin encapsulated in sol-gels. Little research has been done to investigate the processing of these biological sol-gels into aerogels. Cytochrome *c* has previously been encapsulated into aerogels while retaining stability and UV-visible spectroscopic properties. The goal of this project is to encapsulate Myoglobin (Mb), the primary oxygen-carrying protein of muscle tissue, into sol-gels and to process the gels through supercritical drying to form aerogels while preserving the protein structure and function. The success of the encapsulation has been characterized through UV-visible spectroscopic methods focused on any observed changes in the Soret peak that is typically found at 409nm. Different concentrations of Mb as well as different encapsulation processes were investigated.

## **2012/2013 STUDENT RESEARCH IN CHEMISTRY**

*STUDENT RESEARCHER(S):* Christine Villa (2014) and Liz Garvey (2013)

*MAJOR:* Chemistry

*TITLE OF RESEARCH PROJECT:*

Does Silk© Soymilk Actually Contain 50% More Calcium Than Dairy Milk?: Determination of calcium in various milk sources using flame atomic absorption spectroscopy

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Matt Kubasik, Ph.D.

*DATE OF PROGRAM:* Spring 2013

*SPONSOR:* Fairfield University Chemistry and Biochemistry Department

*DESCRIPTION OF WORK (Short Abstract):*

Calcium plays a vital role in human health and is an essential mineral element that helps keep the body functioning properly. Dairy products are known to be a significant source of calcium in our daily diets. The three main constituents of milk are lactose, the distinctive milk disaccharide, caseins, a group of phosphoproteins, and fat. Calcium in milk is bound to casein and forms micelles. Trichloroacetic acid (TCA) is needed to effectively release the calcium from its micelle-bound casein structure in order to be quantified.

Silk Soy milk claims that their original soy milk contains 50% more calcium per serving than dairy milk. Our goal is to test the accuracy of their statement; as well as compare the calcium content in Silk soymilk to that of skim, 2% and whole dairy milk. From preliminary data we have determined that the soymilk does contain the most calcium. Final quantitative analysis will be performed to determine if it is in fact 50% more than the dairy milk. Stop & Shop reports that its Whole, 2%, and Skim milk all contain 30% of the recommended daily Calcium. Silk soymilk reports that a serving contains 45% of the recommended daily calcium. We used flame atomic absorption in our experiment as it is a useful technique for quantitative elemental analysis.

## **2012/2013 STUDENT RESEARCH IN CHEMISTRY/BIOCHEMISTRY**

*STUDENT RESEARCHER(S):* Molly Graffam, Elizabeth Garvey, Bayan Abunar

*CLASS YEAR:* 2013 (MG, EG) 2014 (BA)

*MAJOR:* Biochemistry (MG, AB), Chemistry (EG)

*TITLE OF RESEARCH PROJECT:*

Protein monolayer electrochemistry of self-organized gold nanoparticle~cytochrome  
c superstructures

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Amanda Harper-Leatherman, Ph.D.

*DATE OF PROGRAM:* May 2012 – April 2013

*SPONSOR:* Research Corporation for Science Advancement, Chemistry and Biochemistry  
Department, College of Arts and Sciences, Office of the Associate VP for Academic Affairs

*DESCRIPTION OF WORK (Short Abstract):*

When gold nanoparticles and cytochrome *c* (cyt. *c*) are added together in solution, spontaneous electrostatic and other weak interactions help to create loosely multilayered superstructures of protein, abbreviated as Au~cyt. *c* superstructures. Cyt. *c* is stabilized to unfolding when encapsulated as Au~cyt. *c* superstructures in highly porous aerogels, and even in the absence of the aerogel scaffold, each Au~cyt. *c* superstructure stabilizes thousands of protein molecules to unfolding relative to cyt. *c* alone in solution. We have chosen to expand this work by studying the electrochemical characteristics of Au~cyt. *c* superstructures using protein monolayer electrochemistry. We explore the number of electrochemically active layers of protein within the multilayered superstructures and the stability of organized cyt. *c* to denaturation. We will present the thermodynamic, kinetic, and adsorption environment characteristics of cyt. *c* organized within Au~cyt. *c* superstructures of varying ratios of Au to cyt. *c* compared to unassociated cyt. *c*.

