Cleveland State University
engagedlearning

# UNDERGRADUATE RESEARCH ABSTRACTS

Poster Session: September 9, 2010

10:00— 2:00

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## Contents

# College of Business Administration

# CO2 Emissions and Carbon Mitigation in China

Department of Operations Management & Business Statistics

College of Business Administration

**Student Researcher:** Peter Yang

**Faculty Advisor:** Injazz Chen

Abstract

China's energy efficiency was significantly improved during the last 30 years. However, its coal-dominant energy structure was hardly improved. As a result, although its PPP weighted per capita GDP and $CO_2$ emissions were only 1/5 and 1/4 those of the U.S, China already overtook the latter and became the world's largest $CO_2$ emitter in 2007. Certainly, its per capita figures still support its claim of the developing country status and its position of no binding $CO_2$ reduction commitment. Its current top $CO_2$ emitter status and daunting perspective of $CO_2$ emissions in 2030 equaling 150% of the current U.S. and China combined $CO_2$ emissions or 75% the world's current total $CO_2$ emissions make it difficult to defend such a non-commitment position. In response to this dilemma and increasing international pressure, the Chinese government recently decided to set carbon intensity targets for China. This paper seeks to examine China's dilemma and its response to this dilemma, and to analyze China's energy efficiency program and carbon intensity reduction program in terms of their carbon mitigation effectiveness as solutions to break through this dilemma.

# An Examination into Signaling

Department of Marketing

College of Business Administration

**Student Researchers:** Alex Soldo, Jackie Tu

**Faculty Advisor:** Ashutosh Dixit

Abstract

Due to the lack of up front credible information available to competitors, customers, clients, employers, and others, people must gather information and establish understanding through alternative means. To understand this problem better and to recognize solutions for it, we analyzed over 35 papers looking at an array of topics that pertain to signaling. We started with papers written by the original theorists for signaling and moved through to papers that were written about numerous signals in recent years. As a result we have come to understand just how crucial the role is that signaling plays in the information gathering process. We have come to see how signals can give important clues to what the appropriate reaction or counter signal is in a given situation and that the more cognitive the person is the better he or she will be at decoding these signals. Furthermore, companies have many different reasons to send signals. In conclusion, signals can help to fill a gap in incomplete knowledge for information gatherers.

# College of Liberal Arts and Social Sciences

# Gateway to Cleveland's Past: Analyzing Archaeological Remains from the Gateway Construction Site, Cleveland, Ohio

Department of Anthropology

College of Liberal Arts and Social Sciences

**Students Researchers:** Sarah Arth, Robert Huber, Laura Lemermeier, Dick Powis

Robert Tillman, Valentyne Volk

**Faculty Advisors:** Dr. Paul Aspelin, Dr. Phil Wanyerka

## Abstract

Six undergraduates from the Department of Anthropology at Cleveland State University curated archaeological materials excavated from Cleveland's historic Gateway District. These materials, originally excavated by archaeologists from the Cleveland Museum of Natural History between 1991 and 1992, are now permanently curated here in the Department of Anthropology at Cleveland State University. More than 7,400 artifacts were recovered from the Gateway excavations including both prehistoric and historic materials. The focus of this long-term project was to determine and assess the condition of this archaeological collection by applying the proper methods and techniques of archaeological conservation and museum curation in order to stabilize, protect, curate, and archive these items. The students' contribution to this research project represents an important step in saving and protecting Cleveland's forgotten past.

**Language Arts and Cultural Competency in Health Service Learning**

Department of English

College of Liberal Arts and Social Sciences

**Student Researcher:** Amita Venna

**Faculty Advisor:** Adrienne Gosselin

Abstract

One goal of this larger language arts research project was to address the need for curriculum designed to instruct skills and attitudes identified with cultural competency and to demonstrate the viability of service learning to cultivate those skills and attitudes early on in higher education. Research was conducted through *Let It Ride: Game Ready 4 Life*, a work-based, experiential learning program sponsored by the Cleveland Treatment Center for at-risk youth, ages fourteen to eighteen. The Cleveland Treatment Center is a comprehensive, community-based, not-for-profit drug and alcohol treatment agency committed to providing services that advocate and support prevention and to facilitate and foster the emotional and physical health, growth, and development of at-risk youth. *Let It Ride: Game Ready 4 Life* provides projects and services that are both restorative and remedial in nature. The program arts activities are divided into four tracks: Creative Writing, Video, Theater, and Graphic Design. Amita Venna, CSU Engaged Learning Research Assistant, was the student leader for the Creative Writing track and one of two undergraduate program supervisors. Defining cultural competency as the ability to interact effectively with people of different cultures and backgrounds, this component of the Engaged Learning Research Project was designed to contribute a student self-reported evaluation of personal and social development and practical competence as qualitative data of cultural competency training in service learning research.

**Cleveland State University Summer Stages Apprentice Company: Preparing New Theatre Artists for a New Millenium**

Drama Department

College of Liberal Arts and Social Sciences

**Student Performers:** Tania Benites, Stephen Farkas, Charles Hargrave, Amy Schwabauer, Stephanie Wilbert

**Technicians:** Cory Shy, Josh Heidinger, Sarah Moore, Zach Svoboda

**Recent Alumni** Denise Astorino, Eric Perusek, Justin Steck

**Faculty Advisor:** Michael Mauldin

Abstract

CSU Summer Stages integrates professional, national caliber theatre artists with CSU students in a repertory theatre environment, rehearsing and performing three full length productions. Augmenting the rehearsal and performance schedule are daily master classes from the guest professional actors, directors and designers, and a practicum of costuming, lighting, set construction, dramaturgy, box office and publicity. Students are able to develop the tools needed to write, direct, produce, design and market their own productions with a working knowledge of expected professional standards. This intensive environment allows the students to understand the melding of the practicum and scholarship of the theatre, and prepares them to be proactive creative artists rather than passive prospective employees.

**Content Analyzing Movie Trailers--Romantic Comedy and Dark Comedy :FR:AMES (Film Research: Advanced Methods for Empirical Study)**

School of Communication

College of Liberal Arts and Social Sciences

**Student Researchers:** Andrew Scheid, Matt Egizii

Faculty Advisor: Kim Neuendorf

## Abstract

Abstract: How do motion pictures market their style of humor to the average movie viewer's comedic sensibilities? For this study, film trailers--short-length advertisements for a movie--were systematically content analyzed (Neuendorf, 2002, The Content Analysis Guidebook). The study focused on two subgenres of film comedy, romantic and dark comedies. The content for trailers of films that are cinematically rendered as either romantic or dark comedies highlight the characteristics for each respected genre, and satisfy the expectations of each genre's target audience. In order to obtain these desired results, the trailer utilizes cinematic cues, mechanisms, and subject matter that "frame" the referenced film for potential spectators (e.g., as a star vehicle, as the output of a particular auteur, as a narrative emphasizing a certain humor style, or in some other way). Further, humor can be achieved via four discrete mechanisms; this study uses a thorough coding scheme to gauge the multidimensional humorous intent of the filmmaker. Two student researchers served as trained coders, and a pilot study was conducted--twenty comedy trailers, ten romantic and ten dark, analyzing each individual shot. By charting a litany of measured indicators, including humor types, this study has begun to empirically differentiate the two subgenres.

**Narrative Interpretation: The Effects of Film Technique and Editing Style :FR:AMES (Film Research: Advanced Methods for Empirical Study)**

School of Communication

College of Liberal Arts and Social Sciences

**Student Researchers:** Matt Egizii, Andrew Scheid, & Jasmine Golphin Nick Evert, Nate Miller, Heath Olausen, & Maggie Rice

**Faculty Advisors**: Evan Lieberman, Kim Neuendorf

Abstract: Film semiology is the study of understanding significance in the image of film; however it is most often used when researching the semantics of the image itself. The syntactic study of film's formal structure often cites Suture as the minutest enunciation of a sequence, where Suture is defined as how narration includes the field of the spectator's vision as a space that must be accounted for and folded into the space of the film. The method by which the space is revealed varies: the classic Shot-Reverse-Shot sequence (Oudart, Cinema & Suture), Long Shot/Long Take, Montage (most often associated with Soviet films of the past), and the relatively new Intensified Continuity (Bordwell, Intensified Continuity). The last consists of variations of rapid editing, bipolar extremes of lens length, closer framing of dialog scenes, and a free ranging/mobile camera. The :FR:AMES team scripted and shot a short film (titled Sunset Gates) that involved variations on multiple takes of each shot in the film. These shots will be edited into sequences that represent the aforementioned four Suture techniques, with the end product being an instrument to be used in the gathering of spectator response experimental data throughout the 2010/2011 school year.

