



***PENN STATE BEHREND - SIGMA XI
2002
ELEVENTH ANNUAL
UNDERGRADUATE STUDENT RESEARCH
AND
CREATIVE ACCOMPLISHMENT CONFERENCE
ABSTRACT BOOK***

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(Contains proprietary information - no abstract included)

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Expression of the *Saur* Promoter in Response to Endogenous Auxin from Germination to Maturity of Wild Type and R15 Auxin-Resistant Mutant Transgenic *Nicotiana Plumbiginifolia*

David E. Beil (Catharina Coenen), Allegheny College – Biology

Auxin, a major regulatory hormone of plant growth and development, is frequently studied in plants. By using mutant plants with a specific alteration in the auxin pathway along with transgene insertion, auxin-related promoters can be spatially or temporally analyzed by the expression of a reporter gene such as β -glucuronidase, or *Gus*. By comparing the response of endogenous auxin in wild type to the response of the R15 auxin-resistant mutant of *Nicotiana plumbiginifolia*, more can be understood about the role of auxin. In order to make direct comparisons of gene expression in the wild type and R15 mutant, a genetic cross has been performed using Mendelian genetics to establish lines with identical placement of the same transgene. Patterns of gene expression have been characterized throughout development in most plant tissues and organs by examining staining patterns due to the inserted *Gus* reporter gene.

Determination of Genetic Diversity in Subpopulations of *Phragmites australis* Using Deletions in Non-Coding Regions of Chloroplast DNA

Patricia Bettinger (Larry Eckroat), Penn State Behrend, School of Science – Biology

Phragmites, *Phragmites australis*, a dominant component of many wetlands, has become an invasive element of the southern shore of Lake Erie, namely in the Presque Isle region. Although native to the Great Lakes area, the expansion into this new region is a threat to its environment. *Phragmites* reproduce sexually via seed production and asexually by growth of horizontal rhizomes. Studies suggest that *phragmites* of different locations vary genotypically. However, very little is known about the genetic variability of the invasive *phragmites* of the Presque Isle region. The genotypic variation within a *phragmite* stand and among isolated stands can determine the method of reproduction utilized by the plant. Comparison of known deletions in non-coding regions of chloroplast DNA can demonstrate hybridization patterns for parental and progeny generations. This research involves isolation, amplification, and comparison of these DNA regions on polyacrylamide gels. Information on the reproductive patterns of these populations can be an invaluable resource to their control and management. The results have thus indicated that plants within stands demonstrate the same variability, as well as among isolated stands.

The Mutagenicity and Cyto-Toxicity of Anthracyclines in *Salmonella typhimurium* and *Escherichia coli*

John M. Brumfield (William Mackay), Edinboro University of Pennsylvania, Department of Biology and Health Sciences – Biology

For more than 30 years, the natural anthracycline antibiotics have represented one of the most commonly used classes of anticancer drugs. However, the clinical usefulness of these drugs is limited due to acute cardiotoxic effects and a dose-related cardiomyopathy. Much effort has been involved in creating less toxic analogues with improved pharmacological properties. It is known that anthracyclines interact with DNA in a very complex manner, and these compounds can induce frameshift and base-substitution mutations. Studies in our lab have shown that daunomycin, adriamycin, idarubicin, and epirubicin can induce frameshift mutations and transition events in *Salmonella typhimurium*. In future attempts to improve the clinical efficacies and reduce the mutagenic and possible pre-carcinogenic effects of these compounds, it will be important to understand better the role of DNA repair pathways, which are involved in correcting anthracycline-induced DNA damage. Current research involves the analysis of the protective functional role of 3-methyladenine DNA glycosylase (Aag) in recognizing and repairing anthracycline-induced DNA damage. Normal (AB1157) and Aag mutant *alkA tag* (MB1900) *Escherichia coli* strains were utilized in this study. Cell survival for each strain was determined after exposure to each anthracycline antibiotic.

Nicotine Levels Increase in *Nicotiana sylvestris* Exposed to Artificially Damaged Conspecifics

Sara C.D. Carpenter and Nate McCartney (Catharina Coenen), Allegheny College – Biology

The release of volatile organic compounds from damaged plants may allow nearby conspecifics to prepare defensive mechanisms against herbivores or pathogens attacking the population. This study investigates between-plant communication of artificially damaged *Nicotiana sylvestris* with unwounded conspecifics by testing the induction of nicotine synthesis, an inducible defense mechanism of tobacco. Unwounded tobacco was incubated in the dark for 12 hours with freshly wounded or with unwounded tobacco. Five days following exposure to the headspace of damaged plants, nicotine levels in leaf tissue of undamaged tobacco were quantified by HPLC. Levels of nicotine in leaf tissue of unwounded tobacco were higher when the plant had been incubated with damaged conspecifics than when the plants had been exposed to undamaged plants (Two-tailed paired t-test, $P= 0.002$).