## 2012/2013 STUDENT RESEARCH IN CHEMISTRY

*STUDENT RESEARCHER(S):* Timothy Jacisin and Timothy Zeko

*CLASS YEAR:* 2014, 2013

*MAJOR:* Biochemistry and Chemistry

*TITLE OF RESEARCH PROJECT:*  
Synthesis and FT-IR Characterization of Isotopologues of Z-Aib<sub>6</sub>-OtBu

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Matt Kubasik, Ph.D.

*DATE OF PROGRAM:* June 2012 – May 2013

*SPONSOR:* Hardiman Fund of Fairfield University

### *DESCRIPTION OF WORK (Short Abstract):*

Oligomers of the achiral amino acid  $\alpha$ -aminoisobutyric acid are known to form  $3_{10}$  helical secondary structures in solution, even at short ( $n = 6, 8$ ) oligomer lengths. Additionally, oligomers of this achiral amino acid form racemic mixtures of left- and right-handed helices. Despite the favorable conformational properties of the  $\alpha$ -aminoisobutyric acid residue, the geminal methyl groups reduce peptide-coupling efficiency due to steric hindrance. Recent synthetic (e.g., isotopic enrichment) and spectroscopic (e.g., infrared and nmr) results will be presented. FT-IR spectra will be compared to quantum chemical calculations.



## 2012/2013 STUDENT RESEARCH IN CHEMISTRY

STUDENT RESEARCHER(S): Erin N. Sullivan

CLASS YEAR: 2014

MAJOR: Chemistry

TITLE OF RESEARCH PROJECT:

Zinc and Copper Analysis of Eastern Oyster (*Crassostrea virginica*) Fluid

HOST UNIVERSITY OR INSTITUTION: Fairfield University

NAME OF FACULTY RESEARCH SUPERVISOR: Amanda S. Harper-Leatherman, Ph.D.

DATE OF PROGRAM: Fall 2012 – Spring 2013

SPONSOR: Chemistry & Biochemistry Department, and Biology Department

DESCRIPTION OF WORK (Short Abstract):

Flame atomic absorption spectrometry is being used to determine the concentrations of zinc and copper metal in the mantle fluid of the *Crassostrea virginica* Eastern oyster collected over the course of a year from Long Island Sound. Previously performed lysozyme tests didn't fully account for the antimicrobial properties of the oysters, indicating that significant amounts of zinc and copper may also be responsible for the antimicrobial properties. Seasonal changes of metal content were studied to understand more about the properties of the oysters. Oysters were collected each month for one year and the mantle fluid was extracted from the flesh of the oyster. Initial analysis of three separate months of oyster mantle indicated the decline of zinc concentration from the fall of 2010 to the summer of 2011. In October of 2010, the zinc concentration was determined to be  $59 \pm 3$  ppm and dropped down to  $28 \pm 3$  ppm in March of 2011, and declined further to  $21 \pm 4$  ppm in July of 2011. The copper concentration also declined during this period from  $2.49 \pm 0.06$  ppm in October of 2010 to  $2.14 \pm 0.03$  ppm in March 2011 to  $1.59 \pm 0.03$  ppm in July of 2011. A month-to-month analysis was also performed from the months of December 2012 to April 2013 to predict how the values may change seasonally as well as to compare the changes in the matrix of the samples by comparing results from a standard addition method of analysis to an external calibration method of analysis. Based upon these results, it was determined that the matrix was changing month-to-month in this period of time.

## 2012/2013 STUDENT RESEARCH IN CHEMISTRY

*STUDENT RESEARCHER(S):* Timothy Zeko

*CLASS YEAR:* 2013

*MAJOR:* Chemistry

*TITLE OF RESEARCH PROJECT:*

Synthesis and analysis of isotopologic homo-oligomers of  $\alpha$ -amino isobutyric acid

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Matt Kubasik, Ph.D.

*DATE OF PROGRAM:* September, 2012-May, 2013

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

Oligomers of the achiral amino acid  $\alpha$ -aminoisobutyric acid are known to form  $3_{10}$  helical secondary structures in solution, even at short ( $n=6, 8$ ) oligomer lengths. Through isotopically enriching carbonyl carbons with carbon-13 at various positions along the peptide chain, individual Amide I vibrations can be identified using infrared spectroscopy. In-phase and out-of-phase coupling between doubly-enriched peptides were interpreted with the help of quantum calculated visualizations. Synthetic and spectroscopic (e.g., Infrared, NMR, and LCMS) results were obtained for eight isotopologic hexamers and will be presented.

