



***PENN STATE BEHREND - SIGMA XI  
2001  
TENTH ANNUAL  
UNDERGRADUATE STUDENT RESEARCH  
AND  
CREATIVE ACCOMPLISHMENT CONFERENCE  
  
ABSTRACT BOOK***

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## **TOXICITY OF COPPER AND ZINC IN COMBINATION ON CRAYFISH**

Amanda J. Adamski (Mark Pyron and Thomas Spudich), Penn State Behrend, School of Science  
– Biology and Chemistry

Assessment of aquatic systems that are unbalanced by high levels of metal contaminants is one way to monitor environmental quality. Work has been done focusing on one contaminant affecting the lifespan of crayfish, but there have not been any published reports on combination effects of any metals in solution. The 50 percent lethal concentration (LC<sub>50</sub>) of both copper (~5 mg/L) and zinc (~65 mg/L) were found prior to the experiment (Mirenda and S.M. Naqvi et al.). The goal of this toxicological study is to determine the lethal concentrations of copper and zinc combined that will eliminate half of the population of Louisiana crayfish. Crayfish were acquired (Kyle LeBlanc Crayfish Farms, Raceland, Louisiana), acclimated and treated with soluble forms of copper and zinc. Treatments included: high levels of zinc (~65 mg Zn/ L) combined with low levels of copper (~1 mg Cu/L); medium levels of both copper and zinc (~25 mg Zn/L and ~2.5 mg Cu/L); and low levels of zinc (~10 mg Zn/L) and high levels of copper (~5 mg Zn/L). After treatment, the crayfish were frozen and then oven dried for digestion of tissues. Atomic absorption was used to determine the lethal concentrations of copper and zinc found in tissues of the deceased crayfish. The results were interpreted by ANOVA and other statistical analysis.

## **MITOCHONDRIAL DNA SEQUENCE POLYMORPHISMS BETWEEN TWO MIGRATORY AMERICAN WOODCOCK (*Scolopax minor*) POPULATIONS**

Alyson R. Baker (Fred Brenner and Durwood Ray), Grove City College – Biology

Conservation geneticists welcome new mitochondrial DNA (mtDNA) sequence data in their effort to identify unique subpopulations within a single animal species. They question whether animal populations that are separated geographically could be unique genetically as well. Our current study addresses this question concerning American woodcock populations of North America. First, mtDNA was extracted from the feathers of migratory American woodcock native to Pennsylvania and Maine. Second, primers were designed from published American woodcock sequences, and portions of the 12s Ribosomal RNA (rRNA) and Cytochrome b (Cyt. b) genes were amplified using Polymerase Chain Reaction (PCR) technology. Current project efforts seek to isolate the hyperpolymorphic D-loop region of the mitochondrial genome, which is believed to lie between the 12s rRNA and Cyt. b genes. Determination of the complete nucleotide sequence will allow for D-loop sequence comparisons between birds of the Atlantic and Central flyways.

## **SWIMMING ENDURANCE AND MORPHOLOGY OF NORTH AMERICAN MINNOWS (CYPRINIDAE)**

Eric J. Billman (Mark Pyron), Penn State Behrend, School of Science – Biology

We compared swimming performance of minnows in a laboratory chamber to test if performance is a reflection of the habitat in which they are normally found, or if swimming performance is a product of their evolutionary history (more closely-related taxa have more similar performance functions). We measured the ability of individual minnows to maintain position in a flow-through laboratory swimming chamber, following a two-week acclimation period. We examined effects of morphology on swimming performance by including body shape variables that were reduced with principal components. Our regression analyses included control for phylogenetic relatedness through the use of independent contrasts.

## **LENGTH POLYMORPHISM IN THE PROMOTER REGION OF THE HUMAN MITOCHONDRIAL SINGLE-STRANDED DNA-BINDING PROTEIN IN BREAST CANCER**

Timothy R. Blosser, Rachel A. Richards, and Danielle Lovett (Durwood Ray), Grove City College - Biology

Mitochondrial single stranded DNA binding protein (mtSSBP) is a nuclear gene involved in the replication of mitochondrial DNA (mtDNA). The mtSSBP holds the displacement loop (D-loop) open to protect the displaced strand from nuclease attack and to suppress the non-specific initiation by DNA primase. Research in our lab has shown previously that mtDNA copy number is elevated in metastatic breast cancer. The aim of this study is to ascertain if this protein may be altered in cancer cells. Primer set HSSBPF/HSSBPR used in PCR was expected to amplify the known published 766 base pair sequence of the promoter region of this gene. Unexpectedly, we observed two PCR products with this primer pair, one ~790 bp long and one ~855 bp long. This paper describes our efforts to sequence both forms and determine the structural difference between them.

Two primers, HSSBPF/HSSBPR, were designed to amplify a portion of the promoter region. By agarose gel electrophoresis two bands were observed. These PCR products were inserted into PCR phagmid, transfected into *E. coli* and cloned. Plasmids from ten clones were isolated and amplified by PCR with T3/T7 primers. Agarose gel electrophoresis revealed large and small size plasmid inserts. DNA sequencing of these cloned PCR products is under way.

## **THE EFFECTS OF SELECTION FOR *Brassica rapa* RESISTANCE TO *Leptosphaeria maculans* AND *Albugo Candida* ON PEROXIDASE AND CHITINASE ACTIVITY**

Maryann A. Borsick (Catharina Coenen), Allegheny College – Biology

Disease resistance is often a function of several mechanisms that operate together, each contributing to the overall defense of the plant. Pleiotropy, when a single gene affects a range of phenotypic characteristics in an organism, may cause ecological trade-offs if defense mechanisms affect different species in different ways causing trade-offs among resistance to certain pathogens. This research project examines the pleiotropic fitness costs of artificially selecting for resistance to one pathogen on resistance levels within a population to a different pathogen. *Brassica rapa*, a rapid-cycling, agriculturally important plant species, was chosen as a model system to work with two common fungal pathogens, *Leptosphaeria maculans* and *Albugo candida*. Seeds were inoculated with one pathogen and resistant plants were chosen to propagate a second generation. Seedlings from both the *L. maculans* and *A. candida* resistant plants were tested for differences in their response and susceptibility to each pathogen, as well as for activity of two defense-related enzymes, chitinase and peroxidase. Plant chitinases may play a role in resistance by degrading chitin components in cell walls of fungal pathogens. Increases in peroxidase activity are hypothesized to occur in certain tissues in which resistance has been induced.

## **CHARACTERIZATION OF A PUTATIVE FRAGILE X MENTAL RETARDATION RELATED PROTEIN HOMOLOG IN ZEBRAFISH**

Leanne M. Donovan and Richard L. Gill Jr. (James Warren Jr.), Penn State Behrend, School of Science – Biology

Fragile X syndrome is a leading cause of mental retardation in humans. It is an X-linked disorder that affects one out of 4,000 males and one out of 6,000 females. The syndrome results from the absence of expression of the fragile X mental retardation gene 1 (FMR1), which codes for an RNA binding protein (FMRP) (Khandjian 1999). A fragile X related protein gene has been cloned in zebrafish from a cDNA library (zf FXR1). The sequence is 2,781 base pairs long with an open reading frame of 677 amino acids. Through the use of mRNA *in situ* hybridization, the expression pattern of zf FXR1 gene has been analyzed in the zebrafish embryo at different stages of development. At early stages in development (16hpf and 24hpf), expression of zf FXR1 is strong in the somitic tissue of the posterior embryo. At later stages in development (48hpf and 72hpf), cell-specific staining in the brain was observed. The next step in the research is to map the fragile X gene to determine its physical location in the zebrafish genome.