Characterization of the Antibody EN0 for Detection of BRI Peptide in Transgenic Models

Steven J. Cole¹ (Luisa Onstead² and Steven Ropski¹), ²Mayo Clinic-Jacksonville and ¹Gannon University, School of Science and Engineering – Biology

Present Alzheimer models rely on over-expression of mutant amyloid precursor proteins or mutant APP expression. To further AD research, a model, which expresses specific A β peptides without over-expressing APP is needed to relate pathological roles of AD associated peptides. British Familiar Dementia is a disease similar to AD; it consists of an integral membrane protein that when mutated releases a peptide plaque similar to the A β plaque of AD. By fusing A β to the BRI protein unique A β peptides can be analyzed without complication of APP and other AD peptides. EN0 is an antibody, which detects the n-terminal end of the BRI protein. This research is to determine the specificity of EN0 to transgenic versus non-transgenic brain tissue by comparing different blocking agents and recording background complications of this antibody for verification of specificity. Preliminary results show EN0 is able to differentiate between transgenic and non-transgenic samples, although not at the predicted molecular weight. To verify that these samples are differentiable, samples need to be dephosphorylated to see if results match prior molecular weights of peptide samples. After characterization, EN0 can be used for analysis of brain samples to shorten genotyping time for development of new genetic mice models.

An Educational Tool for the General Public and Students: The Conflict between Conservation and Beach Maintenance on Presque Isle Peninsula

Theresa Crawford (Pamela Silver), Penn State Behrend, School of Science – Biology

The natural processes of many natural habitats that undergo management for recreational purposes can be altered permanently. The normal dynamics of land erosion and deposition on Presque Isle have been altered to maintain the beaches for recreational use. This maintenance has both ecological and economic impacts, but recreational users of the peninsula are not aware of the consequences of beach maintenance. The proposed research will focus on investigating the consequences of erosion control and beach replenishment on Presque Isle. The goal of this project is to create an educational tool to help the general public and students understand the breakwater system as a model for erosion control, conservation of beaches and recreation, and to appreciate the consequences of this management practice on Presque Isle peninsula in Erie, Pennsylvania.

Investigation of Peroxidase Isoenzyme Function in the Pathogenic Interaction of the Crucifer *Brassica rapa* with Four Common Fungal Pathogens

Andrea DeDent and Beth Snyder (Catharina Coenen), Allegheny College – Biology

The Brassicacea family of plants represents a diverse and economically important agricultural crop, with one of the main threats to disease infection coming from pathogenic fungi. Plant peroxidase enzymes have been implicated in fulfilling various physiological roles within plant cells, including defense from pathogen invasion. However, the presence of various isoenzymes as well as the ubiquitous nature of plant peroxidases has left many gaps in the understanding of the roles they may fulfill in defense. To look more specifically at the role of individual isozymes in response to fungal pathogen infection, the rapid cycling Wisconsin Fast Plant©, *Brassica rapa*, was used as a model system. Peroxidase activity was determined and differences in patterns dependent upon the characteristics of the fungal pathogen present were observed. Methods were tested for use in characterizing individual isoenzymes based on biochemical properties such as substrate specificity and molecular mass. Patterns of expression in relation to specific pathogens as well as characterization of some of the specific peroxidase isozymes present in these host-pathogen interactions can provide insight into the mechanisms and roles of peroxidases in plant defense.

A Study of the Small Mammal Diversity at Findley Lake Nature Center

Meghan Durkin (Steven Ropski), Gannon University – Biology

A study of the small mammals of the Findley Lake Nature Center was conducted through four site visits from April 2001 to November 2001. The study determined which mammals were present at the site in Mina, New York. Three small mammal species represented by 31 specimens were captured by Sherman live-trapping methods. Species taken were Eastern Chipmunk (*Tamias striatus*, 17 individuals), White-Footed Mouse (*Peromyscus leucopus*, 9), and Northern Short-tailed Shrew (*Blarina brevicauda*, 5).