Niccolai Arenas  
Ebuka Arinze  
Joseph Bocchino  
Elizabeth Cortez  
Stephanie Cruz  
Mickey Das  
Vu Thuy Doan  
Serkan Erdas  
Choolwe Hachiita  
Yan Huang  
Andrew Jackowitz  
Roddric Kasen  
Lina Kloub  
Bindya Kiron Nallaghatla  
Alfredo Navarro  
Gabriela Matias Navarro  
Ray Palama  
John Perry  
Caio Porto  
David Keith Adam Powojski  
Melanie Rice  
Jackson Sarneski-Hayes  
Anthony Scheer  
Penpa Shrestha  
Davi Squizzato  
Nicole Stark  
Anusha Tiyyagura  
Joseph Torok II

# ENGINEERING



## ***2012/2013 STUDENT RESEARCH IN ENGINEERING***

*STUDENT RESEARCHER(S):* Niccolai Arenas, Ebuka Arinze, Choolwe Hachiita  
*CLASS YEAR:* 2013  
*MAJOR:* Mechanical Engineering (NA, CH) Electrical Engineering (EA)

*TITLE OF RESEARCH PROJECT:* QuadCopter Development

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ryan Munden, Ph.D.  
Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:* September 2012 - May 2013

*SPONSOR:* School of Engineering, NASA Space Grant Consortium

### *DESCRIPTION OF WORK (Short Abstract):*

The goal of our Senior Design Project was to design and build a Quad Copter. The design for the Quad Copter is mainly intended for military use and rescue missions. We worked with a small company named American Unmanned Systems, which focuses on building drones for military use. The Quad Copter had four main design requirements: (i) the final product had to be easy to assemble and disassemble, so that a soldier can have it ready to fly in a matter of minutes, (ii) it had to be light weight and small size, (iii) it had to have great stability during fly time so that the incorporated camera could capture a clear image and provide better surveillance, (iv) addition of a mechanical arm that would enable the Quad Copter to pick up and drop off items. The upgrades applied on the Quad Copter in addition to its flexibility will provide its users with a more efficient ability to observe areas that are humanly inaccessible. Currently, in collaboration with AUS, a portable QuadCopter has been designed and fabricated with the final assembly expected to be completed by the end of April 2013. Performance testing and any further modifications on the QuadCopter are expected to be performed by early May 2013.

## **2012/2013 STUDENT RESEARCH IN ENGINEERING**

*STUDENT RESEARCHER(S):* Joseph Bocchino, Andrew Jackowitz, John Perry

*CLASS YEAR:* 2013

*MAJOR:* Mechanical Engineering

*TITLE OF RESEARCH PROJECT:* Rainwater Harvesting System

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shanon Reckinger, Ph.D.  
Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:* September 2012 – May 2013

*SPONSOR:* Fairfield University Sustainability Committee, Fairfield School of Engineering

### *DESCRIPTION OF WORK (Short Abstract):*

The team will be designing, building, and implementing a rainwater collection system on the campus of Fairfield University. The plan is to harvest rain water runoff from the Barone Campus Center 3<sup>rd</sup> floor patio area. Using current piping in the BCC, the team plans to collect this rainwater in a large storage tank, which would be installed in the Mechanical Room located directly next to the loading dock in the BCC. The existing infrastructure does not utilize this water for non-potable purposes such as watering the lawn. The harvested rainwater will be used to fill up the University watering truck that is used to water greenery all over the campus. This system will save the University money by reducing its potable water usage and supplement Fairfield University's Green Sustainability Initiative. The team has submitted a proposal for this project to the EPA Campus Greenworks challenge for a grant award. Presently, the design is incomplete; procurement near completion and expect final assembly completion and operation by the end of April 2013.

## ***2012/2013 STUDENT RESEARCH IN ENGINEERING***

*STUDENT RESEARCHER(S):* Elizabeth Cortez, Stephanie Cruz, & Nicole Stark

*CLASS YEAR:* 2013

*MAJOR:* Mechanical Engineering (EC NS), Software Engineering (SC)

*TITLE OF RESEARCH PROJECT:*

SenseFit – Fitness & Health Monitoring Sensors with Conventional Bluetooth Application

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Ryan Munden, Ph.D.  
Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:* Fall 2012 – Spring 2013

*SPONSOR:*

*DESCRIPTION OF WORK:*

We have developed a conventional Bluetooth athletic training and health-monitoring device that reads and records vital information to improve health and/or fitness performance level. Heart rate, pulse oximetry, and muscle activity is monitored and stored on a smartphone application via wireless sensors. The data from the sensors will be wirelessly transferred from the device to the mobile application where the most recent results can be seen in addition to the previous ones. The compact wristband design is lightweight and holds the hardware together efficiently. The design is unique because these three sensors have never been integrated before, the housing is small and it is durable. The Bluetooth has successfully been tested with Android devices. The hardware for the sensors has successfully been tested individually on us. The sensor-application connection will be tested while reading one of our vitals during a workout and sent to our phone.