## **PHENOTYPIC CHARACTERIZATION OF *Drosophila* NEURAL DEVELOPMENT GENES**

Star Dunham (Lauren Yaich), University of Pittsburgh at Bradford, Division of Natural Sciences – Biology

A cascade of genetic interactions controls *Drosophila* neurogenesis. A pivotal gene in this process is named *cut*. Flies that are mutant for *cut* have external sensory organs that are transformed into another type of sensory organ, called chordotonal organs. Conversely, when *cut* is overexpressed, chordotonal organs are transformed into external sensory organs. A genetic screen was carried out to identify genes that interact with *cut*. Several genes were identified, including some that had previously been cloned, such as *Delta* and *enabled*, and others that are relatively uncharacterized. Several of these novel genes have begun to be analyzed by immunohistochemical staining with neural-specific antibodies. These results, as well as a potential new function for *cut* in terms of head development, will be described.

## **GENETIC DIVERSITY IN BLACK CHERRY, *Prunus serotina*, USING MICROSATELLITE DNA MARKERS**

Sarah J. Fry (Michael Campbell), Penn State Behrend, School of Science – Biology

Black cherry, *Prunus serotina*, is a major forest commodity in portions of Pennsylvania, but little is known of its genetic diversity. In this study, we utilized microsatellite markers to assess the genetic diversity of *P. serotina*. Primers derived from peach, sweet cherry, and sour cherry were used to amplify microsatellite markers in DNA from two populations of black cherry trees located in Pennsylvania and Ohio. Amplification products were observed using polyacrylamide gel electrophoresis. The successful amplification of the DNA showed that microsatellite markers can be used for population genetic studies on black cherry trees in Pennsylvania and Ohio, and genetic variation is abundant within and between the populations from these two regions. Gene frequency analysis was used to quantify the variation within and between the two populations. Knowing genetic variation exists between the progeny beneath an individual black cherry tree and the individual, further research to create a genetic profile of a single black cherry tree can be conducted. Following this, crossbreeding distances can be measured and genetic diversity examined.

## **SYNTHESIS AND COMPARISON OF NONDORMANT, DORMANT, AND RAPIDLY DIVIDING POTATO TISSUE CDNA LIBRARIES**

Jeff Gustin (Michael Campbell), Penn State Behrend, School of Science – Biology

Dormancy in perennial plants is a developmental process that is not well understood. In order to investigate changes in gene expression, three different gene libraries were constructed associated with different phases of dormancy: rapid cell division, dormant, and non-dormant meristems. Libraries were synthesized from mRNA that was isolated using a guanidine thiocyanate procedure followed by purification over oligo dt cellulose columns. Primary libraries were produced from an excess of  $1 \times 10^5$  mRNA molecules, and amplified to titers greater than  $1 \times 10^8$  pfu/ml. The cDNA inserts were amplified using polymerase chain reaction, and then sequenced using fluorescent dye terminators. Sequenced clones were compared using BLAST-n algorithms to GenBank accessions to find the closest analogous protein to the cDNA sequence. Analogous proteins were grouped into six categories; transcription factors, wound inducible, structural, metabolic, miscellaneous, and unknown proteins. The analysis of the categories showed differences between the three gene libraries. For example, a high number of structural proteins were found in the rapidly diving cells as compared to the other libraries. More defined differences in the three phases of dormancy will continue to be found through further sequencing and comparison.

## **DETERMINING GENETIC DIVERSITY IN BLACK CHERRY, *Prunus serotina*, USING ISOENZYMATIC ANALYSIS**

Erin M. Hersman (Larry Eckroat), Penn State Behrend, School of Science – Biology

Black cherry, *Prunus serotina*, a major forest commodity in portions of Pennsylvania, is utilized in the finished wood and furniture industry. As Pennsylvania becomes more developed and the forests become fragmented, isolation of black cherry stands will occur. However, little is known of black cherry's genetic diversity and the results of forest fragmentation are unknown.

The phenotypic differences of black cherry determine its commercial value. Black cherry displays different timber quality phenotypes depending on its geographic location. Random amplified polymorphic DNA markers (RAPDs) were previously used to gather information concerning the genetic variations of black cherry in several different locations (Grimm, 1996). This study was successful, but the results were not conclusive, mainly because RAPDs do not identify heterozygotes. A more recent study examined isoenzymes allowing heterozygous genotypes to be identified at various loci (Roberts, 1998). Robert's study indicated some genetic variability; however, the desired outcome was not fully achieved. After conducting a literature search, it was determined that a different set of isoenzymes: leucine aminopeptidase, malate dehydrogenase, phosphogluconate, and phosphoglucomutase isomerase could be more successful in the identification of heterozygous genotypes. The study was conducted using this new set of isoenzymes. The data were then analyzed using Genetic Data Analysis to determine that the genotypes of trees vary with geographic location.

## **ISOLATION AND CHARACTERIZATION OF BRANCHED-CHAIN AMINO ACID AMINOTRANSFERASE GENES IN THE HABANERO CHILI PEPPER**

Gabriel Josset (Michael Campbell), Penn State Behrend, School of Science – Biology

Amino acids are central to plant metabolism. In the habanero chili pepper, capsaicin is the compound responsible for its pungency. Capsaicin is synthesized through a branch of BCAT metabolic pathway. Using complementation of deficient *E. coli* cells, we have managed to isolate several positive clones. However, these did not produce valid sequence data. We hypothesized that the original phage library sent to us by Mary O'Connor from New Mexico State University containing habanero placental DNA either did not include long enough genes or that the quality of the library degraded with time. Further searching through the phage library might produce true positive clones rather than revertants. However, it is also possible that the placental tissue does not contain many copies of the BCAT gene we were looking for. In this case, the solution would be to make a new phage library from a different part of the plant.

## **PURIFICATION OF A GST FUSION PROTEIN FOR USE IN VERIFYING INTERACTION BETWEEN THE FbxA AND FbiA PROTEINS OF *Dictyostelium discoideum***

Sarah E. Petricca, Stacey C. Miller, and Maryann A. Borsick (Margaret Nelson), Allegheny College – Biology

The FbiA protein of *Dictyostelium discoideum* was identified via yeast two-hybrid analysis in a search for proteins capable of interacting with the WD-40 repeat region of the F-box/WD-40 repeat-containing protein FbxA. In order to independently verify this interaction, we wished to carry out a GST “pulldown” assay using a GST-FbiA fusion protein. We have subcloned a portion of the FbiA coding region into the pGEX-6P-1 vector to create an IPTG-inducible, in-frame fusion with GST. The resulting plasmid was sequenced to verify the fusion junction and transformed into the protease-deficient bacterial strain BL21. Production of the GST fusion protein was monitored via Western Blot analysis with an anti-GST antibody. We found that optimal expression was obtained when cells were grown at 37°C to an OD<sub>600</sub> of 1.5 in LB-Amp medium supplemented with 2 percent glucose prior to induction for 60 minutes with 100 μM IPTG. The fusion protein fractionates with the insoluble fraction, presumably due to incorporation in inclusion bodies. Treatment of the inclusion body pellet with up to 2 percent Tween-20, 0.03 percent SDS, or 10 mM DTT did not result in release of the protein from the insoluble fraction. However, incubation with 6M or 8M urea does solubilize the fusion protein.

