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UNDERGRADUATE RESEARCH ABSTRACTS

Poster Session - September 5, 2013

10 a.m. – 2 p.m.

Student Center Atrium

Supported by the Office of the Provost

Quadrophobia, analyst recommendations, and financial reporting system

Ahuja College of Business

Student Researchers: Eugene Groff Jr.; Stefan Vladan Blagojevic; Taras Koshylovskyi

Faculty Advisor: Haigang Zhou

Abstract

"Quadrophobia" is a relatively novel term that corresponds to a type of 'fear' or 'misrepresentation' that can manifest itself during the process by which companies report their earnings per share (EPS) values to the public. This study sought to conduct an in-depth examination into the process by which company's reported their respective EPS amounts, in order to determine the degree to which they manipulate the fourth number after the decimal place to bolster their perceived value. Our research focused on analyzing the actual v. reported EPS data (via Worldscope) of various companies being trading on different exchanges throughout the world, and from these sets of data, ascertaining the fundamental causes for quadrophobia and possible solutions to this pervasive problem. Our analysis concludes that a higher degree of quadrophobia was prevalent in developed countries, than in emerging markets.

The African American Experience in Cleveland: Oral History and Digital Exhibition

College of Liberal Arts and Social Sciences

History Department

Student Researchers: Bethany Hollowell, Timothy Klypchak, Katherine Taylor

Faculty Advisor: J. Mark Souther, Ph.D.

Abstract

Our project examines themes in African American history from the 1910s to 1970s through the lens of Cleveland, drawing upon the voices of more than 60 Clevelanders interviewed by our team. After collecting more than 60 hours of digital sound using oral history best practices, we produced minute-by-minute logs to aid researchers, created a selection of short story clips for the *Cleveland Voices* website, and curated new sites for the *Cleveland Historical* mobile app. Among our interviewees are the oldest living eyewitness of the 1920 Matewan Massacre in the coalfields of West Virginia, the first African American licensed pilot, and the first black architecture firm owner in Ohio. Many of our interviewees were participants in the Great Migration or Second Great Migration. Some have firsthand experience of sharecropping in the South in the early 20th century, and their local experience covers Cedar-Central, Glenville, Mt. Pleasant, and the Heights. Topical strengths within this new oral history series—part of the 900+ interview Cleveland Regional Oral History Collection—also include black music, leisure, and recreation venues, black suburbanization, school desegregation, housing discrimination (including hate crimes), fair housing activism, and urban riots.

Female Labor Force Participation and Economic Development in Developing Countries: Case Study of Turkey

College of Liberal Arts and Social Sciences

Economics Department

Student Researcher: Salih Yasun

Faculty Advisor: Aycan Koksal

Abstract

In this research project, we explore the factors that influence women's labor force participation(WLFP) in developing regions through a case study of Turkey. Several researchers claim that WLFP exhibits a U-shape during the process of economic development. U-shaped hypothesis proposed that WLFP decreases in the early stages of industrialization, and increases again once women acquire skills and education needed to find jobs in non-agricultural sectors. Through regression analysis we found that U-shaped pattern exists for Turkey's different regions. This also proved that there are large differences in economic development of regions in Turkey. Our study indicated that lack of investment, and opportunity cost of working for women are hindering both economic development and WLFP. We recommend policy makers to attach women employment incentives to stimulus packages, invest on tourism, bring child care subsidies, and complete the roads for connecting Anatolian regions to domestic and foreign markets. We also found that in Metropolitan regions, there is a labor market matching problem where high school graduate women gradually quit labor force. To solve the matching problem, we recommend policy makers to extend vocational and technical high school programs in Metropolitan regions and attract more females to these programs.

History and Archaeology at Irishtown Bend: Life in a Nineteenth Century Cleveland Irish Community

College of Liberal Arts and Social Sciences

Anthropology Department

Student Researchers: Taliesin Haugh; Geoffrey Horn; Arvin Mathur

Faculty Advisor: Phillip Wanyerka, Ph.D.

Abstract

To most Clevelanders, the west bank of the Flats brings to mind the bustle of busy nightclubs or the rusting facades of Cleveland's now fading steel industry. Few people would generally associate this area with archaeology, let alone remember that during the nineteenth century this area was home to one of Cleveland's earliest and most influential ethnic communities. Known as Irishtown Bend, many Irish immigrants made their way to this close-knit, working class neighborhood of small ramshackle houses crammed closely together along the narrow bluffs of the Cuyahoga River. Most of the arriving Irish immigrants who came to Cleveland beginning in the 1820's and 1830's sought jobs working as laborers either on the construction of the Ohio and Erie Canal or on the city's docks as the shipping industry began to rise. Irishtown Bend thrived throughout the nineteenth century. The types and qualities of artifacts analyzed from Irishtown Bend can be used to offer a wealth of detailed information on the social, economic, and political life of one of Cleveland's earliest ethnic communities. Thus this project has shown how archaeology can be used as a critical tool to help inform and help shape our ideas about Cleveland's urban "melting pot."

Ancestra - Part of the Intersections Project

College of Liberal Arts and Social Sciences

Department of Theatre and Dance

Student Researchers: Hannah Krainz; Katie Huskey; Mary-Francis Miller; Christina Dennis

Faculty Advisor: Holly Holsinger

Abstract

The vision of The Department of Theatre and Dance's Intersection Project was to provide points of intersection between artists and community with experiences that all creative artists share, focusing especially on inter-generational exchanges. One element of the Intersections Project was the collaborative creation of an original performance entitled *Ancestra*. Four student researcher/performers joined twelve Cleveland performance artists, ages 18-73, to create and present the docu-performance, *Ancestra*. Research for this project focused on the transcript of the 1853 National Women's Rights Convention held in Cleveland, OH as well as other primary sources from the Women's Suffrage Movement. The group also examined epigenetic scientific discoveries, which hypothesize that humans are genetically linked to the experiences of ancestors as well as their physical traits. These two lines of research provided the basis for a rich conversation between past and present which was integrated into the performance. Women in the project also researched their personal histories and wrote poetry, prose, and dialogue based on themes, memories, and experiences. These writings, together with the research discoveries were montaged into the final script which was rehearsed and performed in a "work in progress" showing at CSU on August 2nd, followed by a discussion about the work and process.

Investigating Gendered Health, Reproduction, and Biosociality Among Senegalese Men: a Methodological Comparison

College of Liberal Arts and Social Sciences

Department of Anthropology

Student Researcher: Richard T. Powis III

Faculty Advisor: Barbara G. Hoffman, Ph.D.