## **2012/2013 STUDENT RESEARCH IN SOFTWARE ENGINEERING**

**STUDENT RESEARCHER(S):** Mickey Das, Anusha Tiyyagura, Bindya Kiron Nallaghatla, Caio Porto, Gabriela Matias Navarro, Lina Kloub

**CLASS YEAR:** Undergraduate and Graduate (2013)

**MAJOR:** Software Engineering

**TITLE OF RESEARCH PROJECT:** Intuitive Office Project Manager Software

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Amalia Rusu, Ph.D.

**DATE OF PROGRAM:**

**SPONSOR:** School of Engineering, Fairfield University and Sikorsky Aircraft Corporation

### **DESCRIPTION OF WORK (Short Abstract):**

As large companies, such as Sikorsky, are involved in performing various projects and deploying its personnel across various locations, there is a need to keep track of all projects' progress and maintain weekly reports of the updates. In order to maintain and track the progress of these projects, companies need a software system through which it would be able to effectively gather, update and provide the information required. This is accomplished by developing an intuitive office project manager software system. The intuitive office project manager software system is designed for Sikorsky Aircraft Corporation to provide ease for the project managers and team members to rapidly update the project statuses, add graphics and other supplementary materials. The software generates weekly memos and reminds the users if the updates are past due.

The software system aims to facilitate interaction among employees by maintaining the status of each project. Each employee can maintain its own status and view the status of another employee working on any project as well as adding comments visible to all members. The system also has the ability to automatically generate weekly memo that collates all statuses into a single Microsoft Word file. With this software system the information can be facilitated and always kept updated.



## ***2012/2013 STUDENT RESEARCH IN MECHANICAL ENGINEERING***

*STUDENT RESEARCHER(S):* Alfredo Navarro, Jackson Sarneski-Hayes

*CLASS YEAR:* 2013

*MAJOR:* Mechanical Engineering

*TITLE OF RESEARCH PROJECT:*

Bearing Radial/Axial Clearance Measurement Device Development

*HOST UNIVERSITY OR INSTITUTION:* RBC Heim Bearings

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:* Spring, 2013

*SPONSOR:* Roller Bearing Corporation

*DESCRIPTION OF WORK (Short Abstract):*

The objective of this project is to create an accurate measuring device that fulfills all the requirements of SAE Aerospace Recommended Practice 5448/8 (for both axial and radial clearance) while having enough flexibility to assist other projects and specifications.

## **2012/2013 STUDENT RESEARCH IN ENGINEERING**

*STUDENT RESEARCHER(S):* David Keith Adam Powojski

*CLASS YEAR:* 2013

*MAJOR:* Mechanical Engineering

*TITLE OF RESEARCH PROJECT:* Frame Stability Enhancement: Formula F Race car

*HOST UNIVERSITY OR INSTITUTION:*

*NAME OF FACULTY RESEARCH SUPERVISOR:* Prof. Stephen Roux  
Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:* Fairfield University School of Engineering

### *DESCRIPTION OF WORK (Short Abstract):*

The performance of a Formula F racecar is hindered by the occurrence of unwanted angular bending and vibration. An increase in rigidity in critical locations of the vehicle's chassis will help to minimize these movements. A computer model of the chassis was analyzed using the Finite Element method that revealed these critical areas most susceptible to angular bending and vibration. The most attractive solution was decided to be the addition of steel truss members to the chassis. The final design is complete and plans to manufacture our solution are in place. Data recording equipment will be used to validate that our enhancements were beneficial.