The Use of Microarray to Characterize RNA Expression in NDP

Kristin Fleming (Michael Campbell), Penn State Behrend, School of Science – Biology

Recent publication of the DNA sequence for humans and other organisms has created a new paradigm in biology. The focus of this research is to address this issue by characterizing the RNA expression of an unknown gene (NDP) in potato. Trizol procedure is used for RNA extraction and the pellet is suspended in ethanol. A TIGR5K Microarray chip is purchased and sent to University Park. The samples are hybridized, the chip is scanned, and the data are extracted and placed into a spreadsheet program. The data are evaluated and the unknown NDP gene is then analyzed as compared and contrasted against 4,999 other potato genes. The microarrays will be probed with mRNA isolated from potato at different developmental states: dormant and nondormant. Microarray is a relatively new method that supplements techniques such as Northern Blots, tissue printing, and gel electrophoresis in determining the expression of gene distribution. Following analysis, the expression of NDP will then be compared to the other genes on the microarray. This will enable the expression of NDP to be put into the context of a large genetic dataset including genes controlling organism development.

Kinetic Analysis of Root Growth, Gravitropism, and Auxin Induction of the GH3 Promoter in the Auxin-Resistant R15 Mutant of *Nicotiana plumbaginifolia*

Laura Gutierrez (Catharina Coenen), Allegheny College – Biology

The role of the plant growth hormone auxin has been extensively studied in auxin-resistant mutants of the model plant *Arabidopsis*, but less is known about the genetics of auxin response in other species. To understand the role of auxin in roots of *Nicotiana plumbaginifolia*, two auxin-dependent responses, gravitropism and activation of the GH3-promoter, were studied in the R15 mutant, whose root and hypocotyl growth show reduced auxin inhibition. Root response to gravity was observed as the curvature of the root to vertical after placing it in a horizontal position and analyzing root reorientation every 60 minutes. During the first three hours after gravistimulation, mutant roots curved significantly more slowly towards the gravity vector than did the wild-type roots. After three hours, the rate of curvature was similar for mutant and wild-type roots, which suggests that the R15 mutation may slow initial auxin perception or response. The induction of the GH3 promoter increased within 30 minutes after auxin (NAA) application and continued to rise up to five-fold within six hours after auxin administration. Dose-response curves suggest a response optimum at 10^{-8} M NAA. These investigations demonstrate that the GH3-promoter can be induced by auxin treatments that are inhibitory to root growth, suggesting that GH3 gene expression in roots is unlikely to be responsible for elongation growth. Extending these investigations to roots of R15 seedlings will clarify whether slowed gravitropism in the mutant is correlated with slowed activation of auxin-inducible genes.

Sequence and Analysis of the Zebrafish Methionine Synthase Gene

Matthew S. Irwin (James Warren, Jr.), Penn State Behrend, School of Science – Biology

Neural tube defects (NTDs), which cover a broad spectrum of phenotypes ranging from spina bifida to virtually complete absence of the spinal cord and brain, affect approximately 1 in 1,000 newborns in the United States. Periconceptual folate supplementation has been found to prevent the occurrence of many NTDs. Though this has been known for many years, the biological mechanism through which folic acid prevents NTDs is still unknown. This research will look at folate metabolism in zebrafish (*Danio rerio*) and more specifically at a gene involved in this process, methionine synthase. A clone of this gene was purchased from Incyte Genomics. Methionine synthase is one of two key enzymes involved in the removal of the metabolite homocysteine. It is these elevated homocysteine levels and low folic acid levels that constitute a risk factor for cardiovascular diseases and neural tube defects in vertebrates. The project involves fully sequencing the methionine synthase gene by primer walking, performing comparison analyses to other species containing the methionine synthase gene, and investigating the enzyme's activity in zebrafish.

The *Oryza sativa* (Rice) Genome Sequencing Project: Closing Gaps in Chromosomes 3, 6, and 10

Erica N. Kalb¹ (Robin Buell² and Michael Campbell¹), ²The Institute for Genomic Research and ¹Penn State Behrend, School of Science – Biology

In recent years, technology has provided the tools to determine the genetic code of countless genomes. The genome sequence of the rice variety *Oryza sativa* L. ssp. *Japonica* cv. *Nipponbare* is expected to be complete by late 2002. This species of rice is a major worldwide food crop that has a small genome size of 430,000,000 base pairs. During my summer/fall 2000 cooperative education experience at The Institute for Genomic Research (TIGR), I worked to close sequencing gaps within five 152,453 average base pair-sized rice DNA segments. Two of these segments were from chromosome 3, one from chromosome 6, and an additional two from chromosome 10. A BAC library of each segment was constructed, which consisted of several thousand randomly cut pieces of DNA that were sequenced, assembled, and edited to determine a consensus strand. The resulting gaps were closed by PCR amplifying and/or sequencing with designed primers. Four of the five rice genome segments are complete and contain 107 genes; most were previously uncharacterized and three were previously known. Sequencing data were made publicly available, which will be beneficial to further rice plant research.