Abstract

The study of health, identity, and agency within the field of Medical Anthropology has a solid history stretching back at least half a century to Goffman's 1963 work on stigma (Whyte 2009). Reproductive anthropology claims to investigate the behavior, conceptualizations, and values of particular *communities* with respect to sex and reproduction, but in fact, the focus has been almost exclusively on the *women* of these communities. This pilot study focused instead on the male residents of Dakar, Senegal, which occupies an intersection of French, Wolof, and Islamic cultures with their distinct ontologies, epistemologies, and moral philosophies. This project tested methods for investigating how Senegalese men conceptualize reproductive health and decision-making in correlation with socioeconomic status, caste status, religious beliefs, marital status, and education. Two classic anthropological research methods were utilized: participant-observation and semi-structured interviews. This poster offers visual comparison of the results of the application of these two methods on questions of the ideological contextualization of the body, the role of and attitudes toward reproductive technologies, types of treatment-seeking behavior, and attitudes about children, parenting, and childbirth.

Conquerors from the East:
An Engaged Learning Experience in Historical Geography

College of Liberal Arts and Social Sciences

History Department

Student Researcher: Adena Muskin

Faculty Advisor: Stephen Cory

Abstract

Our goal was to develop an application that would enable students to use the Map Walk to "walk" through the history of the Mongol conquests and Mongol empires during the thirteenth and fourteenth centuries. As students follow the development of the Mongol empires, they will be able to access additional background information on thirty sites that were critical to the establishment and growth of these empires.

In order to achieve this goal, Adena read several books on the history of the Mongols and selected thirty sites from Central Asia, Eastern Europe and the Middle East to include in the History blog. She conducted background research on all thirty of these sites and wrote short entries of three or four paragraphs for each site, providing historical and contemporary information on the site as well as stories from the Mongol era. She posted these blogs along with pictures of the sites and then created and placed QR codes on the maps corresponding to each site. On the day of the Map Walk, students will be able to use their smart phones to access the blogs and follow the development of the Mongol empires.

To see the blogs, visit the following link: **http://mapwalk.clevelandhistory.org/**

Sound and The Moving Image:
Critical Characteristics for Spectator Response

College of Liberal Arts and Social Sciences

School of Communication

Student Researchers: Kara Rader; Rafeeq Roberts; Matt Egizii; Jeffery Allen; Alex Farmer; Jordan Tobin; Dave Goerz; Kelly McCafferty; Jonathan Herzberger

Faculty Advisor: Kimberly Neuendorf, Ph.D.

Abstract

The prevailing wisdom in the film and video production industries is that audio information outweighs visual information when it comes to spectator responses, but there are few empirical studies to support this claim. In previous research, four critical characteristics of sound have been identified: (1) Music, (2) visual/sound contradictions (defined as sound that is inconsistent with audience expectations based on visual information), (3) multi-channel sound, and (4) sound quality. Building on our previous research into music and film, we have found that many researchers have looked into the question of how music affects emotions (Eschrich et al., 2008; Have, 2008; Konecni, 2008; etc.), but few have investigated how music affects spectators' perception of a film. Research into the effects of the other characteristics is almost non-existent and does not include any empirical studies. We propose four experiments to investigate the four different characteristics and how they affect spectators (e.g., their presence responses, affective measures, enjoyment). We have produced a short film, "Chase Her," that will be manipulated in various ways (including adding music representative of different genres and recording realistic sounds and "contradictory" sounds in our new Foley studio) to test the four characteristics' effects on audiences.

Nondiegetic YouTube Advertising: An Eye-Tracking Investigation

College of Liberal Arts and Social Sciences

School of Communication

Student Researchers: Alex Farmer; Jeffery Allen; Matt Egizii

Faculty Advisors: Paul Skalski Ph.D.; Kimberly Neuendorf, Ph.D.

Abstract

YouTube is an online media site with over one billion hours of user-generated content, and a monthly worldwide viewership averaging over six billion hours. This volume motivates advertisers to reach out to this enormous audience. Advertisers wish to capture the attention of an audience, avoid causing annoyance, and minimize intrusiveness. In this study, a YouTube video tutorial has been used to create five conditions testing reactions to nondiegetic advertising. Participants will be shown one of five versions of the tutorial. Each version includes either no advertisements, or one of the following: A TrueView video advertisement that is not skipped, a TrueView video advertisement that is skipped, a banner advertisement that is not cancelled, or a banner advertisement that is cancelled. Both type and level of intrusiveness of the ad have been manipulated. During viewing, eye-tracking analyses will monitor fixations in specified look zones, and elsewhere onscreen, testing ad attraction and distraction. After viewing, participants will complete a questionnaire designed to elicit their reactions to the advertisement, and ascertain the effect that the advertisement may have had upon their memory/recall, whether or not the level of intrusiveness decreased their enjoyment of the tutorial video, and other advertising and video outcomes.

Audio-Visual Translation in International Film: Mediating Factors in Audience Responses

College of Liberal Arts and Social Sciences

School of Communication

Student Researcher: Kara Rader

Faculty Advisor: Kimberly Neuendorf, Ph.D.

Abstract

An exhaustive review of the literature about audio-visual translation finds that a number of studies have looked at problems facing translators, including translating spoken word to written word and translating cultural references. We tested differences in audience responses to two versions (subtitled and dubbed) of the same film. The dependent variables investigated were enjoyment, presence, and comprehension. Two groups of participants were shown the first thirty minutes of the film *Life is Beautiful*; one group was shown the subtitled version and the other was shown the dubbed version. Based on previous research (e.g., Wissmath et al., 2009), the results are predicted to show no difference in comprehension between subtitled and dubbed versions, but it is predicted that the participants' presence, and thus their enjoyment, will be lower while watching the dubbed version of the film. Results show that there are no significant relationships between the version of the film and the audience's presence, enjoyment, or comprehension. However, mediating variables such as intercultural exposure and gender were shown to have significant influence. A future study will use eye tracking technology to look at differences in visual attention paid to details within the film during the subtitled film and the dubbed film.

Exploring New Chemotherapeutic Strategies Against Brain Cancer

College of Science and Health Professions

Departments of Chemistry and Biology

Student Researcher: Seol Kim

Faculty Advisor: Anthony J. Berdis, Ph.D.

Abstract

Approximately 4,000 children in the United States are diagnosed each year with a brain tumor. Brain cancers are the deadliest of all pediatric cancers as they have survival rates of less than 20%. Typical treatments include surgery and radiation therapy. However, chemotherapy is the primary therapeutic option for children, especially against aggressive brain tumors. An important chemotherapeutic agent is temozolomide, an alkylating agent that causes cell death by damaging DNA. In this project, we tested the ability of non-natural nucleosides developed in our lab in order to increase the ability of temozolomide to kill brain cancer cells. Our results show that combining low doses of our nucleoside with temozolomide kills more cells compared to treatment with either compound individually. The increase in efficacy is specific for temozolomide as similar effects are not observed in cells treated with other chemotherapeutic agents such as cisplatin, 5-fluorouracil, and taxol. High-field microscopy techniques demonstrate that the combination of our nucleoside and temozolomide causes cell death via apoptosis as opposed to necrosis. A model is provided describing how our novel nucleoside analog increases the cell-killing effects of temozolomide by inhibiting the misreplication of damaged DNA created by this agent. Collectively, these studies provide pharmacological evidence for a new treatment strategy to more effectively treat patients with brain cancers.