# College of Education and Human Services

# Home & Community Literacies of Young Bilinguals

College of Education and Human Services

**Student Researchers:** Daniel Balderas, Selynette Mojica

**Faculty Advisor:** Dinah Volk

Abstract

The project emphasizes the strengths and resources of bilingual children, their families, and communities. Using ethnographic approaches, the project is investigating literacy as a sociocultural practice and consists of 1) research into formal and informal literacy practices in the homes and communities of two Latino boys attending the same English as a Second Language (ESL) first grade classroom in the Cleveland Metropolitan School District; and 2) the identification of community access points to literacy. Student research assistants learned about the ongoing project, its theoretical framework, and methods; conducted field observations and an interview; transcribed and translated recordings; participated in an NVivo webinar, imported data into NVivo, and coded and analyzed data. Preliminary findings detail the boys' preferred texts and practices, home and community learning contexts, and the many "teachers" in their lives. Literacy resources and community access points to literacy were identified. A long-term goal is the development of user-friendly documentation for teachers and community members that will provide practical suggestions for curriculum development, reading instruction, and collaboration. The project was funded by an EDGE grant from the Division of Institutional Diversity as well as the Engaged Learning grant for integrating undergraduates into research projects.

# Effects of Isometric Handgrip Training on Blood Pressure

Department of HPERD

College of Education and Human Services

**Student Researchers:** Gurpreet K. Dhillon, Juan Carlos Gamarra, James Ward, Sohinee Kadylak, & Dionna Kennedy

**Faculty Advisors:** Eddie T.C. Lam, Ph.D., & Cheryl Delgado, Ph.D. RN, C-ANP

## Abstract

Hypertension has long been associated with cardiovascular disease and one of the leading causes of health-related mortality. For example, over seven million people are died from cardiovascular disease each year worldwide (Chobanian et al., 2003). Studies in the last few decades showed that resistance training such as isometric handgrip exercise can significantly reduce arterial pressure (e.g., Hagberg, Ehsani, Goldring, Hernandez, Sinacore, & Holloszy, 1984; Kiveloff & Huber, 1971; Wiley, Dunn, Cox, Hueppche, & Scott, 1992). The purpose of this study was to examine the effects of isometric handgrip training on systolic and diastolic blood pressure over a 6-week period. Participants (N = 28) of this study were students from an urban university in the Cleveland area. Blood pressure of the participants was measured every two weeks. They were provided with a hand grip device and were asked to perform the following protocol: (1) squeeze the device with the right hand and hold it for two minutes, (2) rest for one minute, (3) squeeze the device with the left hand and hold it for two minutes, (4) rest for one minute, and (5) repeat the first three steps once more. Participants were required to do the above steps 3 days a week for 6 weeks. One-way repeated measures ANOVAs were used to examine the blood pressure of the participants at four different periods: baseline, second week, fourth week, and sixth week. No significant differences were found for both systolic blood pressure ($F_{3,66} = 1.04$, $p > .05$) and diastolic blood pressure ($F_{3,66} = 1.57$, $p > .05$). However, results of the paired samples t-tests indicated that there were significant mean differences between the baseline (pretest) and the sixth week (posttest) systolic blood pressure ($t = 2.80$, $p < .01$) and diastolic blood pressure ($t = 2.72$, $p < .05$). The results showed that the handgrip training could significantly lower both the systolic and diastolic blood pressure of the participants. However, such effect only happened after a 6-week training. For this reason, any protocol less than six weeks will not be recommended. Based on the results of this study, we may expect further improvement on the blood pressure of the participants if the training period can be extended

# Gender Differences in Cardiovascular Response to Isometric Handgrip Protocol

Department of HPERD

College of Education and Human Services

**Student Researchers:** Gurpreet K. Dhillon, James Ward, Juan Carlos Gamarra, Dionna Kennedy, & Sohinee Kadylak

**Faculty Advisors:** Eddie T.C. Lam, Ph.D., & Cheryl Delgado, Ph.D. RN, C-ANP,\

## Abstract

Hypertension plays a critical role in all-cause and cardiovascular disease-related mortality around the world (Pescatello, Franklin, Fagard, Farquhar, Kelley, & Ray, 2004). In America, hypertension is a serious health problem that affects 50 million people (Burt et al., 1995). Recent studies demonstrated that isometric exercise such as isometric handgrip training reduces resting blood pressure in individuals with or without hypertension (e.g., Ray & Carrasco, 2000; Taylor, McCartney, Kamath, & Wiley, 2003). However, most of these studies did not compare gender differences. The purpose of this study was to examine gender differences in cardiovascular response to isometric handgrip protocol. Students from a university in the Midwestern region were invited to participate in this study. On the first day of the test, baseline blood pressure of the participants was measured. Then they were randomly provided with either one of the hand grip devices and were asked to do the following: (a) squeeze the device with the right hand and hold it for two minutes, (b) rest for one minute, (c) squeeze the device with the left hand and hold it for two minutes, (d) rest for one minute, and repeat steps (a) to (c) once more. Participants were required to do the above steps on multiple occasions (3-4 days a week for 6 weeks). In addition, participants' blood pressure was measured every two weeks. Participants of his study were 13 females and 15 males. Most of the female participants (69.2%) were between the age of 18 and 35 years old; while the majority of their counterparts (86.7%) were 18-30 years old. When examining the systolic pressure, results of the mixed-design ANOVA indicated that no significant interaction was found ($F_{1,26} = 0.41$, $p > .05$) between gender and blood pressure. However, the main effect for gender was significant ($F_{1,26} = 9.99$, $p < .01$). Similarly, a significant blood pressure main effect was found ($F_{1,26} = 7.39$, $p < .05$). On the other hand, analyses of the diastolic pressure showed no significant interaction ($F_{1,26} = 0.14$, $p > .05$) or main effect for gender ($F_{1,26} = 2.51$, $p > .05$). However, there was a significant blood pressure main effect among the participants ($F_{1,26} = 7.11$, $p < .05$). The results showed that both male and female participants had lowered their systolic and diastolic blood pressure over the 6-week test period. However, male participants had better improvement in systolic blood pressure than their counterparts. This is probably due to the higher baseline blood pressure of the male participants and thus they have more room for improvement. Future studies should include a larger sample size to further examine this question.

# Effectiveness of Isometric Handgrip Devices for Evaluating Blood Pressure

Department of HPERD

College of Education and Human Services

**Student Researchers:** Juan Carlos Gamarra, Gurpreet K. Dhillon, James Ward, Dionna Kennedy, & Sohinee Kadylak

**Faculty Advisors:** Cheryl Delgado, Ph.D., RN, C-ANP, & Eddie T.C. Lam, Ph.D.

There are many health issues associated with high blood pressure. For example, high blood pressure can damage the cells of the arteries' inner lining and causes arteriosclerosis (hardening of the arteries). Other than medication, there are many other ways to control high blood pressure (e.g., maintain physical activities a few times a week). A handful of studies that have examined the benefits of the Zona Plus found that the systolic blood pressure of the participants dropped significantly (e.g., Kelley & Kelley, 2010; McGowan, Visocchi et al., 2006; McGowan, Levy et al., 2006; Taylor, McCartney, Kamath, & Wiley, 2003). The purpose of this study was to compare the effects of two isometric handgrips, the Zona Plus and the GoFit Adjustable Hand Grip, on participants' blood pressure. Participants were students recruited from a university in the Midwestern region. Each participant was randomly provided with either one of the hand grip devices and was asked to do the following:

1. Squeeze the device with the right hand and hold it for two minutes.
2. Rest for one minute.
3. Squeeze the device with the left hand and hold it for two minutes.
4. Rest for one minute.
5. Repeat steps 1 to 3 once more.

Participants were required to do the above steps on multiple occasions (3 days a week for 6 weeks). In addition, participants' blood pressure was measured every two weeks. Repeated Measures ANOVAs were used to examine the changes of blood pressure among the participants. When examining the systolic pressure, no significant interaction was found ($F_{1,26} = 2.14$, $p > .05$). However, the main effect for the handgrip device was significant ($F_{1,26} = 5.06$, $p < .05$). Similarly, a significant blood pressure main effect was found ($F_{1,26} = 8.19$, $p < .01$). On the other hand, the results of diastolic pressure showed no significant interaction ($F_{1,26} = 0.29$, $p > .05$) or main effect for the handgrip device ($F_{1,26} = 0.03$, $p > .05$). However, there was a significant blood pressure main effect among the participants ($F_{1,26} = 7.10$, $p < .05$). The results showed that both hand grip devices were effective in lowering the systolic and diastolic blood pressure of the participants over a 6-week period. Interestingly, the more expensive one was not always the better since the participants using the GoFit Hand Grip (costs less than $10) obtained better results in their systolic blood pressure than using the Zona Plus (costs $400).