## **INDUCTION OF FRAMESHIFT AND TRANSITION MUTATIONS BY DAUNOMYCIN, ADRIAMYCIN AND EPIRUBICIN IN *Salmonella typhimurium***

Lisa A. Phelps, Natalya Teygart, and Kelly Jesse (William Mackay), Edinboro University of Pennsylvania, Department of Biology and Health Services - Premedicine

Anthracyclines are used in the treatment for a variety of cancers. Clinical use of these compounds has been limited due to cardiotoxicity and acute myelosuppression. Recently, synthetic analogs have been developed in an attempt to decrease these harmful cytotoxic effects and improve drug efficacy. The naturally occurring anthracyclines daunomycin and adriamycin are known to interact in a variety of ways with the DNA helix and can induce frameshift and base-substitution events. The objective of this research project is to study anthracycline-induced base-substitution transition mutagenesis in the bacterium *Salmonella typhimurium*. The *Salmonella* Mutagenicity Test has been the standard for evaluating the potential of environmental substances to induce genetic damage. This assay converts histidine auxotrophs to a prototrophic phenotype via a mutational event. Specific strains of the *Salmonella typhimurium* bacterium have been routinely used since the mid-1960s to detect mutagenic compounds. In this study, we show that anthracyclines can induce frameshift and base-substitution transition events. Specifically, frameshift mutations (TA98) were induced by daunomycin (44.6 fold), adriamycin (15.4 fold), and epirubicin (28.4 fold). Furthermore, daunomycin (7.6 fold), adriamycin (5.8 fold) and epirubicin (12.1 fold) induced GC to AT transition events. Interestingly, even though daunomycin (7.3 fold) and epirubicin (3.0 fold) induced AT to GC base substitutions, adriamycin did not induce the event. A Tri-Beta Research Scholarship to the senior author provided partial funding for this research.

## **MITOCHONDRIAL DNA POLYMERASE GAMMA, IMPLICATIONS IN MTDNA COPY NUMBER, DAMAGE, AND DISEASE**

John M. Ryan and Brian Parkin (Durwood Ray), Grove City College – Biology

DNA polymerase gamma is thought to be the sole polymerase involved in replication of mitochondrial DNA. This crucial cellular task has implications in a variety of diseases. Here we report a possible mutation/deletion in the nuclear encoded gene of DNA polymerase gamma. Problems with the genetic elements of DNA polymerase gamma could lead to problems with the proper functioning and expression of the enzyme and therefore proper functioning and copy number of the mitochondrial genome. Ultimately, this can result in a malfunctioning cellular ox/phos system and many disease states. To examine the genetic elements of DNA polymerase gamma, DNA oligonucleotide primers were designed to amplify a gene locus of interest within the polymerase gamma gene. This locus, approximately 300 base pairs long, was amplified using the polymerase chain reaction (PCR). Several identical PCR reactions were run with human DNA extracted from breast cancer, lymph tumor, placental tissue, and normal tissue sources serving as the templates for the reactions. Each of these PCR reactions resulted in two DNA products. DNA sequencing efforts to examine the sequence differences and similarities between the two fragments are in progress. Here we suggest possible explanations for this result.

## **NUTRIENT RESORPTION IN PERENNIAL BEAVER WETLAND PLANT SPECIES IN NORTHWESTERN PENNSYLVANIA**

Tara Staskowski (Catherina Coenen, and Milt Ostrofsky), Allegheny College – Biology

While the efficiency of nutrient resorption in perennial woody plant species has been studied extensively, there have been very few studies on the nutrient resorption efficiency of wetland plant species. In this investigation, the nutrient levels (N, P, Ca, Mg, Na, and K) in the leaves of wetland plant species were measured throughout the autumn until leaf senescence in thirty to see if there is a correlation between nutrient availability and resorption efficiency. The hypothesis tested was that as nutrient availability increases, it is energetically inefficient for the plant to resorb nutrients to the same extent as in a less nutrient-rich environment. The percent of the nutrients resorbed by wetland plants was then compared to published resorption efficiencies in perennial woody plant species.

## **ANALYSIS OF THE MAJOR ODORANTS FOUND IN THE PEEL OIL OF *Citrus clementine* HORT**

Jason A. Jell (Mary Chisholm), Penn State Behrend, School of Science – Chemistry

*Citrus clementine* Hort. has become increasingly popular in Europe due to its lack of seeds and its intensely sweet flavor. In recent years, this popular variety of mandarin fruit has been imported to the United States from Spain. The aroma composition of the clementine has been analyzed using standard dilution gas chromatography-olfactometry, and identifications of the major odor active components of the peel oil were made through the use of gas chromatography-mass spectrometry. The peel oil is composed of about 93 percent limonene and its odor profile includes the major odorants linalool, perilla aldehyde, decanal,  $\alpha$ -sinesal, and  $\beta$ -sinesal. The clementine juice odor profile contains flavor components in much lower concentration and contains some non-citrus odors such as metallic, sweaty, and waxy. Flavor components in the juice include myrcene, decanal, and R-(-)-carvone. The major odorants linalool, decanal,  $\alpha$ - and  $\beta$ -sinesal were found in both the peel oil and the juice.

## **TAURINE UPTAKE IN CELLS: INVESTIGATIONS INTO RADIOPROTECTION**

LeeAnn Sarnowski and Jon Vanderweele (Melissa Barranger-Mathys), Mercyhurst College and (Julian Mesina), Lake Erie College of Osteopathic Medicine – Chemistry and Biochemistry

Taurine (2-aminoethanesulfonic acid) is the most abundant free “amino acid” in animal tissues. Taurine plays a role in bile acids and acts as a neurotransmitter, among other physiological duties. However, its role as a radioprotective agent has evolved slowly despite years of research. It is theorized that cells will take up taurine possibly to cytotoxic levels. Until cells reach the toxic level, the compound exhibits a radioprotective effect. In addition, cancerous cells acquire taurine at a higher rate, thus reaching a toxic level faster than healthy cells. This being the case, healthy cells treated with taurine prior to radiation treatment would be protected, while cancer cells, also receiving taurine, would reach toxic levels and become more susceptible to the radiation. Cancerous prostate cells and healthy skin cells are used as model systems to investigate taurine uptake. Determinations of taurine uptake in cancer cells were performed using a cation-exchange resin and high-performance liquid chromatography in combination with fluorescence spectroscopy. Also, it was necessary to form a taurine-o-phthalaldehyde-2-mercaptoethanol adduct as taurine has no intrinsic fluorescence. Comparisons on a nanomolar scale were made between two types of cancerous cells and normal skin cells, quantifying the taurine levels in the cells and in surrounding media.

## **PREDICTING MERGERS USING MACROECONOMIC VARIABLES**

Ryan Ferguson (John Fizel), Penn State Behrend, School of Business – Business Economics

Mergers in the United States have been a key battleground between government policy makers and corporate businesses. The purpose of this research is to determine a method of predicting merger behavior on a basis of macroeconomic conditions. By identifying certain conditions that exist in the economy before mergers occur, policy makers would be able to identify a time frame when antitrust policy may need to be implemented. The same data may be used by businesses to avoid costly lawsuits and regulation brought on by attempting a merger. The research is empirical in form, utilizing econometric and statistical analysis to identify key variables in the rate of mergers in the U.S. economy. The results identified several statistically significant variables used to explain merger behavior.