Novel methods to study genes with multiple functions

College of Science and Health Professions

Department of Biology, Geology, Environmental Science

Student Researcher: Brendan Skrtic

Faculty Advisor: Aaron Severson, Ph.D.

Abstract

To establish a method for conditional disruption of protein function in *Caenorhabditis elegans*, we are implementing system in which a degron tag is added to a protein of interest. Under certain conditions the tagged protein is recognized by a ubiquitin ligase that catalyzes polyubiquitination of the tag and degradation of the protein. Degron tags are commonly used in yeast and cultured cells. However, the standard degrons cannot be used in *C. elegans* because the restrictive conditions are lethal to worms. Recently, an Auxin Inducible Degron (AID) has been shown to rapidly reduce protein levels in budding yeast, fission yeast, and cells derived from mice, hamsters, chickens, and humans. AID works by tagging the target protein with a polypeptide from plants. In the presence of the hormone auxin, the polypeptide tag is bound by the plant protein TIR1. TIR1 in turn recruits several of the cell's own components of the ubiquitin ligase complex, resulting in polyubiquitination and degradation of the tagged protein. Importantly, proteins tagged with the AID degron function normally until exposed to auxin, and degradation of AID-tagged proteins occurs in conditions compatible with growth of *C. elegans* strains.

Conceptualization and design of a surface translation balance training device

College of Sciences and Health Professions

Student Researchers: Annie Djukic; Omri Tayyara

Faculty Advisors: Debbie Espy, PT, Ph.D.; Majid Rashidi, Ph.D.

Abstract

Research supports the idea that dynamic control of both a person's center of mass and base of support are necessary to prevent falls, and that older adults can learn this combined control through specific balance training. Effective balance training requires a large number of repetitions of task-specific practice. Externally induced movements have been employed in balance studies both to test and train balance responses, most often using mechanized surface perturbations. These systems however are quite expensive; therefore, we chose to investigate a more cost effective solution focusing on surface translation for balance training in our lab.

We performed a literature review of balance testing or training studies which had successfully used a translating surface paradigm. The motion parameters and subject characteristics were compiled (Table 1) to arrive at a decision about the parameters to be designed into our device. The device was designed to meet the space and subject use needs, compiled motion parameters, and engineering and safety requirements. A scotch yoke mechanism was chosen as well as a DC Motor and an appropriate gearbox, which were designed to translate, via a steel arm, a plywood and square tubing platform.

Anti-chaperone activity and cytotoxicity of chemical components in Copaiba oil

College of Sciences and Health Professions

Student Researchers: Daniel Kulman; Janine Naim

Faculty Advisor: Bin Su, Ph.D.

Abstract

Copaiba oil derived from the oleoresin of the Copaiba tree has been widely used as an antiseptic and expectorant for the respiratory tract, and as anti-inflammatory agent in various skin diseases. Studies have indicated that Copaiba oil exhibited anti-carcinogenic properties in various preclinical studies. However, the anti-cancer mechanisms of copaiba oil still remain unclear. There are various diterpenoid compounds within Copaiba oil, which also make the mechanism investigation very difficult. Hardwickiic acid (HAA), a clerodane diterpenoid isolated from Copaiba oil shows anti-chaperone activity from a recent study. In the current study, cytotoxicity and anti-chaperone assay guided isolation led to 9 fractions from Copaiba oil. Three of the fractions showed cytotoxicity in prostate cancer cells. And other three fractions exhibited potent anti-chaperone activity. There are multiple chemical components in the fractions that showed cytotoxicity, which has been confirmed with mass spectrum. The three fractions showed anti-chaperone activity were further purified for structure elucidation. NMR combined with MS reveal that the three fractions are Copaibic acid, Hardwickiic acid and 7-Acetyl-copaibic acid. All three compounds can be used as lead compounds for the development of more potent small molecule chaperone inhibitors.

Exercise Tutor: A System for In-home Therapeutic Exercise Guidance

College of Sciences and Health Professions

Student Researchers: Philip Simon, Brandon Sommers

Faculty Advisors: Ann Reinthal, Nigamanth Sridhar

Abstract

The Exercise Tutor (ET) is a system that uses a Kinect camera motion sensor in conjunction with a number of wearable inertial sensors to monitor home exercise performance. Its purpose is to decrease healthcare costs while concurrently improving clinical outcomes. A clinician programs this system with the particular exercise(s) that a client is to perform, along with several critical parameters for its correct and safe completion. The client then takes the system home and exercises using the ET, which keeps track of the regularity and quantity as well as quality of exercise performance for the clinician. The system also provides real-time feedback to the client while performing the exercise to ensure correct and safe execution. This summer we completed initial ET feasibility testing and planned the next phase of pilot clinical studies.

Initial feasibility testing included task analysis for prototype exercises (identifying joints of interest, velocities, critical angles, etc.), identifying relevant parameters for front end programming, determining error tolerance levels for the exercises, and identifying home usability features (screen size, control features, and avatar characteristics). Finally, two initial clinical trials were planned to assess the ET's effectiveness as a feedback modality during exercise as well as its in-home usability.

Combining orthogonal tRNA/synthatase pair and amber codon suppression to genetically encode oxidative damage in high density lipoproteins

College of Sciences and Health Professions

Department of Chemistry

Student Researchers: Jaclyn Alatrash; Nicholas Gilliam; Alisha House

Faculty Advisor: Valentin Gogonea

Abstract

Apolipoprotein A-I (apoA-I) is the main protein constituent of high density lipoprotein (HDL - the "good cholesterol"). Oxidatively damaged apoA-I has been isolated from circulating plasma and atherosclerosis plaque with the amino acid residue tryptophan 72 (W_{72}) of apoA-I identified as a primary oxidation site. ApoA-I designed to include specific oxidized amino acids can be used to further investigate the role of site-specific oxidative damage in atherosclerosis. Genetic encoding of oxidized amino acids through orthogonal tRNA/aminoacyl-tRNA synthetase (aaRS) pairs offers a reliable method for producing site-specific oxidized proteins. Our project involves the generation of *Saccharomyces* tryptophan-RS mutants for recognition of oxidized tryptophan (ox-W) but not naturally occurring tryptophan. To study the role of oxidative damage on HDL function we need oxidized proteins that mimic the oxidatively damaged protein observed *in vivo*. Thus, our goal was to produce site-specific oxidized apoA-I (ox-W_{72}) for incorporation into reconstituted nascent HDL. The two aims we hope to achieve within this project are 1) to provide targeted mutations that increase the specificity and affinity of aaRS towards 2-hydroxy-W-apoA-I, as well as 2) express and confirm the presence of ox-W_{72} in modified apoA-I.