# Relationship Between Personal Attributes and Changes in Blood Pressure

Department of HPERD

College of Education and Human Services

**Student Researchers:** Sohinee Kadylak, Juan Carlos Gamarra, Gurpreet K. Dhillon, James Ward, & Dionna Kennedy

**Faculty Advisors:** Cheryl Delgado, Ph.D., RN, C-ANP, & Eddie T.C. Lam, Ph.D.

Abstract

Hypertension, or high blood pressure, is the leading cause of death in the elderly in developed countries (Marigliano et al., 1993). The World Health Organization attributes hypertension as the leading cause of cardio-vascular mortality. Previous studies involved isometric handgrip training showed that it could reduce resting blood pressure in individuals with or without hypertension (e.g., Ray & Carrasco, 2000; Taylor, McCartney, Kamath, & Wiley, 2003). Nevertheless, very few studies focused on the comparison between personal attributes of the participants and the changes in blood pressure. The purpose of this study was to investigate the interrelationship between personal attributes such as body weight, height, age, and ethnicity of the participants and the changes in blood pressure. Healthy adults across the campus of an urban university in the Midwestern region were recruited for this study. Participants were provided with a hand grip device and were asked to: (a) squeeze the device with the right hand and hold it for two minutes; (b) rest for one minute; (c) squeeze the device with the left hand and hold it for two minutes; (d) rest for one minute. After this, the participants had to repeat steps 1 to 3 once more. Participants were required to do the above steps on 18 occasions (3 days a week for 6 weeks). In addition, participants' blood pressure was measured every two weeks (i.e., week 2, week 4, and week 6). After the 6-week isometric handgrip training protocol, participants showed significant ($p < .05$) changes between the baseline and the $6^{th}$ week systolic and diastolic blood pressure as identified by univariate repeated measures ANOVAs ($F_{1,26} = 4.41$, $p = .046$, and $F_{1,26} = 6.60$, $p = .016$, respectively). Pearson and Spearman rho correlation coefficients were calculated to examine the interrelationship among the participants' personal attributes (body weight, height, age, and ethnicity), mean visit days, and changes in blood pressure. A weak nonsignificant ($p > .05$) correlation was found among all these variables. Multiple linear regression and multinomial logistic regression further confirmed that all these personal variables were not significant ($p > .05$) predictors of blood pressure. The isometric handgrip training protocol used in this study effectively lowered the blood pressure of the participants. The weak nonsignificant interrelationship among the participants' personal attributes, number of visits, and changes in blood pressure indicated that regardless of their age, height, weight, or ethnicity, they could benefit from the protocol as far as they could perform the training 3 times a week for at least 6 weeks.

**Fenn College of Engineering**

# Optimization of Digestate Media Composition for Maximal Lipid Recovery

Department of Chemical and Biomedical Engineering

Fenn College of Engineering

**Student Researchers:** Brittany Studmire, Jacob Schwenk

**Faculty Advisor:** Joanne Belovich, Ph.D

## Abstract

The need for a sustainable fuel has become more apparent over the years as concerns about the limited amounts of crude oil continue to increase. One such source of a sustainable alternative fuel is microalgae. The standard 3N-BBM media that algae is grown in is not feasible on a large industrial scale due to high chemical costs. Thus a more cost effective media is needed. The use of digestate as a possible source of nutrients for algal growth was proposed. Experiments were done to determine the minimum concentration of digestate in water that would help maximize biomass recovery and lipid content. Results showed that a value of about 1.25% digestate (v/v) in water was the lowest concentration possible that helped maximize biomass recovery and lipid content. Future testing can be done to further fine tune this number, which will help cut costs and increase productivity.

# Sustainable Construction Processes

Department of Civil and Environmental Engineering

Fenn College of Engineering

**Student Researcher:** Michael Rotossa

**Faculty Advisors:** Norbert Delatte, Paul Bosela

## Abstract

Sustainable development has certainly captured the imagination and focus of the U.S. development industry. The US Green Building Council initiated the Leadership in Energy and Environmental Design (LEED) certification program for new construction in 2001. By 2004, 257 buildings had been certified. At the conclusion of 2007, over 16,000 buildings have been registered or certified, and LEED has been expanded to include a total of 9 categories of facilities. Major professional and trade organizations (PTOs) in the construction industry including such prestigious and large organizations as the American Concrete Institute (ACI), Portland Cement Association (PCA), American Institute of Steel Construction (AISC) and numerous others have announced full support of major efforts to promote sustainable development within the industry segments they represent.

A significant portion of the criteria used to determine how well a project rates on the environmental scale is comprised of how much of and what type of energy is used, and the negative effects such as pollutants that result from using it. Resource consumption is especially crucial in the concrete aspect of any construction project due to the immense amount of energy and raw materials used in the production and transportation of the product worldwide. Therefore in order to be sustainable in the construction industry, sustainable developments must be made in the concrete industry.
Council's Committee on Civilian Industrial Technology created national construction goals in the mid- 1990's that included a goal of reducing the waste and pollution associated with construction by 50 percent. Cleveland State University (PI Dr. Delatte) is a subcontractor to Arizona State University on a recently funded research project "PFI Proposal 0917994: An Integrated Framework for Creation and Assessment of Sustainable Construction Processes."

# Learning from Failures

Department of Civil and Environmental Engineering

Fenn College of Engineering

**Student Researcher:** Jeffrey D. Bazzo

**Faculty Advisors:** Norbert Delatte, Paul Bosela

## Abstract

Lessons learned from case studies have substantially affected the practice of civil engineering and other engineering disciplines. The development of practice is largely dependent upon studying past failures, both imminent and actual, and of the changes to designs, standards and procedures made as the result of timely interventions or forensic analyses. In addition to technical issues, concepts such as professional and ethical responsibility are highlighted by the cases.

For undergraduate students, researching case studies provides a unique opportunity to apply critical engineering thought in order to discriminate between possible failure modes and their causes. New case studies have been developed on the Minneapolis I-35W Bridge collapse of August 1, 2007, and the St. Francis Dam failure of March 12, 1928. These, and other case studies, can be incorporated into undergraduate engineering curricula as a means of stimulating student interest and awareness. Several of these case studies have been presented at CSU and other universities as classroom lectures, followed by a survey of the participating students. The survey results are compiled and used to gauge the effectiveness of the case studies on students' interest and understanding of the material.

# Spectroscopic Methods and Mathematical Modeling for the Characterization of Thin Film Deposition Processes

Department of Chemical and Biomedical Engineering

Fenn College of Engineering

**Students Researchers:** Scott A. Hug and Charles F. Tillie

**Faculty Mentor:** Jorge E. Gatica

Abstract

Corrosion resistance and energy efficiency have long been driving forces to substitute low-carbon steels by advanced materials in the manufacture of car body parts. As a result, attention has been directed towards aluminum alloys as one of the prime candidates for this replacement. The use of materials in the automobile industry and other applications, frequently involve painting for corrosion protection or decorative purposes. Most materials, however, will exhibit poor paint adhesion properties without proper surface modification.

For many years, chromate-based coating processes have been used by industry to generate protective coatings on metallic surfaces to ensure the success of subsequent applications. As these processes posse a threat for significant environmental impact, new approaches in coating technology, therefore, need to be investigated to provide alternative practical options that could meet EPA mandates.

The research outlined in this project focuses on calorimetric and spectroscopic analyses to characterize the chemical interaction between precursors and different transition metals. Engaged student learning through Research and Creative Activities consisted in spectroscopic and calorimetric characterization of precursor solutions complemented by mathematical modeling and simulation of transport and fluid flow phenomena in a deposition furnace. Results obtained during this research will assist in the formulation of a phenomenological model of high-temperature interactions between phosphates, additives, and solid surfaces.

# Feasibility of Wind – Solar Hybrid System for Cleveland Ohio

Department of Mechanical Engineering

Fenn College of Engineering

**Student Researchers:** Sutari Harini, Mohan Nair and Rashid Salako

**Faculty Advisor:** Rama Gorla

## Abstract

The weather conditions of Cleveland make the city an ideal place for a source of solar-wind hybrid energy. The two methods can be combined for water and space heating. These heating processes can be attained by the use of low-cost flat plate-collectors and low cut-in wind turbines. By doing so, the city will not have to depend on fossil fuels and thus cut down pollution.

## Summary:

The research analyzes the possibilities to satisfy up to 50 percent of the heating needs of individual houses of Cleveland, Ohio with the utilization of the hybrid wind and solar energy systems. The analysis used the average ten-year climate data as the typical weather year of NASA Surface meteorology to analyze the complementary characteristics of solar radiation and wind power. The hybrid system can satisfy up to 42 percent of the annual energy requirements for the heating in the winter and summer months.

# Intelligent Robotics

Department of Electrical and Computer Engineering

Fenn College of Engineering

**Students Reseachers:** Paul Lozovyy, George Thomas, Carre Scheidegger

**Faculty Advisor:** Dan Simon

Abstract

In previous work, we used biogeography-based optimization (BBO) to tune the proportional-derivative (PD) controllers of two-wheeled robots. We pursued three directions of research this summer: (1) We improved the reliability of our robots by using infrared instead of ultrasonic range-finding sensors, and we designed new printed circuit boards to use these sensors; (2) We implemented fuzzy logic control for our robots to improve their performance; and (3) We developed a distributed implementation of BBO that does not require centralized processing. Our research showed us that the infrared sensors produce a signal with less noise than the ultrasonic sensors, the fuzzy controller performs better than PD control, and distributed BBO can be effectively used under conditions that prohibit centralized processing.