## **DOES AMBIENT TEMPERATURE AFFECT THE WEALTH OF AN ECONOMY?**

Susan Klinger (John Fizel), Penn State Behrend, School of Business – Business Economics

The purpose of this research was to investigate relationships between climate and economic prosperity. The intent is to create new climatic economic indicators. Regression analysis examined the explanatory power of the variance in average temperature, average rainfall, average births, net school attendance, and total exports on GNP per capita using cross sectional data. A sample of forty countries was used to capture the effects of various locations around the world excluding countries of large size and extreme temperatures. The results of this study showed a significant correlation between GNP and temperature, average rainfall, and exports.

## **WHY IS YOUR CITY MORE PRODUCTIVE THAN MINE?**

Clint N. Lewis (John Fizel), Penn State Behrend, School of Business – Business Economics

In years past, a firm simply bought more capital, hired more employees, and expanded its operation when it wanted to increase production. With unemployment at a thirty-year low, employers cannot just hire more workers to increase their output. It may be that the only way that firms can remain competitive is to increase productivity. There has been extensive research regarding how to measure productivity, the shortcomings of productivity, and suggestions of how to increase productivity. The purpose of this research was to determine what characteristics make one city more productive than another. This research included an econometric model that explains productivity as a function of several key independent variables.

## **A LOW EARTH ORBIT SATELLITE COMMUNICATION AND GPS GEOGRAPHIC INFORMATION SYSTEM**

Patrick Hartig and John Book (Robert Gray), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering Technology

Satellite communication (SATCOM) technology is being developed to become a more economically feasible means of the wireless transmission of voice and data information. Smaller sizes and lower SATCOM equipment costs are foreseen to become more prevalent in the future. The research performed in this study developed an integrated system that: quantified the throughput of various sized binary files transmitted under various digital packet sizes; and performed data acquisition of SATCOM signal strength and the global satellite positioning system (GPS) time, latitude, longitude, velocity, and altitude. The information was analyzed using Minitab, Labview, Matlab, and Excel. Data captured was performed in a static and dynamic environment, with dynamic positions and received SATCOM signal strengths being overlaid using mapping provided as a geographic information system. This system is advantageous in mapping signal strengths for geographic regions throughout the world. An advantage that SATCOM devices have over cellular or other terrestrial communication links is that it can be used in remote worldwide locations, including large bodies of water, such as the Great Lakes or oceans.

## **CREATING A CRITICAL EDITION: THE WRITINGS OF ALEISTER CROWLEY**

Susan Rohde (Diana George), Penn State Behrend, School of Humanities and Social Sciences – English

Aleister Crowley (1875-1947), an English author and one of the most famous occultists of the twentieth century, was raised in the Plymouth Brethren tradition, which adhered to Biblical literalism. His intensive study of the Bible, as well as his absorption of popular literature and world religions and mythologies, manifest themselves in Crowley's vivid prose, poetry, and philosophical writings. Yet he is sorely overlooked in university-level literature classes. My Senior Thesis in English focuses on creating a critical edition – an anthology – of Crowley's literary works – as opposed to his occult “textbooks” – that will make such works both teachable by professors and accessible to literature students. Crowley's bibliography is large, and due to time constraints I have chosen three pieces to edit and annotate as the undergraduate phase of my anthology project. I should like to share with conference attendees some of the issues that my research has raised in dealing with texts that, while available to the public, are ignored in the academic setting.

## **TEACHING SHAKESPEARE: STUDENTS RESPOND TO FOUR TEACHING PEDAGOGIES**

Melissa Schaffner (Dean Baldwin), Penn State Behrend, School of Humanities and Social Sciences – English

William Shakespeare's literature remains a vital part of our nation's English curriculum. However, the academic need for students to be taught Shakespeare should not overlook the problems and concerns that arise when students are subjected to his literature for the first time. Students learning Shakespeare need to be taught in such a way that motivates them and actively engages them with Shakespeare's writing without ignoring the important concepts that need to be discussed. Therefore, a pedagogical need exists to find new and practical methods of motivating and engaging students actively with Shakespeare. As such, I set out to find how Shakespeare is presently being taught and what types of teaching pedagogies students find most effective. I teamed up with teachers in the Iroquois School District in Lawrence Park, Pennsylvania, to find the answers to my inquiries. With the students' opinions through questionnaires and the teachers' insights, I was able to effectively gauge which teaching methods were effective and enjoyable for ninth- and tenth-grade students' encounters with William Shakespeare's literature.

## **U.S. PRESIDENTS BEGAN USURPING CONGRESSIONAL WAR POWER LONG BEFORE THE 20<sup>TH</sup> CENTURY**

Robert Markley (John Rossi), Penn State Behrend, School of Humanities and Social Sciences – History

A series of “presidential wars” over the past half-century has instigated an intense and often bitter debate on the question of whether the executive or legislative branch is constitutionally authorized to commence hostilities. Research has shown that adherents of intrinsic executive powers in foreign policy actually lack the support of the original intent of the framers of the Constitution. Nevertheless, these pundits have argued that executive war-making has acquired legal validity through repetition. While many have posited that this power began to shift from the legislature to the executive with President Truman’s unilateral decision to send U.S. forces to Korea, this present study indicates that the power grab began much earlier. President Jefferson actually established the precedent in the early nineteenth century when he dispatched the fledgling U.S. Navy to combat the Barbary powers of northern Africa. With some of the “Founding Fathers” acting as his advisers, Jefferson perverted constitutional war power; he established a precedent maintaining that, while the executive cannot formally *declare* war, he can initiate military action to protect American interests.

## **AN EXPLANATION OF WHY CUSTOMER SATISFACTION HAS IMPORTANT STRATEGIC IMPLICATIONS FOR THE RESTAURANT INDUSTRY**

Carolyn Conway (Syed Andaleeb), Penn State Behrend, School of Business – Marketing

As America enters the twenty-first century, the food service industry will continue to have a significant impact on the American economy. This calls for a better understanding of the specific needs of customer desires to provide the appropriate type and level of service to meet their demands. The main rationale for researching this industry is the recent proliferation of new restaurants in Erie, with more restaurants scheduled to open in the near future. Due to the vast number of food service categories, the sector studied for this research project is the full- service restaurant industry. Different terminology such as customer satisfaction, service quality, and customer loyalty is also explored, along with the rationale for making this distinction. This study also proposes and tests a five-factor model to explain customer satisfaction for the restaurant industry. The model explained 61 percent of the variation in the dependent variable – satisfaction. This study finally proposes a relationship between customer satisfaction and repurchase intentions. Strategic implications of the proposed model and repurchase intentions are discussed.

## **DETERMINANTS OF SATISFACTION WITH LIBRARY SERVICES**

Heather Green (Syed Andaleeb), Penn State Behrend, School of Business – Marketing

This research project was designed to assess customer satisfaction with libraries, determine the failure points in service delivery, and to suggest improvements in service. Since the Internet has become so pervasive in everyday life, libraries may need to come up with new techniques for gaining and retaining patrons. A survey was designed to collect data from public and college libraries. The following variables were expected to explain patron satisfaction with libraries: ease of finding library materials, efficient check-out procedures, ease of distinguishing the different sections of the library, knowledgeable library staff, staff members' willingness to assist patrons, staff members' ability to solve problems quickly, attention received from the staff, and whether expectations of service were met by the library. A regression analysis was run to test the model. Since some of the independent variables were insignificant, a restricted model was tested with satisfactory results.