Motor system markers of depression severity

College of Sciences and Health Professions

Department of Psychology

Student Researchers: Mary Jacobson; Hailee Houston

Faculty Advisor: Andrew Slifkin, Ph.D.

Abstract

Physiological health has been linked to increased complexity in the output of physiological systems. For example, as the severity of cardiac disease increases, EKG time series show reduced complexity. The present study investigated the relation between mental health and complexity in motor output. In particular, we tested the hypothesis that depression severity—as measured by the Symptom Checklist-90-R (SCL-90-R)—should be negatively correlated with motor output complexity. Measurements of motor output were obtained when participants generated long sequences of movements in a cyclical aiming task. The resultant movement amplitude time series were submitted to spectral analysis, from which an index of motor output complexity was derived. According to the results, low levels of depression severity were associated with power spectra tending toward *white noise* (high complexity) and high levels of depression severity were associated with power spectra tending towards *pink noise* (low complexity). The results appear to support the hypothesis that depression severity and motor output complexity are negatively correlated.

Validating TbRAP1-Interacting Candidates

College of Sciences and Health Professions

Department of Biological, Geological, and Environmental Sciences

Student Researchers: Fan Wu; Adaobi Davidson

Faculty Advisor: Bibo Li, Ph.D.

Abstract

Telomeres are specialized protein-DNA complexes located at the ends of eukaryotic chromosomes. They act as caps on the ends of chromosomes to preserve DNA from degradation and rearrangements and are therefore essential for genome stability. *Trypanosoma brucei*, a protozoan parasite that causes sleeping sickness in humans and nagana in cattle, evades the host immune responses by regularly switching its surface antigen, Variant Surface Glycoproteins (VSG). VSGs are expressed exclusively from regions adjacent to telomeres. Hence, understanding the VSG regulation by the telomere complex would help in developing means to eliminate this parasite. Our recent studies indicate that TbRAP1 is a protein associated with the telomere complex and is important for VSG silencing and VSG switching. In order to better understand the underlying mechanisms of TbRAP1-mediated VSG regulation, we attempted to identify proteins that interact with TbRAP1. By using TbRAP1 as bait, we identified a number of TbRAP1-interacting candidates in a yeast-2-hybrid screen. We have now subcloned these candidates into yeast expression vectors and tested their interactions with TbRAP1 directly by the liquid yeast 2-hybrid assay using Ortho-Nitrophenyl-β-galactoside (ONPG) as the substrate of the reporter gene product β-galactosidase.

A quantitative evaluation of growth in *Leptodea fragilis* before and after the arrival of zebra mussels in Lake Erie

College of Sciences and Health Professions

Department of Biological, Geological, and Environmental Sciences

Student Researcher: Elizabeth Barkett

Faculty Advisors: Bob Krebs, Ph.D.; Matthew T. Begley

Abstract

The arrival of zebra mussels in the Great Lakes in the 1980's marked several environmental changes, most notably in freshwater mussels in the Unionidae. There are no studies of population demographics of native Great Lake species before this period of time. In this study, several recent shell collections of *Leptodea fragilis,* a fast-growing freshwater mussel, were made on various beaches along Lake Erie. To compare the effects of the zebra mussels on *L. fragilis*, we compared growth rates, determined from size and estimated age of shells, to additional collections of *L. fragilis* from 1941 to 1967available at the Cleveland Museum of Natural History. The growth rates of this species are exceptional for their speed among freshwater mussels. A modern comparison of growth rates and age are presented with a sexually dimorphic unionid river species, *Lampsilis siliquoidea*, that were collected in Summer 2013. We hypothesized that the arrival of zebra mussels could affect the growth rate of *L. fragilis* by selecting on age of reproduction or growth to reach a minimum size for reproduction, results that could shift growth curves and/or age demography of current populations, and help them persist where zebra mussels remain abundant.

Examination of the Environmental Health of an Impacted Watershed using Freshwater Mussels as an Indicator Organism

College of Sciences and Health Professions

Department of Biological, Geological, and Environmental Sciences

Student Researcher: Paul Orefice

Faculty Advisors: Bob Krebs, Ph.D.; Matthew T. Begley

Abstract

Environmental health of Northeast Ohio watersheds have been at the forefront of local conservation efforts since June 22, 1969, when the Cuyahoga River caught fire due to surface pollution. Numerous studies reflected the declining aquatic diversity, and one of the hardest hit groups appeared to be Ohio's freshwater mussels. Mussels are a diverse group of aquatic invertebrates that not only are an important part of an aquatic ecosystem, but they are excellent indicators of good water quality. Additionally, mussels rely on clean water for reproduction, as larvae can be more sensitive than adults. Mussel species also vary in their tolerance to pollution, suggesting that community composition can be informative of stream condition. This experiment seeks to use the differences in pollution tolerance between two freshwater mussel species; *Lampsilis siliquoidea* and *Strophitus undulatus*, to examine success of regional efforts to restore the impaired Eagle Creek area. Eagle Creek not only provides habitat for numerous species, but also flows into water bodies that provide drinking water for local communities. Both species were collected from multiple sites along the Eagle Creek tributary, crossing areas of varied land use. Analysis of these data should indicate whether or not current conservation efforts are seemingly effective, or if stronger measures need to be enacted to repair the environmental health. Although the number of specimens found indicate positive change, the decline in diversity in the middle portions of the watershed indicate some cause for concern.