# Monitoring Limb Motion on Smartphones Using Electromyography

Department of Electrical and Computer Engineering

Fenn College of Engineering

**Student Researchers:** Igor Ozeruga, Mikey McLaughlin, Calvin Nguyen, Yuri Klimchuk, Victor Klimchuk, Yaroslav Rutkovskiy

**Faculty Advisors:** Nigamanth Sridhar, Wenbing Zhao

## Abstract

Electromyography (EMG) is one of the most valuable techniques used in the field of medicine to study movement, evaluate neuromuscular physiology (mechanisms), and the ability to diagnose neuromuscular disorders. The EMG signal at best represents major changes in current, and voltages, which occur each time muscle fibers are activated by their motoneurons. The objective of the following summer research project was to design, and implement an EMG system for Cleveland State's Physical Therapy Department.

# College of Science

# Potential High Energy Materials: Allene Manipulations and Updated Information on 3,6-Dihydro-1,2,4,5-tetrazine

Department of Chemistry

College of Science

Student Researcher: Sara L. Brunswick

**Faculty Advisor:** David W. Ball

Abstract

Compounds containing a large number of nitro- groups are known to be highly explosive. Last year we took 3,6-Dihydro-1,2,4,5-tetrazine and replaced the hydrogens with nitro- groups to create mono-, di-, tri-, and tetra- substituted compounds. Using the B3LYP/6-31+G** basis set, we found the optimized geometries, vibrational frequencies, and enthalpies of formation and decomposition of all possible isomers. This year we finished those calculations and explored potential problems. We also began work on nitro- and amino- substituted allenes, as allenes are known for their reactivity. This time we used the G2 and G3 levels of theory.

# Role of PCH2 in Crossover Assurance in spo11 Hypomorphs

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researchers:** Marta Makuszewski, Neeraj Joshi

**Faculty Advisor:** G. Valentin Boerner

## Abstract

Meiosis is a form of cell division that involves the pairing of homologous chromosomes, recombination between those chromosomes and two successive nuclear divisions. The end result is that the number of chromosomes is reduced by half. In yeast cells, meiosis results in the formation of four spores. PCH2 is a protein that plays a role in recombination and chromosome segregation in prophase I. It acts as a checkpoint and prevents chromosome segregation when recombination is defective. Chromosome missegregation results in poor spore viability. SPO11 is a protein that catalyzes the formation of double stranded breaks which are required for initiation of meiotic recombination. Double stranded breaks are required for crossovers to occur. Crossovers also help prevent chromosome missegregation. SPO11 mutants do not form double stranded breaks which leads to lower levels of recombination and lower spore viability. SIR2 plays a role in silencing HML (α) and HMR (a), which are silent loci that contain complete unexpressed copies of mating-type genes. This regulates recombination. Absence of SIR2 causes a complete loss of transcriptional silencing and causes defects in the meiotic pachytene checkpoint. One goal was to analyze how spo11 hypomorphs with pch2Δ affect spore viability at different temperatures. Another goal was to insert a sir2Δ into a spo11 hypomorph strain to determine if nucleolar pch2 also plays a role in chromosome missegregation. In a sir2Δ strain, PCH2 is only on the chromosome. Tetrads were dissected to separate spores and determine viability.

# The Screening of Yeast Genome Mutated with Tn7-Transposon

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researcher:** Hanna Morris

**Faculty Advisors:** G. Valentin Boerner, Sneharthi Banerjee

Abstract

Meiosis is a cell division that produces germ cells. In Meiosis I, the DNA in a diploid cell is doubled and homologous chromosomes separate. In Meiosis II, each pair of sister chromatids are separated, resulting in four haploid daughter cells. Three key stages in meiosis are recombination, synaptoneomal complex formation, and cell division. These steps are critical for proper chromosome segregation. When problems with meiotic progression occur, it is usually due to an anomaly in one of those functions. Only a fraction of the genes required for recombination, synaptonemal complex formation, and cell division are presently known. We used a particular phenotype to identify new genes with functions in meiosis.

Temperature sensitivity is a common phenotype of meiotic defects in yeast. Our goal is to find genes, that when deleted, cause flaws in meiotic progression. To find these mutants, we set up a screen of the entire yeast genome mutated with the Tn7 transposon. After subsequent phases of testing are completed on candidates showing promising meiotic temperature sensitivity and poor spore viability, they will be sent for sequencing to identify the deleted gene causing the abnormality. Further research of those genes may give more insight into homologous genes found in higher organisms.

# Dynamics of Linear Polymers in a Microchannel Fluid Flow

Department of Physics

College of Science

**Student Researcher:** Prasenjit Bose

**Faculty Advisors**: Petru S. Fodor, Miron Kaufman

## Abstract

Examination of the dynamics of polymers in a fluid flow is an important topic of research because of potential biomedical applications. We simulated the motion of a linear polymer caried in a laminar fluid flow inside a rectangular channel. Our model polymer is made up of beads which are connected by springs. When the polymer is released in the fluid elastic and advection forces act on each bead. The Newton's $2^{nd}$ law for each bead is integrated numerically using $4^{th}$ order Runge-Kutta technique. The dynamics of this nonlinear mechanical system depends on the values of the spring equilibrium distance (*a*), mass of a bead (*m*), the initial fluid inflow constant (*B*), and the spring constant (*k*). Various trials were conducted by varying some of these parameters and the results were recorded and plotted. It was observed that the motion of the polymer was more noisy for higher values of *a* and *k*. The variation of time periods with the changing parameters was studied numerically.

# Fabrication of Micromnixers with Biomedical Applications

Department of Physics

College of Science

**Student Researcher:** Matthew Wancata

**Faculty Advisor:** Petru S. Fodor

## Abstract

Microfluidic devices offer a wide range of applications in areas such as medicine, biology, and chemistry. Their advantages include smaller amounts of samples and reagents, and increased reaction speed and portability when compared with typical chemical analysis systems. This in turn enables high throughput parallel sample processing trough integration of various analytical processes within areas of the order of square centimeters. The purpose of the current research was to develop and implement a manufacturing system using a multistep optical lithography capable of transferring to functional substrates complex channel geometries. The optical techniques and instrumentation necessary for the characterization of the fluid flow through the microscale devices were also developed.

# Isolation and Characterization of Factor V from Human Plasma

**Department of Chemistry**

**College of Science**

**Student Researchers:** Nick Yurko, John Vaughn, Joseph Weincek, Jamila Hirbaw, KatieTurner

**Faculty Advisor:** Michael Kalafatis

Abstract.

Blood coagulation is the body's primary mechanism to prevent blood from leaking outside of the vasculature and involves numerous proteins working in concert in order to achieve a proper response to vascular injury. Ultimately, the process involves the conversion of prothrombin in turn cleaving fibrinogen resulting in the production of an insoluble fibrin mesh. Activation of prothrombin is done physiologically by the prothrombinase complex composed of factor Va (FVa), factor Xa on a phospholipid surface in the presence of divalent metal ions. Factor V (FV) is found circulating in plasma as a large single chain protein with $M_r$ of 330,000 at a concentration of 7µg/mL. To isolate human factor V, human plasma was subjected to precipitation and centrifugation. Factor V was further isolated using immunoaffinity chromatography. The protein was salted out using ammonium sulfate fractionation. The final factor V product was stored in 50% glycerol. Optical density readings were taken to determine FV concentration. Activation of Factor V was achieved by incubating Factor V with human alpha thrombin. FVa and FV were 100% homogenous as determined by SDS-PAGE and staining with coomassie brilliant blue. Kinetic analyses were also done to determine enzymatic values for prothrombinase when the isolated factor Va was incorporated.

**Substrate Effects on Locomotor Biomechanics: Arboreal, Burrowing, and Terrestrial**

Department of Health Sciences

College of Science

**Student Researcher:** Sean D. Mayerik

**Faculty Advisor:** Andrew R. Lammers

Abstract

Chipmunks travel on a wide variety of substrates, including tree branches, flat ground, and in burrows. Locomotion on branches and in burrows is constrained relative to traveling on open ground. We predict that chipmunks will modify their locomotion in similar ways to deal with the constraints of traveling on a narrow branch and in a narrow tunnel. For example, peak forces on a branch are controlled to limit the oscillation of the substrate, whereas in a burrow it is more difficult to generate a high peak force because vertical space is limited. We ran Siberian chipmunks (*Tamias sibiricus*) on a 2 cm cylindrical trackway, a flat trackway, and within a 5.1 cm diameter cylindrical tunnel. Each trackway contained a region instrumented to measure substrate reaction force. High-speed videography was used to measure speed and kinematic patterns. Preliminary results demonstrate a significant difference between peak vertical forces and speed during branch and burrow locomotion when compared to ground movement. The factors of the environment itself, such as the diameter of a burrow, can be the cause for the deviation between these gaits.