## **A COMPARISON OF WOMEN'S NCAA DIVISION I, II, AND III AND NAIA WINNING 5000-METER TIMES AT INDOOR AND OUTDOOR TRACK AND FIELD CHAMPIONSHIPS**

Elizabeth Bernard, Tina Rubay, and Nicole Wilson (Pradeep Singh), Penn State Behrend, School of Science – Mathematics

The purpose of this research was to use analysis of variance (ANOVA) to determine similarities and differences between female 5000-meter runners participating in the National Collegiate Athletic Association (NCAA) and the National Association of Intercollegiate Athletics (NAIA). The NCAA is composed of Divisions I, II, and III. Data were collected from the indoor and outdoor 5000-meter championship races from all three NCAA divisions and from the NAIA from 1985 through the present. An ANOVA model was built with winning times from each championship race as the response and using factors of division and whether the time was run indoor or outdoor. The results show the comparisons between times in all divisions, between indoor and outdoor times for each division, and between winning times in the NAIA and each NCAA division.

## **THE IMPROVEMENT OF PROBLEM SOLVING SKILLS FOR INTRODUCTORY PHYSICS STUDENTS BY TEACHING OF THE METACOGNITIVE PROCESSES OF PROBLEM SOLVING**

Mark P. Niedermeyer (Jonathan Hall), Penn State Behrend, School of Science – Physics

Introductory physics courses have a history of being difficult because of the course material and because of the required problem-solving skills. The purpose of my research is to improve problem-solving skills for introductory-level physics students by teaching the metacognitive processes of problem solving as presented by Janet Metcalfe and Arthur P. Shimamura (Metacognition 1996). The design includes using part of lab to teach the metacognitive processes to a section of an introductory physics course and comparing the problem solving skills to the remaining sections of the course. The first part of each lab teaches the metacognitive processes over a ten-week period, while the remaining sections practice weekly problems without metacognitive instruction. We expect not only an improvement of problem-solving skills for physics, but also for others courses involving solving problems.

## **ISOLATING AND SEQUENCING THE CYTOCHROME OXIDASE SUBUNIT I GENE IN THE mtDNA OF THE LARGE CARPENTER BEE, *Xylocopa virginica***

Miranda T. Deemer (Stephen Jenkins and Durwood Ray), Grove City College - Biology

The goal of this study was to amplify and sequence a fragment of the cytochrome oxidase subunit I (COI) gene from a local population of the large carpenter bee, *Xylocopa virginica*. Using two primer sets originally designed for the honeybee (*Apis mellifera*) and polymerase chain reaction, we were able to successfully amplify a fragment of the COI gene in *Xylocopa virginica*. Our samples of mtDNA were assayed in duplicate and single bands were seen on the 1.5 percent agarose gel for each of the samples. Primer set BBH2675/BBL2247 was expected to isolate a 429 bp fragment of the COI gene. An approximate 340 bp fragment was isolated in each mtDNA sample. Primer set BBH2675/BBL1991 was expected to isolate a 685 base pair sequence of the gene. The fragment of the COI gene in each of our mtDNA samples was approximately 650 base pairs. In addition, we compared two mtDNA extraction procedures. The results determined that replicable amplification of mtDNA is effective by dissection of the thoracic musculature and by grinding the thorax of large carpenter bees. Significantly, the utility of these primers and of the COI gene fragment for molecular amplification studies within the superfamily Apoidea was established in this study.

## **CHARACTERIZATION OF A PUTATIVE FRAGILE X MENTAL RETARDATION RELATED PROTEIN HOMOLOG IN ZEBRAFISH**

Leanne M. Donovan and Richard L. Gill Jr. (James Warren Jr.), Penn State Behrend, School of Science – Biology

Fragile X syndrome is a leading cause of mental retardation in humans. It is an X-linked disorder that affects one out of 4,000 males and one out of 6,000 females. The syndrome results from the absence of expression of the fragile X mental retardation gene 1 (FMR1), which codes for an RNA binding protein (FMRP) (Khandjian 1999). A fragile X related protein gene has been cloned in zebrafish from a cDNA library (zf FXR1). The sequence is 2,781 base pairs long with an open reading frame of 677 amino acids. Through the use of mRNA *in situ* hybridization, the expression pattern of zf FRX1 gene has been analyzed in the zebrafish embryo at different stages of development. At early stages in development (16hpf and 24hpf), expression of zf FXR1 is strong in the somitic tissue of the posterior embryo. At later stages in development (48hpf and 72hpf), cell-specific staining in the brain was observed. The next step in the research is to map the fragile X gene to determine its physical location in the zebrafish genome.

## **CHARACTERIZATION OF A PUTATIVE APOPTOSIS RELATED FACTOR IN ZEBRAFISH**

Lisa M. Kobylinski (James Warren Jr.), Penn State Behrend, School of Science – Biology

Apoptosis is the programmed death of cells in embryogenesis, metamorphosis, and tissue turnover (Itoh et al., 1991). Apoptosis consists of condensation of cytoplasm, loss of microvilli of the plasma membrane, and degradation of chromosomal DNA (Itoh and Nagata, 1993) and is morphologically different from necrosis (Enari et al., 1995). FAF-1 is a protein originally cloned in the mouse that binds to the apoptosis factor FAS and has been shown to facilitate apoptosis. The gene FAF-1 has recently been cloned and sequenced in the zebrafish (*Danio rerio*) from a cDNA library. The zebrafish FAF-1 gene (zf FAF-1) is 69 percent homologous to human and 68 percent homologous to the mouse at the amino acid level. *In situ* hybridizations are being used to determine when and where in the developing embryo the zf FAF-1 gene is expressed. Sections of embryos used for *in situ* hybridizations will reveal precisely which cells are expressing the mRNA for zf FAF-1. The next objective is to map the zf FAF-1 gene to determine its location in the zebrafish genome.

## **A STUDY OF AN UNUSUAL RELATIONSHIP BETWEEN A PLANT AND ANIMAL**

Jennifer M. Miller (Mary Puterbaugh), Allegheny Institute of Natural History, University of Pittsburgh at Bradford, Division of Natural Sciences – Biology

Bryophyte and invertebrate interactions abound, but they are poorly understood. We examined the frequency of Bdelloid rotifers within lobular-shaped leaves of an epiphytic liverwort (*Frullania eborensis*) in northwestern Pennsylvania. We randomly sampled liverworts from the bark of three neighboring streamside trees from July through September, 2000. Between 13 and 68 percent of the lobules on any given plant contained at least one rotifer (mean = 28 percent; N = 24 samples; 3609 lobules). Of lobules containing rotifers, 72 percent contained one rotifer, 17 percent two, and 11 percent three or more. This distribution is significantly different from that expected at random (Poisson,  $X^2 = 475$ ,  $df = 4$ ,  $P < 0.01$ ). Although further analyses are needed to confirm this conclusion, the excess of lobules with multiple rotifers supports the hypothesis that rotifers reproduce within lobules and that the plant-animal interaction could have fitness consequences for the rotifer.