Light Scattering and Spectrophotometry Studies of Polymeric Microgels as a Prototype for Temperature-Sensitive Drug-Releasing Carriers

College of Sciences and Health Professions

Student Researchers: Janna Mino; Justin Flaherty; Pratheek Koneru

Faculty Advisors: Kiril A. Streletzky, Ph.D., Department of Physics; Mekki Bayachou, Ph.D., Department of Chemistry

Abstract

FDA approved Hydroxypropylcellulose (HPC) polymer can be cross-linked to form microgel nanoparticles that undergo a temperature dependent volume phase transition. We studied the structure and dynamics of HPC microgels and HPC polymer that microgels were made from using Dynamic (DLS) and Static Light Scattering (SLS) and Spectrophotometry. Our results determined the transition behavior of the microgels and polymer as temperatures were varied from T_{room} to well above the critical transition temperature T_C~41°C. The 200-250nm HPC microgels showed a reversible factor of 4-8 volume shrinkage as temperature was brought above T_C. This shrinkage is caused by HPC chains becoming more hydrophobic at the T_C and aggregating together to diminish water contact. The transition in polymer was found to be sharper than in microgels. Also, above 50°C, the microgel particles seemingly aggregate with each other, forming larger clusters. In addition to apparent size from DLS, SLS yielded the molecular weight (M_W) and shape factor of the microgels. The M_W decreased steadily from 20°C to 40°C possibly due to microgels losing water, and then increased at 45°C, and again at 50°C, possibly due to loose polymer chains fusing into microgel particles. The shape factor ratio ranged from 0.4 to 0.7, consistent with a soft sphere. The light scattering study of microgels was complemented by Atomic Force Microscopy.

Atomic Force Microscopic and electrochemical study of polymeric microgels as a prototype for temperature-sensitive drug-releasing carriers

College of Sciences and Health Professions

Student Researchers: Janna Mino; Justin Flaherty; Pratheek Koneru

Faculty Advisors: Kiril A. Streletzky, Ph.D., Department of Physics; Mekki Bayachou, Ph.D., Department of Chemistry

Abstract

Crosslinked hydroxypropylcellulose (HPC) form unique microgel particles that display reversible temperature-driven volume change with a critical temperature (Tc) right around values of human fever (~39°C). Heating these microgel particles above Tc results in volume contraction upon internal hydrophobic collapse and expulsion of water. HPC is FDA-approved and thus represents a perfect candidate for a drug-releasing carrier in response to systemic temperature change.

This summer undergraduate subproject is one part of a cross-disciplinary project between labs of Dr. Bayachou (Chemistry) and Dr. Streletzky (Physics). The overall project uses a combination of light scattering (Streletzky Lab), and atomic force microscopy (AFM) and electrochemistry (Bayachou lab) to study temperature-driven shape changes and uptake/release of therapeutic agents by HPC microgels.

In this part of the project, we will present results of investigations by AFM imaging of various HPC microgel particles both in air and in liquid suspensions. Volume contraction of HPC particles as triggered by temperature increases on the AFM stage provides us with the opportunity to monitor particle size changes as a function of temperature. Detailed analysis of shapes and cross-section of features observed by AFM (Bayachou Lab) will be compared and contrasted with independent measurements by dynamic light scattering studies (Streletzky Lab).

CASE TRANSITION FORMAT DOES NOT AFFECT LEXICAL DECISION PERFORMANCE

College of Sciences and Health Professions

Student Researchers: Risa F. Orlosky; Kathryn G. Van Gunten; Megan Cerbin

Faculty Advisor: Albert F. Smith

Abstract

Reading MIXed caSE ITEms is harder than reading UPPERCASE or lowercase items, but whether the type of case transition in mixed-case items affects performance is unknown. We investigated whether the type of case transition (e.g. PLAnt vs. plaNT) impacts lexical decision performance—deciding whether a letter string is a word. Abstract letter identification models propose that due to perceptual learning, we should process uppercase-to-lowercase items better than lowercase-to-uppercase ones. Eleven students participated in a lexical decision experiment consisting of twelve 32-trial blocks. In six blocks, the type of case change was constant (all uppercase-to-lowercase or all lowercase-to-uppercase); in the other six blocks, type of case change varied over trials. Within each block, item length was constant, and word frequency varied. On each trial, a letter string was presented on a computer screen, and the participant was to respond whether the string was a word or a nonword by pressing buttons as quickly as possible. In overall analyses (of correct responses to words and nonwords), there were significant effects of lexicality and item length, but no significant effect of format. In correct responses to words, there was a significant effect of word frequency, but no significant effect of format.

Climate change from oxygen isotopic variation of pore water from sediments in Punderson Lake, Northeast Ohio

College of Sciences and Health Professions

Student Researcher: Rachel Daley

Faculty Advisor: Fasong Yuan, Ph.D.

Abstract

The environment in Ohio has changed over time. The hydroclimate, which is the climate of the water, shows changes from the Industrial Revolution to the present. Evidence for these changes can be found in levels of $\delta^{18}O$ and $\delta^{2}H$ isotopes in the layers of sediment and water in the lakes of Northeast Ohio. Mass spectrometry can be used to test the levels of $\delta^{18}O$ and $\delta^{2}H$ isotopes from pore water samples within sediment cores. In this study, surface soil and water samples were collected from cores in Punderson Lake at Punderson State Park in Newbury, Ohio. Pore water was extracted from the sediment core every centimeter. Next the oxygen isotope composition ($\delta^{18}O$) and the levels of $\delta^{2}H$ of the pore water in the sediment layers were measured using a Picarro Cavity Ringdown Spectrometer. A record of the $\delta^{18}O$ and $\delta^{2}H$ of Punderson Lake was then recorded to determine the climate variability over a period of approximately 350 years. Changes in the $\delta^{18}O$ and $\delta^{2}H$ of lake water can be used to see changes in precipitation and water balance. Determining past climate and hydroclimate changes can help us predict future changes in the climate of Northeast Ohio.

Comparison of arsenic uptake and oxidative stress by Christmas fern and Spider brake fern

College of Sciences and Health Professions

Chemistry Department

Student Researchers: Paul Ilkanich; Pratheek Koneru

Faculty Advisor: Robert Wei, Ph.D.

Abstract

Plants are widely considered the most cost effective and environmentally friendly way to clean soils and waters contaminated with toxic metals, e.g. arsenic and mercury. We have focused our research on the uptake of arsenic and its biochemical effect on two species of fern, *Spider brake fern* and *Christmas fern*. Spider brake fern is known to be capable of accumulating significant amounts of arsenic. We wish to determine whether the levels of arsenic uptake in *Christmas fern* are comparable to *Spider Brake fern* (>1g kg^{-1} plant biomass) when both are grown under the same conditions. Another aim of the research was to see whether these plants respond differently to the arsenic stress. For that purpose, we used a technique referred to as one and two-dimensional gel electrophoresis. In addition, we plan to test whether the stress, if present, is due to the presence of oxidant (oxygen radicals) by measuring the activity of an antioxidant enzyme (superoxide dismutase).

Function of a novel checkpoint protein in the germ line

College of Sciences and Health Professions

Department of Biological, Geological & Environmental Sciences

Student Researchers: Steven Drellishak; Marina Bykova

Faculty Advisor: G. Valentin Börner, Ph.D.