# Effects of Acceleration and Deceleration on the Biomechanics of Locomotion

Department of Health Sciences

College of Science

**Student Researcher:** Andrew Leith

**Faculty Advisor:** Andrew Lammers

## Abstract

Quadrupedal animals frequently need to adjust their speed for many reasons, whether it is to escape possible harm or slowing down to make sharp turns. The importance of being able to accelerate and decelerate has made animals develop certain biomechanics to allow for such rapid speed changes. To understand how these biomechanics assist in accelerating and decelerating, we trained three Siberian chipmunks (*Tamias sibiricus*) to run on a flat trackway (10.3 cm wide, 210 cm long). A force plate was fixed in the middle of the trackway to collect vertical, craniocaudal, and mediolateral forces while the chipmunks ran. High speed videography was used to capture footfall and gait patterns, along with collecting speed data. The force and speed data presented significant differences among accelerative, decelerative, and balanced trials. While most studies have shown higher vertical forces in forelimb landings than in hindlimb landings, accelerative force data has shown to actually have higher vertical forces in the hindlimbs rather than the forelimbs. Higher vertical force in the hindlimbs would be beneficial in acceleration, as a higher vertical force can create more friction with the substrate creating a stronger propulsive force from the hindlimbs. Thus, there do seem to be biomechanical differences allowing for acceleration and deceleration.

# Characterize the interaction between tbTRF and tbRAP1 Using Yeast 2 Hybrid Analysis

Department of Biological, Geological and Environmental Sciences Department

College of Science

**Student Researchers:** Brandon Smith, Unnati Pandya

**Faculty Advisor:** Bibo Li

Abstract

*Trypanosoma brucei* is a protozoan parasite that causes Human African Trypanosomiasis. While inside the mammalian host, *T. brucei* cell regularly switches its surface antigen, variant surface glycoprotein (VSG), to escape the host's immune attack. VSGs are exclusively expressed from subtelomeric VSG expression sites (ESs) but only a single type of VSG is expressed at any time. Such monoallelic VSG expression ensures the effectiveness of VSG switching and maximizes its efficiency. Hence, monoallelic VSG expression is essential for *T. brucei* pathogenesis. We have previously shown that tbRAP1, an intrinsic component of the *T. brucei* telomere complex, is essential for silencing all ES-linked VSGs but one. In addition, tbRAP1-mediated VSG silencing appears to depend on its localization at the telomere. Interestingly, tbRAP1 does not seem to be able to bind the telomere DNA directly but is recruited to the telomere through the interaction with tbTRF, a duplex telomere DNA binding factor. The interaction between tbRAP1 and tbTRF is therefore important for tbRAP1's function in VSG silencing. To determine which region of tbRAP1 is capable of interacting tbTRF, we expressed fragments of tbRAP1 and various mutations of tbTRF in yeast and examined their interaction using yeast 2-hybrid analyses.

# Investigation of hRAP1 as a Telomere Length Regulator

Biological, Geological and Environmental Sciences Department

College of Science

**Student Researchers:** Emiliya Akhumian, Nevedita Clark, Fan Wu. Lihua Song*

Jonathan Antenucci*

**Faculty Advisor:** Bibo Li

Abstract

Telomeres are nucleoprotein complexes located at the ends of linear chromosomes. They are essential for genome integrity, and telomere length control has been implied in aging. Previous studies have suggested that hRAP1, a telomere protein, negatively regulates telomere length, but the underlying mechanisms are unclear. It is known that hRAP1 does not bind telomere DNA directly. Rather, it is recruited to telomeres by TRF2, a duplex telomere DNA binding protein. To study the function of hRAP1 specifically, we aim to target hRAP1 to telomeres independently of TRF2, by fusing hRAP1 to the duplex TTAGGG-binding myb domain of the fission yeast protein TEB1, followed by characterization of hRAP1's effect on telomere length control. We have confirmed that a GFP-NLS-TEB1myb fusion protein binds to telomeric DNA when expressed in human cells. Furthermore, we generated a series of hRAP1 mutations in its TRF2-interacting domain, two of which have shown a dramatic weakened interaction between hRAP1 and hTRF2. Lastly, we generated additional point mutations at two hRAP1 phosphorylation sites in its myb domain, which was previously shown to be important for telomere length regulation. The objective of our ongoing research will be to test these hRAP1 mutations for their effects on telomere length regulation.

* These authors contributed equally to this work

# *T. brucei* Telomerase RNA: an Initial Characterization

Biological, Geological and Environmental Sciences Department
College of Science

**Student Researchers:** Palak Patel[1], Ranjodh Sandhu[1], Kausik Chakrabarti[2], Ph.D.,

**Faculty Advisor:** Bibo Li

## Abstract

Telomeres are nucleoprotein complexes at the ends of linear chromosomes and contain simple repetitive TG-rich DNA. Telomeres are essential for genome integrity. However, conventional DNA polymerases cannot fully replicate the ends of linear DNA. To solve this "end-replication" problem, most eukaryotes use telomerase to synthesize the telomere DNA *de novo* using its internal RNA component as a template. Recently, we have shown that telomeres play an important role in the pathogenesis of *Trypanosoma brucei* that causes fatal Human African Trypanosomiasis. Hence, understanding telomerase-mediated telomere maintenance in *T. brucei* may help us to eradicate this parasite. We have recently identified the *T. brucei* telomerase RNA component gene, tbTER. We are taking several approaches to confirm that tbTER encodes the telomere RNA component: First, we have generated tbTER knockout constructs. Knocking out tbTER genes in *T. brucei* is expected to lead to progressive loss of telomere DNA. Second, we have generated point mutations in the template region of tbTER. Incorporation of the mutant tbTER into *T. brucei* cells is expected to lead to newly synthesized telomere bearing the mutated sequence. Third, we have generated tbTER overexpression construct and will examine telomere phenotypes in cells that overexpress tbTER under the induced condition.

[1] BGES Dept., Cleveland State University
[2] Dept. of Chemistry, Center for Nucleic Acids, Science, and Technology, Carnegie Mellon University

# Effect of Using the Panasonic Core Trainer and Virtual Reality Gaming on Balance and Posture Post-Stroke Part 1 : Clinical Trials

**Departments of HPERD & Health Science**

**College of Science**

**College of Education and Human Services**

**Student Researchers:** Allison Craine, Natalie Helm

**Faculty Advisors:** Ann Reinthal, Kenneth Sparks, Sheila Patterson

## Abstract

According to the American Heart Association, each year in the U.S. there are 795,000 incidents of stroke. About 83% of people survive these incidents. Many stroke patients need rehabilitation due to brain damage, hemiparesis, as well as other side effects of the stroke. The purpose of this study was to test the feasibility of the Panasonic Core Trainer (PCT) as a method of therapy for rebuilding and strengthening core muscles post-stroke. METHODS: The pre-testing and post testing of the subjects included the Limits of Stability test on the Balance Master. This test converts movement into numerical data that can be quantified later during data analysis. The participants were also scored on the Berg Balance Scale. The training consisted of 300 minutes split up into 30 minute sessions on the PCT while virtual reality gaming. Participants were then post-tested using the same methods as the pre-test. RESULTS: The results of this study indicated that the use of the PCT in tandem with the use of the Wii and Playstation 2 created positive results in the participants balance. There was improvement in all 3 subjects Berg Balance scores, as well as improvement in all three subjects' tests on the Balance Master. CONCLUSION: The use of the PCT in tandem with the use of virtual reality gaming is both a feasible and effective method of rehabilitation post traumatic injury and stroke..

# Designing an Augmentative and Alternative Communication Lab

Department of Health Sciences

College of Science

**Student Researcher:** Daniel R. Barnes

**Faculty Advisors:** Monica Gordon Pershey, Taya Neuman,

Abstract

The purpose of this poster session is to discuss a theoretically-based rationale for the development of an augmentative and alternative communication (AAC) lab space in the Cleveland State Speech and Hearing Clinic. This expanded clinic space must support the clients it seeks to serve. This study entailed a three-phase investigation of (1) the clinic's current holdings, (2) research supporting theoretical bases and best practices for lab design and equipment selection, and (3) how to design the lab space within the Clinic to house future acquisition of equipment. As such, the initial phase of this investigation documented the strengths and weaknesses of the Clinic's current holdings. Second, the research review suggested that functional skill intervention is a guiding principle that supports choosing the types of new equipment the lab would need. Equipment should be selected which would help clients attain functional technological and vocational skills. Third, this poster will present a physical plan for the clinic space and for future acquisition of AAC equipment.