## ***2012/2013 STUDENT RESEARCH IN SOFTWARE ENGINEERING***

***STUDENT RESEARCHER(S):*** Melanie Rice, Vu Thuy Doan, Penpa Shrestha,  
Yan Huang, Roddric Kasen

***CLASS YEAR:*** Graduate

***MAJOR:*** Software Engineering

***TITLE OF RESEARCH PROJECT:*** Concept Aircraft Visualization Tool

***HOST UNIVERSITY OR INSTITUTION:*** Fairfield University

***NAME OF FACULTY RESEARCH SUPERVISOR:*** Amalia Rusu, Ph.D.

***DATE OF PROGRAM:*** 2012-2013

***SPONSOR:*** School of Engineering, Fairfield University and Sikorsky Aircraft Corporation

***DESCRIPTION OF WORK (Short Abstract):*** A partnership with Sikorsky Aircraft Corporation, a manufacturer of commercial and military, fixed wing or rotary aircrafts, has been established to develop a system that will allow engineers and designers to work together to develop initial plans of concept aircrafts, taking various aspects into account, from component size and position to center of gravity analysis. The software system will be used to develop different views of the exterior of the aircraft, focusing on the design of the aircraft and being able to assess its capabilities. Given the functionality of the system, the aircraft engineers will have their jobs simplified, thus be able to eliminate excess work and save time, as well as experiencing increased task efficiency and accuracy due to automatic processes.

The Concept Aircraft Geometry Layout Software will allow users to experiment with and compose aircraft design. The software will combine experimental, adjustable design with accurate mathematical analysis pertaining to the properties of the aircraft such as side moments-of-inertia. The key (current and future) software features include: ability to rapidly model and design various rotary- and fixed- wing aircraft configurations; ability to layout and indicate the locations of major aircraft systems, including rotors, propellers, wings, engines, and tail surfaces; ability to assess aircraft transportability; ability to size and layout cabin for crew, passengers, and/or cargo transport; and ability to analyze configuration information. The software should allow data to be uploaded from Excel or manually through the interface, and similarly output data could be exported to Excel.

## ***2012/2013 STUDENT RESEARCH IN ENGINEERING***

*STUDENT RESEARCHER(S):* Anthony Scheer, Ray Palama, Serkan Erdas

*CLASS YEAR:* 2013

*MAJOR:* Mechanical Engineering (AS, SE); Electrical Engineering (RP)

*TITLE OF RESEARCH PROJECT:*  
Brain Buddy – Athletic Helmet integrated impact detection system

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:* Fall 2012 – Spring 2013

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

Brain Buddy is a low cost modular sensor system for use with athletic helmets. Concussions are often undiagnosed because athletes rely on symptoms rather than data. Our design is able to alert the athlete, coach, or parent via a Bluetooth receiver that the helmet has received an impact greater than a predetermined concussion-probable threshold. Our concept corrects the shortcomings of other systems currently on the market. This system will be user friendly and easy to install and operate. Bluetooth technology allows the system to have long battery life as well as provides an operating platform that the end user already owns and is familiar with operating. For athletes that are involved in many sports, our design is interchangeable between multiple helmets. Our design is cost effective for the consumer so that they will not have to risk undiagnosed injuries due to financial constraints. The design and manufacturing phases have been completed for the system. Final testing of the system is currently in progress.

## ***2012/2013 STUDENT RESEARCH IN MECHANICAL ENGINEERING***

*STUDENT RESEARCHER(S):* Joseph Torok II and Davi Squizzato

*CLASS YEAR:* 2013

*MAJOR:* Mechanical Engineering

*TITLE OF RESEARCH PROJECT:*  
Aerodynamic Nose Improvement of a Formula Ford Racecar

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Professor Stephen Roux  
Shahrokh Etemad, Ph.D.

*DATE OF PROGRAM:* September 2012 – May 2013

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

Formula F race cars exhibit a unique challenge to develop the most aerodynamically sound vehicle while conforming to the Sports Car Club of America (SCCA) formula regulations. In this project, an in-depth aerodynamic analysis of a nosecone for a Formula F race car was performed through the use of computational fluid dynamics (CFD). Improvement was made in generating increased downforce and reducing the aerodynamic drag of the vehicle, leading to higher top end and cornering speeds, which will in turn reduce lap timings, and thus improve the car's performance during competition. The existing vehicle geometry was modeled and analyzed to establish baseline performance metrics of the current in-use design. The nosecone geometry was then iteratively modified and compared to the base line results to determine the ideal design. Currently, this optimal design is being manufactured utilizing modern composite materials. Once complete, the improved nose cone will be installed on the vehicle for on-track testing and evaluation during May 2013 to confirm improved performance results.