## **INCREASED BRANCHED-CHAIN AMINO ACID AMINOTRANSFERASE EXPRESSION IN POTATO TISSUE**

Lee T. Szkotnicki (Michael Campbell), Penn State Behrend, School of Science – Biology

Branched-chain amino acid aminotransferase (BCAT) catalyzes the production and degradation of the amino acids leucine, isoleucine, and valine. Two genes encoding for this enzyme have recently been characterized in potato (BCAT1 and BCAT2). Using Northern-blotting techniques these genes have been localized to major tissues. Expression has been shown to occur in meristem, leaves, stems, and roots. To further characterize BCAT at the cellular level, I have utilized *in situ* hybridization of RNA probes to frozen sections of potato. Digoxigenin-labeled antisense mRNA probes to both BCAT 1 and BCAT 2 were probed against 10  $\mu\text{m}$  interval sections of flower bud and meristem tissues. Analysis shows that both BCAT 1 and 2 mRNA's are expressed in potato pollen grains and regions surrounding the microsporangium. This expression could be the result of higher levels of branched-chain amino acid synthesis, or their catalytic break down yielding free amino groups that then become available to be used in other reactions. Further analysis and localization of BCAT will be discussed.

## ***Pseudomonas putida* AND *Alcaligenes xylooxidans* SUBSP. *denitrificans* DEGRADATION OF TRICLOSAN, A CHROMATOGRAPHIC ANALYSIS**

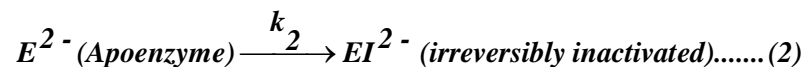
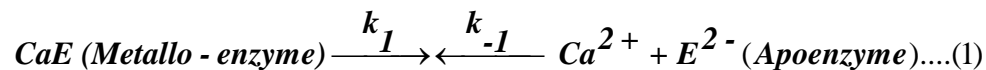
Rebecca L. Waddell and Joshua Hayden (Maura Meade-Callahan), Allegheny College – Biology-Microbiology

Triclosan (2,4,4'-trichloro-2'-hydroxy diphenyl ether) is a broad-spectrum antibacterial agent that was once thought to function as a biocide. Currently, triclosan is used in over 700 household and hospital products. Active efflux, glycosylation, and alteration of target site of the compound, the fatty acid biosynthesis enzyme FABI, have previously been reported to be the mechanisms of triclosan resistance of several species of bacteria. A fourth mechanism of resistance, degradation, has been identified in our laboratory. Two soil bacterial isolates, *Pseudomonas putida* TriRY and *Alcaligenes xylooxidans* subsp. *denitrificans* TR1 are resistant to high concentrations of triclosan. Both have been found to be capable of degrading other halogenated phenols. When grown in supersaturated broth containing concentrations as high as 0.2 percent triclosan, these organisms reduce the total amount of the compound over time. This has been monitored through HPLC separation and measured spectrophotometrically at 280 nm. TriRY and TR1 can cause a drastic reduction in liquid suspensions of triclosan within a period of approximately 228 hours. The decreasing concentrations of triclosan are indicative of degradation as a resistance mechanism. Further biochemical analysis may be used to determine the degradative breakdown products or possible nontoxic chemical conjugates.

## ENZYLE INACTIVATION AND REACTIVITY IN PRESENCE OF ALCOHOL

Vincent T. Calabrese, Jason W. Minns, and Tyler D. Hodson (Arshad Khan), Penn State DuBois – Chemistry

The inactivation studies provide information on structure, properties, and function of enzymes that are responsible for many biologically and industrially important reactions. The present study on  $\alpha$ -amylase (enzyme) suggests that the rate of inactivation is decreased (stabilization increased) as percent of alcohol is increased in the solution. Contrary to expectations, the reactivity of the enzyme toward starch hydrolysis is decreased as alcohol concentration is increased. The flexibility of protein structure seems to be important for both inactivation as well as reactivity reactions toward starch hydrolysis. Increased alcohol concentration presumably rigidifies protein by reducing the number of H-bonding atoms in the solution, and is responsible for the above inactivation and reactivity trends. A two-step inactivation model (A. Khan, 1989) is valid for various alcohol concentrations ranging from 1 percent to 50 percent.



$$\text{Fraction inactive (XD)} = 1 - \text{EXP} \left( \frac{-k_1 k_2 t}{k_{-1} [Ca^{2+}] + k_2} \right) \dots (3)$$

## SYNTHESIS AND CHARACTERIZATION OF A MACROCYCLIC LIGAND: TETRAAZA[1,6,11,16][b,g,l,j]TETRABENZOCYCLOEICOSINE

Brian Coleridge (Alan Jircitano), Penn State Behrend, School of Science – Chemistry

A ligand having a large center cavity may better accommodate metals of larger size, specifically second or third row transition metals or lanthanide ions. The target molecule of this research is 2-(aminomethyl)benzaldehyde (amb)I. Schiff base condensation of four molecules of amb in the presence of a transition metal ion would give a macrocyclic ligand with a 20-membered inner ring. The ligand is synthesized by first adding  $CN^-$ , through a Sandmeyer reaction to methyl anthranilate, followed by reduction with  $LiAlH_4$  and then oxidation with  $MnO_2$ . The resulting amb can then be cyclized around a transition metal or lanthanide ion to form a macrocyclic complex II. A complex of this nature could be used as a Magnetic Resonance Imaging (MRI) contrast agent. An alternative approach to this synthesis involves reacting trimethoxymethane with 2-cyanobenzaldehyde to form a protecting group on the aldehyde. This product can then be reduced, forming a more stable ligand, which can be directly cyclized about a metal ion without undergoing oxidation first. Progress towards both these methods will be discussed.

## ACOUSTO-OPTIC BACKGROUND CORRECTION SYSTEM FOR UV ATOMIC EMISSION SPECTROSCOPY

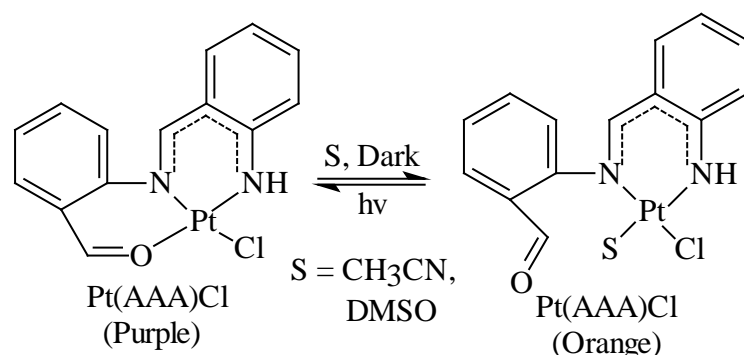
Stacy L. Cox (Thomas Spudich), Penn State Behrend, School of Science – Chemistry

Current research involves the development and use of an acousto-optic (AO) background correction system for atomic emission spectrometry. The ultra-violet (UV) region of the spectrum is being characterized due to the fact there are a high number of emissions that can be observed in this region as opposed to the visible region of the spectrum. Most emission methods typically introduce high background signal fluctuations (noise) which can hinder detection. An acousto-optic device (AOD) was chosen to control background correction since it is a solid state (no moving parts) device, and is relatively inexpensive. Initial research consisted of optimizing the spectrometer, which included adjusting the entrance and exit slits, and calibrating the monochromator utilizing a mercury lamp. The acousto-optic was then adjusted to maximize AO diffraction and was also characterized using various acousto-optic driver power settings. Further research will consist of determining the signal to noise ratio (S/N) and limit of detection (LOD) for copper and chlorine utilizing microwave-induced plasma (MIP) for analyte excitation.