# Using the Panasonic Core Trainer and Virtual Reality Gaming Post-Stroke. Part 2: Changes in Posture and Gait

Department of Health Sciences

College of Science

**Student Researcher:** Jeffrey Swiers

**Faculty Advisor:** Ann Reinthal

## Abstract

Many individuals post CNS injury need rehabilitation due to motor, balance and other deficits. The purpose of this study was to test the feasibility incorporating use of the Panasonic Core Trainer (PCT) as a method of therapy for motor and balance retraining post-injury. METHODS: This pilot case series examined three individuals post stroke and incomplete spinal cord injury. Pre-testing and post-testing included gait analysis to assess changes in full body kinematics and trunk muscle activation. (EMG) Training consisted of 300 minutes split into approximately 30 minute sessions on the PCT while playing dynamic video games (Wii and PlayStation 2 with EyeToy). RESULTS: The results of this study indicated that the use of the PCT in conjunction with gaming resulted in various changes in gait kinematics as well as increased trunk muscle activation. CONCLUSION: The use of the PCT in tandem with virtual reality gaming is feasible and may be an effective method of rehabilitation post CNS injury. Changes in walking were apparent in all three participants in this pilot case series.

# Mechanosensation and the Primary Cilium

Department of Physics

College of Science

**Student Researcher:** Joseph Glaser

**Faculty Advisor:** Andrew Resnick

Abstract

The primary cilium has come under increased scrutiny as a site for mechano- and chemosensation by cells. We have undertaken a program of study using mouse renal cell lines from the cortical collecting duct to quantify how mechanical forces arising from fluid shear are transduced into cellular responses. Fluid flow through a model nephron has been analyzed to determine the in vivo forces. A novel two-sided flow chamber has been calibrated to simulate physiologically relevant renal flow conditions."

# Dielectric Signature Patterns of Human Cytokines Characterized by Dielectric Thermal Analysis (DETA)

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researchers:** Salaam Saleh, Susan Moreno-Molek,

**Faculty Advisors**: Alan Riga, Tobili Sam-Yellowe

Abstract:

Malaria pathogenesis in severe and complicated disease involves immune system dysfunction or dysregulation associated with proinflammatory and anti-inflammatory cytokines. Detection of specific cytokines associated with infection, disease progression and disease prognosis will aid the early diagnosis of malaria infection. Human cytokines can serve as biomarkers for the diagnosis of malaria. In this study, human cytokines and soluble cytokine receptors; IFNγ, TNFα IL-4, sIL-2 receptor α, IL-1 receptor agonist, sTNF-receptor type II were analyzed by dielectric thermal analysis at 37ºC. Measurements were performed at three different cytokine concentrations at a frequency range of 0.1-100,000 Hz. Permittivity and loss factor measurements were used to calculate Tan δ values. Peak frequencies and response times were used to determine dielectric signatures for each cytokine and receptor. Peak frequencies, response times and polarization times were concentration dependent. Increased charge mobility of the proteins corresponded to increase in the concentration of protein analyzed. The peak frequencies and response times appeared different for each cytokine and receptor analyzed. Detection of unique dielectric signals will aid the development of sensitive immunosensors capable of detecting cytokines in various human samples.

# Immobilization of *Plasmodium falciparum* and *P. berghei* Rhop-3 Specific Antibodies on a Gold Electrode Modified with Cysteamine and Colloidal Gold via Electrochemistry.

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researchers:** Salaam Saleh, Susan Moreno-Molek,

**Faculty Advisors:** Tobili Sam-Yellowe, Alan Riga

Abstract:

Dielectric thermal analysis (DETA) was used to characterize the dielectric properties of *Plasmodium* rhoptry proteins. Rhop-3 specific antibodies; FL Rhop-3 and #686 were immobilized onto the surface of a gold electrode modified with cysteamine and colloidal gold as matrices to detect Rhop-3 antigens. Immobilization was performed at room temperature and at 37°C. Self- assembly of colloidal gold onto the self-assembled monolayer film of cysteamine modified gold electrode was performed to increase electrode surface area and facilitate attachment of antibody. Differential pulse voltammetry (DPV) method was used to determine successful interaction between the immobilized antibody and their antigen in solution. Antibody binding was enhanced by incubation at 37°C compared to room temperature incubation suggesting that an immunosensor can be developed to aid the detection of Rhop-3 antigens in malaria patient samples.

# Detection of Threshold Levels of Human Cytokines and Antibodies in Non-immune Human Sera and Immune Sera from Mice Immunized with *Plasmodium yoelii* rhoptry proteins using enzyme-linked immunosorbent assay (ELISA) and western blotting.

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researchers:** Lisa Choban, Amanda Rewak

**Faculty Advisor:** Tobili Sam-Yellowe

## Abstract

In previous studies, $T_{H1}$ and $T_{H2}$ cytokines were detected in antiserum from immunized mice challenged with *P. yoelii*. IL-10 levels were elevated in mice immunized with peptide 05-173 and challenged with *P. yoelii* compared to mice immunized with peptide 05-175. In addition, IgG subisotypes; IgG1, IgG2a, IgG2b, IgG2c and IgG3 were detected in antisera from both immunizations. In the present study mouse antisera, human serum and plasma was screened by ELISA to detect additional cytokines produced by $T_{H1}/T_{H2}/T_{H17}$ cells. In non immune and immune human serum, IL-1A, IL-1B, IL-2, IL-17A and TNFα were detected. One of two immune human sera contained IL-4, IL-10, GM-CSF, IL-8, and IL-12. TGF-β1 and IL-13 were detected in all human serum and plasma samples. In antisera from a mouse immunized with peptide 05-173, IL-1A, IL-4, IL-5, IL-6 and IFNγ were detected. Mouse antisera from 05-175 immunized and challenged mice contained IL-1A, IL-1B and IL-2. The cytokines IL-1A, IL-1B, IL-6, IL-10 and IL-23 were also detected in antiserum from control adjuvant immunized mice suggesting that induction of these cytokines may not be parasite specific. The detection of TGF-β1 in serum from sham-injected mice also suggests TGF-β1 may not be parasite specific. Cytokines associated with the disease and immune status of malaria infection may serve as biomarkers for diagnostic purposes.

# Endogenous Targets of miR 488* microRNA in Prostate Cancer

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researchers:** Andrew Guzowski, Jinani Slaibi, Jagjit Singh,

**Faculty Advisor:** Girish Shukla

Abstract

Micro (mi) RNAs are short ribonucleic acid segments 19 to 24 nucleotides in length. They are non-protein coding RNAs, first discovered in the nematode C. Elegans, and are highly conserved in eukaryotic organisms. The human genome encodes hundreds of miRNAs that target approximately 60% of human genes and are prevalent in many human cell types. MiRNAs post-transcriptionally regulate gene expression by binding to the 3' untranslated region (UTR) of mRNA. This binding typically negatively affects the expression of the target gene. Our lab has shown that a miRNA, hsa-miR-488* down regulates luciferase activity for plasmids containing androgen receptor (AR) 3' UTR segment. Using bioinformatics and rational approaches we have identified 43 more potential target genes of miRNA hsa-miR-488*. In this study, we have generated a library of luciferase reporters expressing 3' UTR segments of potential target genes of hsa-miR-488*. Our data show that hsa-miR-488* can suppress luciferase activity for plasmids containing 3' UTR target sites of many other genes and suggest negative regulation of multiple genes in prostate cancer. Further studies would determine the role of hsa-miR-488* and its potential array of target genes in prostate cancer development and progression.

# Study of Protein Dynamics in Viscous Solvent

Department of Physics

College of Science

**Student Researcher:** Krista G. Freeman

**Faculty Advisor:** Kiril A. Streletzky

**Collaborators:** Alexander Agapov[1,2], Alexei P. Sokolov[1]

[1]Departments of Chemistry and Physics & Astronomy, The University of Tennessee

[2]Department of Polymer Science, The University of Akron

Abstract

The dynamic processes apparent in glycerol:water:lysozyme solutions over a large temperature range were studied with Dielectric Spectroscopy (DS) and Dynamic Light Scattering Spectroscopy (DLS). Analysis of the DS spectra reveals a decoupling of large-scale protein motions from the main structural relaxation of glycerol. Further studies show a decoupling of protein rotation, large-scale protein motions, and protein diffusion (as measured by DLS) from solution viscosity. The decoupling is analogous to that of chain and segmental polymer dynamics with small-scale heterogeneities explained by preferential hydration of the protein in solution.