Lauren Bruchansky  
Devan Conroy  
Cassandra DePietro  
Laura Gioco  
Johanna Ortiz

# MATHEMATICS





## ***2012/2013 STUDENT RESEARCH IN MATHEMATICS***

*STUDENT RESEARCHER(S):* Lauren Bruchansky and Cassandra DePietro

*CLASS YEAR:* 2014 (LB); 2013 (CD)

*MAJOR:* Mathematics

*TITLE OF RESEARCH PROJECT:*

The Prevalence of the Cutoff Phenomenon in Markov Chains

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Mark Demers, Ph.D.

*DATE OF PROGRAM:* 6/2012-8/2012

*SPONSOR:* National Science Foundation

*DESCRIPTION OF WORK (Short Abstract):*

Markov chains are popular models from probability which describe random, memory-less processes that transition between states according to certain probabilities. In this study, we focus on mixing Markov chains with a finite state space; such systems are known to converge to equilibrium at an exponential rate. A Markov chain is said to exhibit a cutoff phenomenon if the convergence to equilibrium is initially delayed before converging rapidly to its equilibrium distribution. We explore the prevalence of the cutoff phenomenon in both large deterministic and large randomly generated matrices by manipulating their size and sparseness, using MATLAB to model their behavior. We find that randomly generated sparse matrices do tend to exhibit cutoff and that the cutoff in deterministic matrices becomes more pronounced as the probability of long jumps shrinks. These findings increase our understanding of finite-time behavior in this type of probability model, as opposed to the usual focus on asymptotic behavior.

## **2012/2013 STUDENT RESEARCH IN MATHEMATICS**

*STUDENT RESEARCHER(S):* Devan Conroy, Laura Gioco, and Johanna Ortiz

*CLASS YEAR:* 2013

*MAJOR:* Mathematics

*TITLE OF RESEARCH PROJECT:* Analyzing Algal Blooms in Lake Lillinonah

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Laura McSweeney, Ph.D.

*DATE OF PROGRAM:* Spring 2013

### *DESCRIPTION OF WORK (Short Abstract):*

Our study focuses on the seasonal algal blooms of Lake Lillinonah, the second largest man made lake in western CT. We analyze data collected in 2012 from an automated buoy that measures water quality along with atmospheric and water conditions. Our main goal is to determine which factors are related to adjusted chlorophyll, phycocyanin and dissolved oxygen levels. We used correlation analysis to better understand the interactions of the different variables along with the impact on algal blooms. Linear regression and time series analysis was used to model the relationship between the variables and the patterns of algal blooms. We compare our results to the analysis previously done on buoy data collected in 2011 and discuss common trends.

Annie Buckley  
Allisa Ciccia  
Laura M. Cucinotta  
Frederick Garland  
Emily Goodman  
Regina Hipolito  
Manouchka Jean-Risme  
Kara Maltese  
Alicia Masucci  
Mairead McConnell  
Taylor McGuinness  
Lucas Nixon  
Jacqueline Nucero  
Brian O'Keefe  
Ariana Philbin  
Francesca Romano  
Amina Seyal

# PSYCHOLOGY



## ***2012/2013 STUDENT RESEARCH IN PSYCHOLOGY***

*STUDENT RESEARCHER(S):* Laura M. Cucinotta

*CLASS YEAR:* 2013

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:*

The Effect of Oxytocin Exposure during Adolescence on Reproductive Behaviors  
in Adult Male Rats

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shannon M. Harding, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

Adolescence is a sensitive period of brain development when changes in hormone levels may have significant effects on neural organization and resulting behaviors. Recent studies have suggested that the neuropeptide oxytocin (OT) administered during adolescence can have long-term effects on anxiety and social behaviors (Bowen, 2011). OT is also known to affect behaviors with sexual partners; however the effects of OT exposure during adolescence on reproductive behaviors in adulthood have not been fully examined. In the current study, twenty male Long Evans rats were administered OT (1 mg/kg, n=10) or Saline (Control, n=10) daily from postnatal days 34-47 during adolescence. Sexual performance, motivation, and arousal were assessed later in adulthood using tests for copulation, partner preference, ultrasonic vocalizations, and scent marking. Overall, we found that OT exposure in adulthood had negligible effects on sexual performance; however the social aspects of reproduction were profoundly impaired in the OT group. These findings have crucial implications in the field of mental health. As a result of OT involvement in social behaviors, it is also being employed as a treatment for disorders with social deficits, such as autism. The current study suggests that oxytocin may have detrimental long-term effects with regard to opposite sex social skills.