Abstract

Successful reproduction of *Saccharomyces cerevisiae* relies on the organism's ability to complete the meiotic cell cycle and produce viable gametes. Zip1 is a protein that constitutes the central component of a protein structure that connects homologous chromosomes known as the synaptonemal complex. Zip1 is important for progression through the meiotic cell cycle. The C terminus of the coiled-coil Zip 1 protein is responsible for localization to the axes of the chromosomes. An internal deletion near the C terminus of Zip1, called zip1-c1, yields a stronger meiotic arrest than a mutation where Zip1 is completely deleted. The more efficient meiotic progression in a Zip1 deletion mutation versus the zip1-c1 mutant suggests that zip1-c1 prevents an alternative pathway of meiotic progression. A genomic screen of the Nasmyth genomic library revealed candidate plasmids N5 and N89 containing yeast genes which, when overexpressed, increase spore viability and bypass meiotic arrest in the zip1-c1 mutant. This has implications that the genes on the overexpression plasmids serve some function in correcting mistakes in meiosis when Zip1 is mutated.

Analysis of turning behavior in the African Clawed Frog

College of Sciences and Health Professions

Department of Biological, Geological & Environmental Sciences

Student Researchers: Rachel Andrikanich; William Hein

Faculty Advisor: Jeffrey Dean

Abstract

African Clawed Toads turn toward waves created by prey. We studied turning of four frogs. We concentrated on body movement, leg action and hip, knee and ankle movements, classified respectively as pushing/pulling or extension/flexion/return. As expected, we observed symmetrical patterns for left and right stimuli. Very rostral stimuli (+- 30 °) generally elicited a forward movement as the legs extended and pushed; hips extended while knee and ankle movement varied according to turn angle. More lateral and caudal stimuli commonly elicited an initial backward movement of the rear of the body as one or both legs pulled, reflecting hip flexion. Knee and ankle movement again varied by turn angle and together with the pulling initiated body rotation. Turning usually continued with a sweeping push by the contralateral leg, involving hip and knee extension and knee flexion. Overall leg movement patterns are similar when compared amongst frogs though the strength of joint flexion and extension vary. Variation in joint movement may be influenced by the overall size of the frog.

Role of programmed proteolysis during meiosis

College of Sciences and Health Professions

Department of Biological, Geological & Environmental Sciences

Student Researcher: Vincent Matthews

Faculty Advisor: G. Valentin Börner, Ph.D.

Abstract

Meiosis is the process which forms gametes and spores for reproduction in eukaryotic cells. During the pachytene phase of meiosis I, a protein structure, called the Synaptonemal Complex (SC), forms between homologous chromosomes and creates a scaffold for genetic recombination. In yeast, the Zip1 protein is a major structural component of the SC. At restrictive temperature for meiosis, ZIP1 is required for completion of meiotic divisions. At permissive temperature ZIP1 is required for proper chromosome segregation. We observed that chemical inhibition of the proteasome, with MG132, results in arrest at prophase of meiosis I. Based on these results, we questioned whether there is a regulatory relationship between the SC and the proteasome. Our findings demonstrate the localization of the proteasome along the SC, consistent with proteolysis of SC proteins by the proteasome. Furthermore, lack of double-strand breaks, lack of SC and lack of recombination proteins, result in failed proteasome recruitment to chromosomes during meiosis I. This implies that the proteasome plays not only a role in proper meiotic division, but also double-strand break repair and chromosomal recombination. Fluorescent microscopy techniques were applied to determine the chromosomal localization of the proteasome. Epitope tagged recombination proteins (ZIP1, ZIP3 and MSH4) were utilized along with tagged proteasome components to determine the pattern of proteasome localization to meiotic chromosomes. This is significant as a clearer, fundamental understanding of the proteasome's role in meiosis may serve to illuminate the causation of many birth-defects, miscarriages and stillbirths.

Examining the Levels of Microcystin and Nutrient Inputs and Their Effects on Lake Quality in Cuyahoga County, Ohio.

College of Sciences and Health Professions

Department of Biological, Geological & Environmental Sciences

Student Researcher: Tom Bienvenu

Faculty Advisor: Julie Wolin, Ph.D.

Abstract

The purpose of this project is to acquire baseline understanding of the urban lakes in Cuyahoga County, Ohio. The researchers used canoes, a Van Dorn water sampler, 63µm Wisconsin net, and a modified Livingstone corer in the lakes to collect water, plankton, and sediment samples from the lakes that were visited. The Northeast Regional Ohio Sewer District (NEORSD) will analyze the water samples for quantitative and qualitative levels of microcystin. The remaining samples including diatoms in the sediment and the plankton in the water will be analyzed by the researchers in the labs at Cleveland State University. The data collected can be combined with the National Lake Assessment (NLA) to better understand and utilize the natural services provided by lakes in urban ecosystems. The project is in the data collection stages and has not yielded any results yet, although it is hypothesized that the lakes with less artificial inputs and a larger buffer area should have lower risk of harmful algae and higher levels of water quality.

The Influence of Land-Cover/Land-Use on the Quality of Inland Lakes Located in Cuyahoga County, Ohio

College of Sciences and Health Professions

Department of Biological, Geological & Environmental Sciences

Student Researcher: Justin Ostry

Faculty Advisor: Julie Wolin, Ph.D.

Abstract

The purpose of this research was to determine the extent of the effects of land-use/land cover on water quality, ecological integrity, and hydrology present within surrounding water bodies. The methods used to determine land-use/land cover types include physical habitat assessment of the riparian zone and banks, human influence characterizations, and satellite imagery and historical map analysis. The expected results to this investigation are that overall lake quality partially depends on the size and condition of the land-use/land cover types surrounding the water body. Highly vegetated buffer zones are expected to produce favorable water quality conditions. Non-vegetated buffer zones consisting of impervious, barren, and grass surfaces are expected to serve as poor buffer zones and contribute to high amounts of nutrient input and erosion. These formulated results can be compared with similar studies conducted by the National Lake Assessment to aid planners in maintenance and restoration of urban water bodies.

Space perception across the lifespan

College of Sciences and Health Professions

Department of Psychology

Student Researchers: Kimberly Moran; Derek Menzies; Anita Isom

Faculty Advisor: Naohide Yamamoto, Ph.D.

Abstract

Summary: It has recently been shown that older observers (in their 70's) judge distance to a nearby target (up to 12 m away) very accurately, while younger observers (in their 20's) significantly underestimate the same distance. Although this finding has important scientific and practical implications, more research is needed to confirm whether the observed age difference truly reflects improved accuracy in distance judgment. Importantly, it is possible that there is tendency to increasingly overestimate the distance as observers grow older, and the seemingly accurate performance exhibited by the older observers is a mere consequence of canceling the intrinsic underestimation of distance with the age-related overestimation. The present study is being conducted to address this issue by investigating whether distance judgment stays accurate in even older ages (i.e., 80's). If distance judgment is indeed improved in older age, these observers should continue to show accurate performance in the distance judgment task. Additionally, we aim to test middle-aged observers on the same task to uncover the time course of the change in distance perception through adulthood. This will provide an important clue for understanding what underlies the possible age-related improvement of distance perception.