# Characterizing Polystyrene Chain and Probe Standards Using Coupled Dynamic and Static Light Scattering

Department of Physics

College of Science

**Student Researcher:** Sean P. Sheridan

**Faculty Advisor:** Kiril A. Streletzky

Abstract

In order to test an experimental technique, an experiment with known standards should be executed and checked against literature. The goal of this summer project was to master a unique and powerful combination of two experimental methods: Dynamic and Static Light Scattering (DLS and SLS), used to characterize structure and dynamics of nanoparticles in solutions. The standards used were polystyrene spherical probes for DLS and polystyrene chains for SLS. In DLS measurement of hydrodynamic radius of probes, we found that best data was obtained at higher probe concentration. Additionally, we concluded that in order to successfully distinguish between sizes of two mixed probe standards, concentration of both sizes (especially the small one) had to be relatively large and filter pore size had to allow large probes through. Performing SLS experiment on 50nm- in-diameter probes, we measured radius of gyration to be 28.9nm. We also studied a chain standard of 400kg/mol polystyrene (PS) in THF using SLS. Its dn/dc value was measured to be 0.173mL/g. Performing the full Zimm Analysis on the PS chain standard we found the radius of gyration of 25.5nm, the molecular weight of 432.9kg/mol, and the second virial coefficient of 3.10E-4mol*$m^3$/$kg^2$ all in good agreement with literature.

# Developing Data Analysis Program for Static Light Scattering Experiment

Department of Physics

College of Science

**Student Researcher:** Ravin Vyas

**Faculty Advisor:** Kiril A. Streletzky

## Abstract

Reliable *in-situ* analysis of macromolecular particles, such as polymer chains, micelles, proteins, microgels presents an important challenge to researchers. One of the established methods of studying these particles is Static Light Spectroscopy (SLS), in which a laser light of a given wavelength is brought to a particle upon which any scattered light is picked up by a detector that measures the average intensity of the scattered light at various angles. Of the well-known 'reliable' methods of SLS analysis are the Guinier, Zimm, and Berry approximations which yield radius of gyration, molecular weight, and second virial coefficient for the system of interest.

Over the summer, I worked on creating a program that offered a user friendly interface for researchers that would read in files generated by a SLS setup and perform various SLS analysis on it allowing user to look at the resulting graphs and the numerical output drawn from those graphs.

While the analysis process is somewhat user-intensive, the program I worked on developing seeks to take strain off of the user and organize data in a way where results are easier to show, modify (i.e.: remove bad data points), present, and publish.

# *O*-Cyanate Chain-End Functionalized Glycopolymer for Chemoselective Conjugation to Proteins

Department of Chemistry

College of Science

**Student Researcher:** Valentinas Gruzdys

**Faculty Advisor:** Xue-Long Sun

## Abstract

Covalent attachment of synthetic macromolecules is an effective way to improve protein stability with reduced immunogenicity and extended plasma half-lives. In addition, secondary property can be introduced, such as protein targeted delivery. Glycoengineering aimed adding carbohydrates to proteins to alter their pharmacokinetic properties such as increasing *in vivo* activity and prolonging the duration of action. This has been a promising approach for protein therapeutics. In this presentation, a facile synthesis of protein-glycopolymer conjugate is reported. Briefly, an *O*-cyanate chain end- functionalized glycopolymer presenting multiple copies of lactose epitope units was conjugated to proteins *via* isourea bond formation. Bovine serum albumin (BSA) and lysozyme were employed as amine-containing model proteins, and the resulting protein-glycopolymer conjugates were characterized by SDS-PAGE. Furthermore, glycopolymer was conjugated to amine-functionalized biotin and was later complexed with streptavidin, which was confirmed by streptavidin-HABA assay. The versatility of the synthetic strategy presented in this work was the oriented multivalent carbohydrate modification of protein in a straightforward approach and in aqueous mild conditions.

# The Uptake of Arsenic in Chinese Brake Fern *Pteris Vittata*

Department of Chemistry
Department of Biological, Geological, and Environmental Sciences

College of Science

**Student Researchers:** Jerome D. McGinty, Katie L. Lemmeyer,

Chamari Walliwalagedara

**Faculty Advisors:** Harry van Keulen, Robert Wei

## Abstract

The aim of this study is to determine the uptake of arsenic in *Pteris vittata* (Chinese brake fern) and to identify proteins that are differentially expressed in response to arsenic. The ferns were grown hydroponically and were exposed to 150 µg and 300µg of arsenic (As (V) for seven days. The plants were harvested and were analyzed used for the uptake of arsenic and proteomic studies. Arsenic analysis was performed by Inductive coupled Plasma spectroscopy (ICP) following digestion with $HNO_3$ (USEPA Method 3050B). The ICP data revealed that *P.vittata* is capable of accumulating As (v) higher than that of other plants. The results also indicated that fronds have the higher levels of arsenic accumulation than roots. Proteomic analysis was performed using polyethelene glycol fractionation (PEG) for protein extraction and one-dimensional SDS gel electrophoresis (SDS-PAGE) technique to identify the As stress regulated proteins. The proteins obtained from SDS-PAGE gel were inconclusive. Further studies are needed to examine the effects of wider range of concentrations and different forms of arsenic to better understand the metal uptake and the As stress regulated proteomic changes in *P. vittata*.

The aim of this study is to identify proteins that are differentially expressed in response to arsenate [As(V)] and arsenite [As(III)] in a hydroponic system using

*Pteris vittata*. The ferns were exposed to 150ug and 300ug for one week. We ran two experiments using [As(V)] and [As(III)]. First, we found the concentrations of the metals using ICP, using a method of digestion that extracted the metals. We also used separate plants to test the proteins in the fronds and roots and whether or not they had been stressed during the arsenic uptake, using PEG fractionation. The results from the ICP showed that the fronds had a greater ability to take up arsenic than the roots, and the 1-D gel ran from the PEG fractioned proteins was inconclusive. We then used higher concentrations of 450um and 600um. These are going to be digested in the future.

# Crystallization of the Catalytic Subunit of *M. jannaschii* Aspartate Transcarbamoylase with Ligands

Department of Physics,

College of Science

**Student Researchers:** Charlie Dorflinger, Khadidja Benmerzouga, Jonathan Allen, Nura Orra

**Faculty Advisor:** Jacqueline Vitali

## Abstract

Aspartate transcarbamoylase (ATCase) is the enzyme that catalyzes the second step in pyrimidine biosynthesis, the reaction between carbamoyl phosphate and L-aspartate to form N-carbamoyl-L-aspartate and inorganic phosphate and is a highly regulated enzyme. We crystallized the catalytic subunit of ATCase from the hyperthermophilic and barophilic archaeon *Methanococcus jannaschii* isolated, in complex with the anti-cancer drug N-phosphonacetyl-L-aspartate (PALA) which is an analog of both substrates and in complex with tricarballylic acid which is a product analog. The crystals will be analyzed with x-ray diffraction to better understand the binding of these ligands to the enzyme. The three dimensional structures of these complexes will give insight in the mechanism of catalysis and help design anticancer drugs with less toxicity, more effectiveness, and better function.

# Effects of Free Radical System on Enzyme Activity; Chymotrypsin as Model Enzyme

Department of Chemistry

College of Science

**Student Researchers:** Marley Greiner & Ross VerHeul

**Faculty Advisor:** Robert Wei

Abstract

Reactive oxygen species (ROS) are known to cause structural and functional changes to a wide range of biological molecules. This study focuses on the relationships between oxygen radicals and proteins. However, there is little direct evidence that free radicals have direct effects on proteins. Here we used chymotrypsin (CY) as a model enzyme and xanthine/xanthine oxidase (X/XO) as a system for producing oxygen radicals. We first defined the saturating levels of substrate (xanthine) for the given activity of enzyme to estimate the amount of oxygen radicals produced. Next, we optimized the method for measuring chymotrypsin; there are several published methods, but we developed a variation from these. The method we finally decided on uses p-nitrophenylacetate (NPA) as a surrogate substrate. This system was optimized and was shown to be inhibited by a known inhibitor TPCK. Using this optimized quantitative system, we plan to test the potential effects of the oxygen radicals on the model enzyme, chymotrypsin.

# Using Adult Fish Assemblages to Determine Water Quality in the Lower Cuyahoga River

Department of Biological, Geological, and Environmental Sciences

College of Science

**Student Researcher:** Derrick D. Cooper

**Faculty Advisor:** Julie Wolin

## Abstract

Adult fish assemblages were sampled in the Lower Cuyahoga and Grand Rivers this summer and compared with more than 20 years of historic data to determine if water quality has improved in the Cuyahoga. The Grand River was used as a comparable high quality reference site. I hypothesize that the abundance of pollution intolerant and moderately intolerant species of fish in the Cuyahoga River will increase from the early 1980's as an indication of improved water quality. Adult fish were collected using Ohio Environmental Protection Agency (OEPA) standard electrofishing methods. Historic fish data were obtained from the OEPA to determine if changes in fish species had occurred since the mid-1980s. Fish were categorized based on their OEPA pollution tolerance. Historic data show that moderately intolerant fish have increased in the Cuyahoga River over the last 20 years, most notably in miles 3.5 to 7. Moderately intolerant species composed 16.56% of the spring 2010 sample data. The percent of moderately intolerant fish in the Cuyahoga has increased in recent years, an indication that water quality has improved. However, when compared to the Grand River, pollution intolerant fish were not present in the Lower Cuyahoga and water quality can still be improved.