## ***2012/2013 STUDENT RESEARCH IN PSYCHOLOGY***

*STUDENT RESEARCHER(S):* Emily Goodman, Jacqueline Nucero, Regina Hipolito, Manouchka Jean-Risme, Brian O'Keefe, and Amina Seyal

*CLASS YEAR:* 2014, 2013 (JN)

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:* Frustration and Aggression as a Function of Race

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Dorothea D. Braginsky, Ph.D.  
Judy Primavera, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

150 Fairfield University students were administered a modified Rosenzweig Picture Frustration Test in which the frustrator in half the conditions was white and the other half was black. We hypothesized that the race of the frustrator would have an impact on the type of response made by our subjects (i.e. either explicitly aggressive, minimizing the situation, or internally blaming oneself). The data indicates that there were different responses depending on the race of the frustrator and the gender of the participant (more detailed analyses are being conducted). Since the vast majority of our subjects were middle class white students, we have gathered for future analyses a sample of minority high school students.

## ***2012/2013 STUDENT RESEARCH IN PSYCHOLOGY***

**STUDENT RESEARCHER(S):** Emily Goodman and Amina Seyal

**CLASS YEAR:** 2014

**MAJOR:** Psychology & Sociology; Psychology

**TITLE OF RESEARCH PROJECT:** Enhancing School Readiness through the Arts

**HOST UNIVERSITY OR INSTITUTION:** Fairfield University

**NAME OF FACULTY RESEARCH SUPERVISOR:** Judy Primavera, Ph.D.  
Dorothea D. Braginsky, Ph.D.

**DATE OF PROGRAM:**

**SPONSOR:**

### ***DESCRIPTION OF WORK (Short Abstract):***

Research shows that arts integrated into school curriculums has been seen to increase social competence and literacy in grade school children (Lobo & Winsler, 2006; Phillips, Gorton, Pinciotti, & Sachdev, 2010; Lorenzo-Lasa, Ideishi, & Ideishi, 2007). This study seeks to determine whether preschool involvement in the *Kindergarten Readiness through Dance* program increases social-emotional, cognitive, and language scores on a standardized Kindergarten readiness test, *Creative Curriculum*. Participants in the program were matched to a control group; scores before and after participation were analyzed using a two-way repeated measures ANOVA. Results indicate that children's social-emotional and cognitive scores significantly increased through participation in the program and language scores approached significance. These results suggest that there are valuable benefits of participation in arts programs particularly for school readiness.

## **2012/2013 STUDENT RESEARCH IN PSYCHOLOGY**

*STUDENT RESEARCHER(S):* Kara Maltese, Ariana Philbin, Francesca Romano

*CLASS YEAR:* 2013 (KM), 2014 (AP and FR)

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:*

Helping others to avoid suffering vs. helping others to approach joy:  
Message framing shapes the helping responses of positive and negative empathizers

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Michael Andreychik, Ph.D.

*DATE OF PROGRAM:* Spring 2013

*SPONSOR:* Fairfield University

*DESCRIPTION OF WORK (Short Abstract):*

Empathy—or the ability to resonate with the emotions of others—is a strong motivator of helping behavior. But, to date, empathy has largely been viewed as the ability to resonate specifically with the *negative* emotions of others. We examined whether the capacity to resonate with others' negative emotions (i.e., negative empathy) is distinct from the capacity to resonate with others' positive emotions (i.e., positive empathy), and whether positive and negative empathy are related to helping in different types of situations. Preliminary results suggest that positive and negative empathy are distinct capacities and that framing helping appeals in terms of helping others to avoid suffering is especially likely to energize helping in negative empathizers whereas framing helping appeals in terms of helping others to approach joy is especially likely to energize helping in positive empathizers.



## **2012/2013 STUDENT RESEARCH IN PSYCHOLOGY**

*STUDENT RESEARCHER(S):* Alicia Masucci

*CLASS YEAR:* 2013

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:*

The Effects of Oxytocin Exposure during Adolescence on Social Anxiety and Interaction with Same Sex Peers in Male Rats

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Shannon M. Harding, Ph.D.  
Michael Andreychik, Ph.D.