Functional Morphology of Rat Hands and Feet: Correlation with the Ability to Grip Tree Branches During Locomotion

College of Sciences and Health Professions

School of Health Sciences

Student Researcher: Jessica E. Fonce

Faculty Advisor: Andrew R. Lammers

Abstract

Anatomy and function are usually closely related. Since locomotion on tree branches is common among mammals, we expect to find that the anatomy of the hands and feet is well-suited toward gripping narrow, cylindrical, branch-like substrates. We hypothesize that the ability of rats to grip arboreal supports relies on musculature responsible for adducting the first digit (thumb and big toe) and opposing medial-most and lateral-most digits. We dissected the hands and feet of four rat cadavers. There is a substantial muscle that may be responsible for the flexion/adduction of the thumb in the hands. We also found lumbricals, and dorsal and palmar interossei. These muscles are responsible for flexing metacarpophalangeal joints as necessary for gripping, or for adducting digits. Foot anatomy looked very similar to that of the hands. Based on the anatomy alone, rats are built for locomotion across cylindrical branches as well as terrestrial substrates. We trained four live rats to walk on cylindrical trackways, 2 cm and 1 cm in diameter. We videotaped these rats as they walked on the branch-like supports so that we could determine how they use their hands and feet to grip. We are still in the process of processing the data collected.

An American Sign Language Translation System Based on Kinect

Fenn College of Engineering

Student Researchers: Vitaliy Sinyuk; Sam Yokoyama; Kelsey Bujdos

Faculty Advisor: Wenbing Zhao

Abstract

In this project, students have attempted to implement a computer-vision based translation system for American Sign Language (ASL). A set of ASL signs, including "Hello", "How are you", "Good", "Thank you", "Yes", "What", "Blue", "Noise", and "Tall", were recorded via a computer program using the Kinect sensor. The Hidden Markov Model (HMM) was used as the machine learning classifier to recognize ASL signs. The HMM classifier was implemented in C# and trained using the recorded data. Unfortunately, the experimental results were disappointing. The accuracy of ASL sign recognition is not acceptable. We conclude that alternative template-based method might be more suitable for the ASL sign recognition. Nevertheless, the project provided a good learning experience for students, and the recorded ASL signs will be valuable for future research.

Comparing Two Driving Simulation Practice Scenarios for Steering and Speed Control

Fenn College of Engineering

Department of Civil and Environmental Engineering

Student Researcher: Nancy Seck

Faculty Advisor: Jacqueline Jenkins Ph.D., PEng.

Abstract

A driving simulation experiment was conducted to test the effectiveness and relative efficiencies of two practice scenarios. In Scenario 1, participants followed the posted speed limits, which ranged from 30 to 65 mph, and made 50 lane changes. In Scenario 2, participants drove at 50 mph, increased their speed as they were comfortable to do so, and made 20 lane changes. Each scenario used pylons to indicate the desired travel lanes and lane changes. The lateral position at the pylons and the travel times between pylons were used to define functions for cost and cumulative cost per lane change. These functions were tested for whether they fit a power curve, indicating whether the participants learned, were still learning, or were not learning to interact with the simulator. Both scenarios were shown to be effective in providing participants practice. Scenario 1 was shown to be more efficient, as indicated by lower variances after 10 lane changes and an increase in the range of observed travel speeds. Therefore, directing participants to travel given speeds improves their learning to interact with the driving simulator.

Design Optimization of an Above-Knee Prosthesis with Energy Regeneration

Fenn College of Engineering

Department of Electrical and Computer Engineering

Student Researchers: Taylor Barto; Holly Warner; Rick Rarick

Faculty Advisor: Dan Simon

Abstract

Above-knee amputees who use a prosthetic leg typically have to compensate for its shortcomings with unnatural hip motions. This compensation eventually leads to adverse health issues such as arthritis. We propose an active prosthesis to improve performance. The motor in our prosthetic knee allows the patient to move his hip normally, thus reducing the possibility of ancillary health issues. To improve the efficiency of the prosthesis, we use the braking phase of the prosthesis to regenerate energy. By storing energy in a supercapacitor during braking, the prosthesis lasts longer between each charge than it would without regenerative braking. We are considering two knee motor designs—a gear drive and a ball screw drive. Both designs appear to have the potential for regeneration. Several parameters characterize the prosthesis design. We use biogeography-based optimization (BBO) to determine these parameters. We are currently optimizing the prosthesis design to achieve accurate tracking of the knee angle. Future optimization criteria will include efficient energy use and generation.

Protecting Security and Privacy of Smartphones/Tablets

Fenn College of Engineering

Electrical and Computer Engineering Department

Student Researchers: Nick Ruffing; Lulu Terrill

Faculty Advisor: Ye Zhu

Abstract

As the smartphone/tablet industry continues to grow, so does the concern of possible malicious attacks and privacy. Statistics show that there are over 1.08 billion smartphone/tablet users in the world today and 91.4 million of them are in USA. Currently Android devices have the largest market shares. Other major competitors are Apple's iPhone/iPad, Windows phones/tablets, and Blackberry smartphones. In this project, we plan to identify the possible security and privacy attacks to the smartphones/tablets. The obvious benefit of this study is to raise awareness among smartphone/tablet users of the potential threats that they are exposed by accessing web applications especially through apps installed in their platforms. We will further develop general defensive mechanisms and countermeasures to specific attacks in this project.

Adaptation of Scenedesmus dimorphus to Brackish Water

Fenn College of Engineering

Department of Chemical and Biomedical Engineering

Student Researcher: Dustin Bowden

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

Abstract

Microalgae is a promising biofuel feedstock for replacement of conventional transportation fuels. Microalgae does not require arable land for cultivation, and the biofuel production rate per acre of land is an order of magnitude greater than that needed for crop-based production methods. Though microalgae to biofuel processes are attractive, none have proven commercially successful due to the high costs of algae dewatering. Moreover, the scarcity of fresh water in many parts of the world prevents development of this process because of competition with drinking water supplies. Our lab has developed an efficient dewatering method using an inclined gravity settler. It is possible to adapt the freshwater *Scenedesmus dimorphus* to brackish water, without significantly changing growth rate nor lipid content. In this research, we investigate whether this saltwater-adapted algae species can be dewatered using the gravity settling method.

The settling velocity was measured by a settling column using absorbance at 600 nm to measure cell concentration. Our preliminary results yielded settling velocities of 0.76 cm/h, which is similar to earlier measurements of 0.87 cm/h for freshwater *S. dimorphus*. Based on these settling velocity measurements, we have found that saltwater acclimation will have minimal effect on the separation efficiency of S. dimorphus.