## RADIATION CHARACTERIZATION OF PHOTOCHROMIC Pt(II) COMPOUNDS OF *o*-AMINOBENZALDEHYDE AND DERIVATIVES

Tessa R. Marshall and Bryan C. Katzenmeyer (Thomas Spudich), Penn State Behrend, School of Science – Chemistry

Work has been done focusing on the synthesis of platinum (II) compounds of *o*-aminobenzaldehyde and derivatives. It was noted that the synthesized compound, *cis*-[N-(*o*-aminobenzylidene)anthranilaldehydato-O,N,N']-chloroplatinum(II), Pt(AAA)Cl, undergoes a color change while being in the dark or not being exposed to visible radiation. The reaction observed is dependent on the radiation being present, or is a photochromic reaction. The compound reacts to form the product below:



The solution was traversed by radiation (h $\nu$ ) generated by a Xeon-Arc Lamp from a fluorimeter at defined wavelengths. This wavelength range is from 400 nm to 700 nm in 50 nm increments. The reaction was characterized using a UV-VIS spectrophotometer (PC-2000, Ocean Optics, Dunedin, Florida) measuring the absorbance of the solution over time. Work presented will include replicate analyses using acetonitrile as solvent as well as one analysis using DMSO as solvent. Further analysis will be needed to determine whether the reaction is photon-specific, wavelength-specific, or even solvent-specific.

## **COMPLEXES OF $\alpha$ -CYCLODEXTRIN WITH $I_3^-$ AND $I_2$**

Jason W. Minns (Arshad Khan), Penn State DuBois – Chemistry

Complexation reactions involving  $\alpha$ -cyclodextrin (CD) are very important in the drug delivery system technology as well as the separation and food industries. These reactions serve as excellent models for understanding general inclusion phenomena and enzyme-substrate interactions. It is believed that the binding of guests by CD (host) involves insertion of less polar part of the guest molecule into the hydrophobic cavity of CD, while the more polar or charged group remains as far as possible at the outer face of CD and is exposed to the bulk solvent. The purpose of the present study is to determine the composition of the  $\alpha$ -CD complexes with  $I_3^-$  and  $I_2$  together with their binding energies. Possible structures are also postulated.

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LeeAnn Sarnowski and Jon Vanderweele (Melissa Barranger-Mathys), Mercyhurst College and (Julian Mesina), Lake Erie College of Osteopathic Medicine – Chemistry and Biochemistry

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## **HYDROPHONE INTERFACED WITH A MICROCONTROLLER**

James Aspden and Chris Bottorff (Kevin Torres), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering Technology

Ultrasonic cleaning of medical equipment is on the breaking edge of technology. A method for testing the effectiveness of the cleaning devices is not technical. Currently, these methods include coloring ceramic discs with number 2 pencil and dipping them in the ultrasonic tanks. A need exists for a device that can accomplish the same task in a small handheld electronic device. Through the use of a hydrophone and a microcontroller the team of Electrical Engineering Technology students from Penn State Erie are designing and prototyping this device. A hydrophone is a piezoelectric device that detects sound under water. It has been used for such things as recording the songs of whales and finding submarines deep in the sea. A hydrophone will produce a signal that changes according to the frequency and intensity of the sound hitting it. Using filters and signal conditioning, the students were able to design a DC signal that would increase and decrease respectively with the intensity of the sound. This DC signal is then processed by a Lascar Electronics microcontroller and a power reading is displayed on a starburst LCD. Further modifications include, interfacing a thermocouple to obtain temperature readings of the cleansing agent used in the tanks. The final product will resemble a small digital voltmeter with a detachable thermocouple.

## **STRESS CONCENTRATIONS IN DRILLING**

Kevin P. Barbash (L. Ken Saunders), Penn State Behrend, School of Engineering and Engineering Technology – Mechanical Engineering

The formation of a burr during cutting applications is a common and expensive occurrence. A current Finite Element Model exists to model the cutting process during breakthrough; however, a stress concentration is formed due to the geometry of the part as the tool passes through it. The goal of this work is to explore methods for modeling stress concentrations using a Finite Element approach and how to apply these techniques in ANSYS, a Finite Element Modeling program. A search for relevant publications on modeling stress concentrations was conducted to determine current techniques for modeling these concentrations. Finite Element Theory as well as a Finite Difference Approximation was evaluated to determine the source of the singularity that occurs resulting in the stress concentration. A simple Finite Element Model using a cantilever beam was created to simplify the geometry of the drilling process. A typical technique for dealing with stress concentrations is to modify the geometry, replacing sharp corners with small radii. This technique was used in the simple cantilever model to demonstrate a convergence in the stress level as the radii was reduced. Findings were then incorporated into the current drilling model.

## **A LOW EARTH ORBIT SATELLITE COMMUNICATION AND GPS GEOGRAPHIC INFORMATION SYSTEM**

Patrick Hartig and John Book (Robert Gray), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering Technology

Satellite communication (SATCOM) technology is being developed to become a more economically feasible means of the wireless transmission of voice and data information. Smaller sizes and lower SATCOM equipment costs are foreseen to become more prevalent in the future. The research performed in this study developed an integrated system that: quantified the throughput of various sized binary files transmitted under various digital packet sizes; and performed data acquisition of SATCOM signal strength and the global satellite positioning system (GPS) time, latitude, longitude, velocity, and altitude. The information was analyzed using Minitab, Labview, Matlab, and Excel. Data captured was performed in a static and dynamic environment, with dynamic positions and received SATCOM signal strengths being overlaid using mapping provided as a geographic information system. This system is advantageous in mapping signal strengths for geographic regions throughout the world. An advantage that SATCOM devices have over cellular or other terrestrial communication links is that it can be used in remote worldwide locations, including large bodies of water, such as the Great Lakes or oceans.

## **UPDATE OF THE 1999 NOURISHMENT SAND MOVEMENT ON THE PRESQUE ISLE PENINSULA, LAKE ERIE AT ERIE, PENNSYLVANIA**

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From 1989 to 1992 the U.S. Army Corps of Engineers Presque Isle Erosion Control Project constructed fifty-five offshore segmented breakwaters along the Lake Erie perimeter of the 11 km (7 mi) recurved spit which is Presque Isle State Park (PISP) at Erie, Pennsylvania. The purpose of the \$23.8 million breakwater construction was to reduce the annual \$1,000,000 expense of nourishment. Assuming success, the annual nourishment for 1993 to 1998 was reduced from 228,000 to 86,000 tons (38 percent of the pre-construction volume). This proved inadequate as evidenced by the failure of the distal end of the spit, called Gull Point, to grow at least 0.4 acres per year from 1996 to 1999. Massive sand nourishment (54 thousand tons) was deemed necessary and occurred from July to September 1999. The present study extends to a full year the monitoring study reported at the 1999 NEGSA for the fall and winter of 1999–2000. The area from the back-beach offshore to a depth of 4 m (13 ft) was mapped periodically from October 26, 1999, through October 15, 2000. Shoreline changes and volumetric cut-and-fill analysis of subdivisions of the map area provide detailed information of offshore and along-shore movement of the nourishment sand. Ten north-to-south transects were mapped covering 340 m (1120 ft) of nourishment area and 600 m (1800 ft) downdrift from the back-beach offshore to a depth of 4 m (13 ft). The exposed beach and the lake bottom at an offshore buoy was mapped with a Lietz Total Station infrared laser theodolite. The deeper subaqueous portion from the buoy lakeward was surveyed with a Lowrance X-16 precision depth recorder. Contour maps were generated using Lietz's proprietary Sokkia Map and Contours software. Sokkia Volumes software was used to calculate volume changes over time by comparing the surfaces thus mapped. ArcView GIS Spatial Analyst and 3-D Analyst were also be used.