*DATE OF PROGRAM:* Fall, 2012

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

Oxytocin (OT) is a neuropeptide that may reduce anxiety and facilitate normal social behaviors, including interactions with sexual partners, offspring, and same-sex peers. Its role in social behaviors makes OT an attractive candidate for the treatment of disorders like autism, where social deficits are often observed. However, the long-term effects of OT exposure during childhood and adolescence, when critical brain development occurs, have not yet been studied. The present study was designed to examine effects of OT exposure on social anxiety and interaction with same sex peers. Twenty male Long-Evans rats were pair-housed and assigned to either OT (n = 10) or Control (saline, n = 10) groups and were injected i.p. with solution (1mg/kg) from postnatal day 34-47 during adolescence. After injections, all rats were tested for anxiety and social behaviors using (1) a social preference test, (2) a resident-intruder test (3) an elevated plus maze and (4) a pro-social test with a trapped cage-mate. Data analysis suggests that the OT group was less anxious overall, spending more time in open arms, showing more aggression, spending more time with other rats, and displaying more exploration during each of the tests (although not all data points reached statistical significance). The combined findings suggest that early exposure to oxytocin produces an overall reduction in social anxiety consistent with other studies (Bowen, Carson, & Spiro, 2011). This may have direct implications for the treatment of clinical disorders including autism.

## **2012/2013 STUDENT RESEARCH IN PSYCHOLOGY**

*STUDENT RESEARCHER(S):* Taylor McGuinness, Mairead McConnell, Frederick Garland, Allisa Ciccio, and Annie Buckley

*CLASS YEAR:* 2013 (TM, MM, FG); 2014 (AB), 2015 (AC)

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:*  
The Cultural Differences in Tolerance for Ambiguity and EEG

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* John F. McCarthy, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

The present study is part of an ongoing effort to investigate the impact of culture on cognition. Marked syntactical differences between the languages of German and English have led McCarthy et al. (2007, 2008) to believe that different language processing strategies exist between these native speakers and may account for the cultural differences that seem to exist in their thinking and behavior. Based upon our previous research, the present study sought to explore how such differences impact tolerance for ambiguity. Tolerance for ambiguity is a measure of how a person reacts to concepts or situations that are not definite and which may require a decision without full knowledge of the consequences (Buhr & Dugas, 2001). We tested the hypothesis that native German-speaking Germans would possess more tolerance for ambiguity than native English-speaking Americans based on the complexity of German syntax and German's corresponding language processing style. In order to evaluate tolerance for ambiguity, a number of measures were employed. Among them were a tolerance for ambiguity questionnaire that consisted of 20 items and an artwork decision task that we developed in an earlier study (Williams et al., 2011). Consistent with our prediction, results indicated that native German-speaking Germans were more tolerant for ambiguity than native English-speaking Americans.

## ***2012/2013 STUDENT RESEARCH IN PSYCHOLOGY***

*STUDENT RESEARCHER(S):* Lucas Nixon

*CLASS YEAR:* 2013

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:*

Using external explanations to improve implicitly- and explicitly-measured attitudes toward outgroups

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Michael Andreychik, Ph.D.

*DATE OF PROGRAM:*

*SPONSOR:*

*DESCRIPTION OF WORK (Short Abstract):*

Our lab examined whether or not extremely negative attitudes towards certain groups (in this case, terrorists) could be changed at both an implicit and explicit level by highlighting the external causes of that group's behavior (e.g., historical maltreatment). At the same time, we examined whether the Implicit Association Test (IAT), a test commonly used to measure implicitly prejudicial attitudes towards social groups, is in fact measuring prejudice, or if it is measuring empathy towards the group in question, since strongly empathic reactions can look identical to prejudicial reactions on an implicit level.

## **2012/2013 STUDENT RESEARCH IN PSYCHOLOGY**

*STUDENT RESEARCHER(S):* Jacqueline Nucero

*CLASS YEAR:* 2013

*MAJOR:* Psychology

*TITLE OF RESEARCH PROJECT:* Racial Attitudes, Unconscious Feelings and Opinions

*HOST UNIVERSITY OR INSTITUTION:* Fairfield University

*NAME OF FACULTY RESEARCH SUPERVISOR:* Dorothea Braginsky, Ph.D.

*DATE OF PROGRAM:* Spring 2013

*SPONSOR:*

### *DESCRIPTION OF WORK (Short Abstract):*

This project is an independent research project I created a proposal for at the end of last semester (Fall 2012). I conducted this study under the guidance of Dr. Braginsky as my research professor. I created a test that I ran on 96 randomly selected Fairfield University students to test if by the use of a prime, my subjects project implicit or unconscious stereotypes that may hold toward black people. I analyzed my data using a 3-way factorial ANOVA with 3 conditions using a 2 (male or female) x 2 (negative black prime or neutral prime) x 2 (black artist or white artist) between-subjects test.