Using Ultrasonic Pulse Velocity (UPV) to Predict Properties and Performance of Pervious Concrete

Fenn College of Engineering

Civil and Environmental Engineering Department

Student Researcher: Jeremy Adato

Faculty Advisor: Norbert Delatte, P.E., Ph.D., F.ACI, F.ASCE

Abstract

Pervious concrete is a type of porous portland cement concrete with interconnected voids. This material has been increasingly used to reduce the amount of stormwater runoff from paved areas. It has also been shown to improve the water quality near low volume and low speed pavements as well as in parking lots. Due to the low compressive strength of pervious concrete associated with the high void content, it currently is not used in highway structures except perhaps as an overlay for conventional concrete pavement. The large, open pore structure of this material allows water to pass through its structure, thereby helping to reduce the deleterious effects of storm-water runoff. Since pervious concrete is a relatively new type of material, standard methods for testing its performance characteristics are currently being developed. For this purpose, a total of 42 pervious concrete cylinders removed from different field installations in the United States were collected and studied. Density, void ratio, hydraulic conductivity (falling head method) of pervious specimens was evaluated. UPV tests were conducted on all specimens and the results were compared to develop the use of UPV to estimate the properties and performance of pervious concrete.

Catalytic Gasification as a Waste Management and In-Situ Resource Utilization (ISRU) Alternative

Fenn College of Engineering

Department of Chemical and Biochemical Engineering

Student Researchers: Stephen A. Reeves; Shreya Adhikari; Joshua Cmar

Faculty Advisor: Jorge E. Gatica, Ph.D.

Abstract

The efficient use of material sent into space is a concern for all missions. Catalytic reactions can be used to convert polymer (plastic) waste into combustion products. These gases can be compressed or vented to vacuum which reduces or eliminates storage space needs for the trash. In addition, secondary reactions can further convert products to methane which can be used as a fuel source, and hydrogen which is a common rocket propellant.

Using a Gas Chromatography machine, the composition of affluent gas following experimental catalytic reactions can be measured. This composition allows the calculation of how much waste was gasified. Repeat experimental reactions under different conditions provide data for the dependency on temperature and reaction length. This study aims to find the most suitable reaction parameters for efficient gasification when the process is scaled up. It also aims to modify the reaction from a batch process to a continuous process.

Live Cell Imaging on Titanium Surfaces: Comparison of Image Processing Technique

Fenn College of Engineering

Department of Chemical and Biochemical Engineering

Student Researcher: Teisha Mullins

Faculty Advisors: Surendra N. Tewari; Joanne M. Belovich

Abstract

Titanium is a viable material for prosthetic implants due to its biocompatible surface which facilitates cell adhesion. In this study, titanium discs are used as a substrate for mesenchymal stem cells which have been genetically altered with Green Fluorescent Protein (GFP). Due to the reflective properties of the titanium discs, standard light microscopy could not be used for cell growth analysis. Thus, a fluorescent microscope and camera were used to record periodic images of live cell growth.

Trial images were analyzed for a variety of properties including cell proliferation, growth, migration, area, and perimeter. Images were analyzed by using ImageJ, an image processing and analysis program created by the National Institute of Health. The cells in the images were either automatically analyzed using built-in functions or they were traced manually and then analyzed. This study focuses on the comparison of these two methods in regards to measuring the area and perimeter of the cells.

Controlling the Size and Shape of Polypeptide Colloidal Particles: Temperature Dependence of Particle Formation

Fenn College of Engineering

Department of Chemical and Biochemical Engineering
Department of Physics

Student Researcher: John P. Gavin

Faculty Advisors: Nolan B. Holland, Ph.D.; Kiril A. Streletzky, Ph.D.

Abstract

A promising approach for developing new drug delivery vehicles is by using stimuli responsive hydrogel nanoparticles. Polypeptide surfactants designed in our lab have been shown to form micellar particles of varying sizes and shapes depending on the solution salt concentration. These responsive polypeptide surfactants consist of a small charged protein domain (foldon) with three elastin-like polypeptide (ELP) chains forming a three-armed star polymer. The size and shape of the micelles they form is dependent on the ratio of total ELP volume to head group area. By introducing linear ELP into the ELP-foldon solution, the total volume of ELP in the aggregate would be increased if the linear ELP is incorporated in the micelle. This method could control the particle size and shape. To determine if the linear and three-armed ELPs co-assemble, we have observed aggregation as a function of temperature using turbidity measurements in a UV-vis spectrometer. We have found that higher concentrations of linear ELP increases the difference in transition temperature between the linear and three-armed ELP. At these higher ratios, the linear ELP aggregates prior to micelle formation. When the ELP-foldon subsequently passes through its critical micelle temperature, they break down the linear ELP aggregates resulting in smaller colloidal emulsions. Light scattering will be used to characterize the size and shape of these aggregates.

Controlling the Size and Shape of Polypeptide Colloidal Particles: Characterization by Light Scattering "

Fenn College of Engineering

Department of Chemical and Biochemical Engineering
Department of Physics
Mechanical Engineering Department

Student Researchers: Hannah E. Shuman; Grace Gaeckle

Faculty Advisors: Nolan B. Holland, Ph.D.; Kiril A. Streletzky, Ph.D.

Abstract

Temperature-dependent polymer surfactants have been developed by connecting three elastin-like polypeptide (ELP) chains to a charged protein domain (foldon), forming a three-armed star polymer. At low temperatures, the polymer is soluble, while at higher temperatures, the ELP phase separates into a hydrophilic head group and hydrophobic tails, forming micelles. These particles have potential applications in drug delivery, as they are both small and biocompatible. The behavior of mixtures of the three-armed star ELP (E20-Foldon) and H-40 linear ELP chains was analyzed under different salt and protein concentrations, as well as with various foldon to linear ratio combinations using Dynamic Light Scattering (DLS) and Depolarized Dynamic Light Scattering (DDLS). Pure E20-Foldon solutions with the same protein and salt concentrations were also analyzed and compared to their respective mixtures. It was expected that under certain conditions, the pure E20-Foldon would form spherical micelles, and that by adding the linear ELP, those micelles would increase in size and the conditions under which they formed would change. It was determined that the pure E20 did indeed form largely spherical micelles with an apparent size of about 10nm in solutions with salt concentration between 15mM and 100mM and protein concentration between 10μM and 100μM. It was also determined that low salt (up to 25mM) mixtures of E20-Foldon and H-40 linear ELPs yielded large colloidal particles with an apparent radius of 200-500nm and properties of non-spherical particles above the transition.