**Temporal Discrepancy Between Real and Imagined Walking**

Department of Psychology

College of Science

**Student Researcher:** Dagmara E. Mach

**Faculty Advisor:** Naohide Yamamoto

Abstract

The present study explored why people underestimate the time required to walk to a previewed target in imagined walking (IW) tasks. Experiments 1-3 tested whether walking speed is overestimated in IW, as well as whether anticipation error (that leads to underestimation of time required to contact a target) occurs in IW. Participants estimated distance travelled while walking or imagining walking during various time intervals. Overestimation of walking speed in IW should result in longer distance estimates in IW than real walking (RW). Alternatively, the absence of prior knowledge about where to walk would remove the anticipation error, thereby eliciting similar distance estimates from RW and IW. Results showed little difference between RW and IW, suggesting that the anticipation error plays some roles in IW. Experiments 4-6 tested whether faster IW results from visual under-perception of target distance. Participants walked or imagined walking to a previewed target placed at different distance intervals. Results showed that real target-directed walking was accurate but imagined target-directed walking was still faster than RW, showing that IW error does not result from visual under perception of target distance. Collectively, these findings suggest that underestimation of IW time is partially explained by the increased error of anticipation.

**Does External Weight Affect Proprioceptive Percetion of Walked Distance?**

Department of Psychology

College of Science

**Student Researcher:** Dale A. Hirsch

**Faculty Advisor:** Naohide Yamamoto

Abstract

Studies have found support for dichotomous representation of sensory information in both the visual and auditory systems. Sensory input is thought to diverge into two discrete pathways. One pathway is used for spatial/action representation (i.e. location and orientation of objects in space) and the other for perceptual representation (object description and characteristics). We hypothesized that proprioception (the ability to sense the position and orientation of one's own body) also exhibits this representational dichotomy. Our experiments were designed to isolate these discrete modes of representation. The first group was given a blind walking task after which they tossed a bean bag as an estimation of the distance traveled. This task was followed by a verbal estimate of the distance traveled. The second group was also given a blind walking task but in place of the bean bag toss was a tape pulling estimation. The second group also gave a verbal estimation of the traveled distance. The participants wore a back pack while they performed the tasks. We hypothesized that this added weight would affect the distance estimations. The results suggest that external weight decreases action based estimation. However, the change in verbal reports are less conclusive.

# Water Chemistry Study of Lakes in the Tibetan Plateau

Department of Biological, Geological and Environmental Sciences

College of Science

**Student Researchers:** Alexander Swift, Joseph Skidmore,

Jennifer Wiebusch, Chaojun Fan

**Faculty Advisor:** Fasong Yuan

## Abstract

The Tibetan Plateau, an area of over 2.5 million $km^2$ at an average elevation of 4000 m above mean sea level, houses nearly 1100 lakes with surface area of over 1 $km^2$. Here we present water chemical results of 30 water samples collected from 27 lakes in summer 2009. Among these lakes, there are 6 open lakes and 21 closed-basin or terminal lakes. The water chemistry includes the concentration of cations Na, K, Ca, and Mg, and anions Cl, $SO_4$, $CO_3$, and $HCO_3$, showing different major chemical constituents for open/closed lakes. The open lakes contain much higher average salinity (40 g/l) than the open lakes (0.3 g/l). The Na/Na+Ca values are from 0.17 to 0.93 with a mean of 0.63 for the open lakes, and from 0.71 to 1.00 with a mean of 0.96 for the closed-basin lakes. Correlation coefficients between the salinities and the latitudes (r = 0.668), longitudes (r = 0.062), and altitudes (r = -0.691) suggest that more evaporation took place in the northern and lower parts of the Tibetan Plateau, but no evident difference in the west-east transect.

# Identification of Potential Ovarian Cancer Biomarkers by LC-MS/MS

Department of Chemistry

College of Science

**Student Researcher:** Stephen Moreton

**Faculty Advisor:** Aimin Zhou

## Abstract

Ovarian cancer is the most lethal gynecological cancer among women in the United States, mainly due to the late diagnoses of the disease. This late diagnoses results from the lack of a specific ovarian cancer biomarker which can be detected early in the onset of the disease, before metastasizing. To identify possible biomarkers for ovarian cancer, we have analyzed the changing of plasma proteins from athymic mice bearing xerografted human ovarian tumors by LC-MS/MS. Over 100 proteins were found to be up or down regulated during tumor development. Further investigation needs to be conducted to confirm and evaluate these potential candidates. This study provides an assessment of a pipeline for the biomarkers of ovarian cancer and sheds a light on the early detection of this disease.

# Autonomous Cardiac Control in Patients with Epilepsy

Department of Physics

College of Science

**Student Researchers:** Leila Muhieddine and Nura Orra

**Faculty Advisors:** Ulrich Zurcher, PhD, Physics Department and R. O'Dwyer, MD, Epilepsy Center, Department of Neurology, Cleveland Clinic

Abstract

While the heart beats (roughly) once every second, subtle differences have been known since the 18th century when it was observed by *Hales* that heart rates undergo nearly periodic changes during breathing [heart rate accelerates during inspiration and decelerates during expiration]. In normal persons, the heart rate is regulated by the autonomous nervous system. It is now known that the heart rate shows small irregularities: it is generally believed that low heart rate variability [HRV] is associated with disease.

Heart beats are identified by *R*-waves in the standard ECG; times between subsequent *R*-waves are called *RR*-times $T_n$ and are the basis of any investigation of HRV. ECG data of 10 patients from the Epilepsy Unit [Department of Neurology] at the Cleveland Clinic were extracted from a large database, and separated in 2-minutes recording intervals.

We propose a novel method of quantifying HRV that combines ideas based on geometrical and time-domain techniques. It allows us to characterize HRV in the range 0.04-0.15 Hz [3 to 9 cycles/min] that reflects the combined modulation of efferent parasympathetic (vagal) and efferent sympathetic nervous system activity. While this range is accessible by methods in the frequency domain, they require averaging procedures, and thus much longer recording times, making it difficult to interpret power spectra.

Additionally, we calculate the (fractional) heart rates during 1s- time intervals. We calculate the correlation functions of HRV. We show that averaging procedures can be used to find smooth correlation functions that can be used to identify dynamic processes in the range 0.04-0.15 Hz [3 to 9 cycles/min].

# Design and Characterization of Thermally Responsive Nanoparticles: Preparation of Protein-Based Nanoparticles

Department of Chemical & Biomedical Engineering and Department of Physics

College of Science and Fenn College of Engineering

**Student Researcher:** Ciara Seitz

**Faculty Advisors:** Nolan B. Holland, Kiril A. Streletzky

Abstract

Properly designed, elastin-like polypeptides (ELP) produce systems of thermally induced micellar nanoparticles. At room temperature the polypeptides are individually soluble while at higher temperatures assemble into micelles. These have potential for application as biosensors, drug-delivery vehicles, or viscosity modifiers. The basic structure of ELP is a repeat of five peptide sequences found in native elastin. To make systems that assemble into nanoparticles, a trimer forming protein domain (foldon) was added to the ELP using genetic recombination. The polypeptide was then expressed in *E. coli* and purified using thermal cycling. The resulting construct has a three-armed star polymer architecture, held together by the foldon domain. This trimer forms micelles in low salt, high pH, and high temperatures. We have further characterized the effect adding linear ELP has on the micelle formation. This was done with a linear and trimer molecules both containing 40 pentapeptide repeats. In the mixed systems the micelle formation follows the same trend as the in the pure trimer, with robust micelles formed a salt concentrations less than 15 mM. The size of the particles is observed to increase as the ratio of linear to trimer molecules is increased.

**College of Urban Affairs**

# A Web-based Exploratory Mapping Tool for the Rocky River Important Bird Area

College of Urban Affairs

**Student Researchers:** Kacey Cummings, Raymond Flores

**Faculty Advisor:** Sung-Gheel Jang

Abstract

This work presents a web-based exploratory mapping tool that enables citizen and professional scientists alike to explore the five-year survey data of breeding birds collected by the Western Cuyahoga Audubon Society (WCAS) for the Rocky River Import Bird Area (IBA), as well as environmental and demographic information from the Cleveland Metroparks and other public sources. Freely available resources such as Google maps, docs, sites, and Open Source GIS tools play a key role in creating web-based tools effectively and efficiently. In addition to providing an interactive medium for presenting of the survey of breeding birds in the IBA, educating the community on these findings and the status of the data are of utmost importance to this project. Along with bird population data, this project includes developed intensity, forest, trails, streams, primary headwater census, and human population density. It is expected that this work will encourage more college-aged students to engage in the WCAS as well as the Metroparks and become more aware of how the changes of the surrounding landscape (for both the natural and built environments) affect bird habitats, as well as our remaining natural resources.