## **SEQUENTIAL COMBINATION REGIMENS OF TAXOL<sup>®</sup> AND DOXORUBICIN IN HUMAN BREAST CANCER CELLS**

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Taxol<sup>®</sup> (TAX) is an anticancer drug used to treat ovarian and breast cancer. TAX is known to inhibit microtubule disassembly. Recent research, however, has focused on TAX and topoisomerase (topo) II. Low concentrations of TAX increase topo II activity and with time also increase nuclear amounts of topo II protein. Higher concentrations of TAX inhibit topo II. This study focuses on the clinical significance of using TAX with topo II inhibitors, namely doxorubicin (DOX). To accomplish this aim, breast adenocarcinoma cells, MCF-7, were exposed to TAX, and DOX was later added at various time intervals. For comparison, concurrent plates were exposed to DOX and TAX was added later. Seventy-two hours after first drug exposure, an MTT assay was performed providing a quantitative measure of the cytotoxicity of the combination of drugs. Preliminary experiments have shown that with lower concentrations of TAX the addition of DOX 24-48 h later increased cell death, compared to the cell death produced by either drug alone. When both drugs were added at time zero, there appeared to be somewhat less cell death. If indeed TAX reproducibly increases the activity of sequential DOX the findings may alter current clinical chemotherapy regimens.

## **CELL DEATH BY AUTOSCHIZIS FOR BLADDER (T24) AND OVARIAN CARCINOMA (MDAH) CELLS: LM, TEM AND SEM ASPECTS OF MORPHOLOGIC CHANGES INDUCED BY THE SYNERGISTIC ANTITUMOR ACTIVITY OF VITAMIN C: VITAMIN K<sub>3</sub> COMBINATION**

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Previously, it has been found that co-administration of Vitamin C (VC) and Vitamin K<sub>3</sub> (VK<sub>3</sub>) combination (in a VC/VK<sub>3</sub> ratio of 100:1) to a variety of carcinoma cell lines resulted in equivalent antineoplastic activity at concentrations that were 10-50 times lower than when either vitamin was administered alone. Generation of peroxides followed by membrane lipid alteration, DNases activation and RNA destruction by the VC and VK<sub>3</sub> combination in the catalase-deficient cancer cells were some of the cell responses resulting from the potentiation and specificity of the antitumor activity of these combined vitamins. The purpose of this report is to pursue the evaluation of VC, VK<sub>3</sub>, and the VC/VK<sub>3</sub> combination for their antitumor activity against human bladder (T24) and ovarian carcinoma (MDAH) cell lines to document overall morphological changes, to compare these observations with LM, TEM, and SEM to visualize some changes in the subcellular compartments following vitamin treatment. Following exposure of both tumor cell lines to each vitamin and the vitamin combination, cells were harvested at 2 and 4h intervals and processed for transmitted and fluorescence light, transmission (TEM) and scanning (SEM) electron microscopy. This report uses descriptive accounts of LM, SEM and

TEM aspects changes in reference to nuclear and other intracellular changes, especially those related to actin patterns stained with fluorescein-phalloidin to complement previous descriptions of autoschizis. Pleiomorphic cells are spherical to ovoid in shape with diameters ranging between 12 to 30  $\mu\text{m}$  and are characterized by nuclear regions and perikarya that bulge from the cell surfaces. The cell surfaces possess long and short lamellipodia and filopodia which establish short and long range contacts with neighboring cells. Following VC treatment, T24 and MDAH cells appear somewhat flattened and exhibit fine and delicate filopodia. The periphery of the perikarya display elevated rings that surrounds depressed nuclear areas. These cells show a variety of injury including: extruding of cytoplasmic pieces; display enucleation and perforation of the cell membrane.  $\text{VK}_3$ -treated cells are flattened and display large areas of cytoplasm undergoing cuts with cell diameters as large as 55  $\mu\text{m}$ . The nuclear area and overall cell membranes have been damaged in a manner characteristic of oxidative stress. This damage is accompanied by the apparent collapse of the cytoskeleton of the cell. Combined Vitamin treatment results in cells that maintain intact nuclei while extruding substantial pieces of organelle-free cytoplasm. As a consequence, the tumor cells still alive show a small size, loss of DNA, and a morphology characterized by perikarya surrounded by a narrow rim of cytoplasm containing only damaged organelles. Since this type of cell death does not agree with the morphological characteristics of apoptosis or necrosis, we confirm our previous findings and, at the same time strongly suggest that this type of cell death, induced by oxidative stress, to be called autoschizis i.e. cell death induced by loss of cytoplasm due to self morcellation.

## **COMPUTER MODEL OF REACTIVE COMPATIBILIZATION IN POLYMER BLENDS**

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Polymers are long chains of repeated chemical units, monomers, which are very useful in industry, especially as plastics. Scientists are attempting to blend available polymers to produce composites with the better qualities than their constituents, but most polymer blends separate into domains of the same polymers rather than mixing. Copolymers, polymers formed by bonding two different polymers, can be added as compatibilizers to enhance the blending process. By in-situ copolymerization, reactive sites on the ends of chains of two different types of polymers cause the otherwise repulsive polymers to link together at an interface, thus creating copolymers. Theoretical ideas concerning the reactive compatibilization of polymers have not been extensively tested experimentally or numerically. I have written three C++ programs that simulate different stages in modeling this copolymer situation. My poster will present the purpose and procedure of each program as well as some of the methods I have implemented to increase the efficiency of the code. I will also present some of the results from the programs.

## **THE ORBITAL EVOLUTION OF URANUS AND NEPTUNE IN THE EARLY SOLAR SYSTEM**

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Recent research has suggested compelling evidence that the outer Jovian planets, Uranus and Neptune, may have formed much closer to the sun than they are now. Computer simulations of planetary growth have shown that they may have formed in the Jupiter-Saturn region of the solar system (4-10AU). If this is the case, then somehow the ice planets (Uranus and Neptune) have migrated outwards to their current location. The most likely mechanism for achieving this kind of orbital migration is a close encounter with a large planet, most likely Jupiter itself. However this encounter would have thrown the smaller planet outwards with a large eccentricity and possibly a large inclination to the orbital plane. Somehow, this eccentricity and inclination must have been reduced to the current orbits and in Uranus' case, a near perfectly circular orbit. Using the SWIFT orbital integration software and some recent modifications, I have attempted to show that relatively high eccentricities can be “damped out” by interactions with the dust and gas present in the early solar nebula when this migration must have occurred.