Sequence and Analysis of the Zebrafish FAF-1 Gene

Lisa 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 the cytoplasm, loss of microvilli of the plasma membrane, and degradation of chromosomal DNA (Itoh, Nagata, 1993) and is morphologically different from necrosis (Enari, Hase, Nagata, 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 homolog of FAF-1 has recently been cloned and sequenced in the zebrafish (*Danio Rerio*). The zebrafish FAF-1 (zfFAF-1) amino acid sequence has been found to be 77 percent identical to the quail, 69 percent identical to human, and 68 percent identical to the mouse FAF1 homologs. The zfFAF1 gene is 33 percent, 25 percent, and 23 percent identical with the FAF1 genes of *Drosophila melanogaster*, *Caenorhabditis elegans*, and *Arabidopsis thaliana*, respectively. Multiple conserved domains were located in the zfFAF-1 gene. One alpha helix domain located in the zfFAF-1 gene was found to be extremely highly homologous among the FAF-1 homologs in different organisms. The phylogenetic relationships among the organisms included in the multiple-sequence alignment were analyzed.

Creating and Characterizing the *Dictyostelium discoideum* *fbIA*⁻ Mutant

Kelly A. McFeaters¹ and Tomoaki Abe² (Margaret Nelson¹), ¹Allegheny College and ²University of Dundee, Wellcome Trust Biocentre – 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. Based on analogy to FbxA homologues in other systems, this FbiA-FbxA interaction suggests that FbiA is likely to be targeted for FbxA-dependent, ubiquitin-mediated degradation. A tblastx search of the NCBI database using partial sequence data from *fbIA* reveals two regions (each 40-60 amino acids in length) of homology to proteins in humans, mice, *Drosophila*, *C. elegans*, *Arabidopsis*, *S. pombe*, *S. cerevisiae*, *N. crassa*, and *P. falciparum*. These other proteins all appear to be conceptual translations from genome sequencing projects and, as of yet, have no assigned function. Hence, FbiA may be the founding member of a new protein family. As one means of further characterizing the role of FbiA, we have used homologous recombination to create an *fbIA*⁻ mutant. Gene disruption was confirmed via PCR analysis of genomic DNA isolated from blasticidin-resistant transformants. We report here our preliminary analysis of the *fbIA*⁻ developmental phenotype, including the mutation's effect on prespore and prestalk patterning.

Characterization of a Putative Fragile X Mental Retardation Related Protein Homolog in Zebrafish

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

Fragile X syndrome is a leading cause of mental retardation in humans, effecting 1 in 4,000 males and 1 in 6,000 females. This syndrome is an X-linked disorder resulting from transcriptional silencing of the fragile X mental retardation gene 1 (FMR1), which codes for an RNA binding protein (FMRP). Two autosomal homologs to FMR1, Fragile X Related Protein Genes 1 and 2 (FXR1 and FXR2) and FMR1 together form a novel gene family with functional similarities. A fragile X related protein gene has been cloned in zebrafish (zfFXR) from a 24h cDNA library. The sequence of zfFXR is 2,781 base pairs long with an open reading frame of 677 amino acids that are 59.1 percent, 68.9 percent, and 70.2 percent identical to human FMRP, FXR1P, and FXR2P protein sequences, respectively. Preliminary mRNA *in situ* hybridizations to whole-mounted embryos revealed a dynamic pattern of expression for this gene during early embryonic development. Expression is first detected strongly at 24 h in somitic tissue during early somitogenesis but declines by 48 h. Staining is evident in the brain from 24 h to 72 h. Future experiments that manipulate the expression of zfFXR should further our understanding of its role in early development.

The Effects of Campus Deicing Practices on the Salinity of Trout Run

Michael J. Nageotte (Pamela Silver), Penn State Behrend, School of Science – Biology

Runoff from salt-treated roads can increase salinity in aquatic habitats, decreasing biodiversity. Small streams are especially vulnerable to peaks of salinity associated with runoff. Behrend College applies approximately 150 tons of salt each winter. Trout Run, a first-order stream that originates near the Gospel Hill Golf Course crosses Station Road by culvert and runs north of campus roads, parking lots, and sidewalks before entering Four Mile Creek. Ten sites were sampled along Trout Run where runoff from salted surfaces was likely during periods of baseflow and when runoff from snowmelt or rainfall was high. Chloride was measured by titrating samples with $\text{Hg}(\text{NO}_3)_2$, and converted to NaCl salinity. Salinity ranged from 67.32 mg/L to 965.25 mg/L. Baseflow salinity increased with distance downstream, but levels were variable depending upon the time elapsed since the last runoff and temperature, type and amount of runoff, and salt application during the previous few days. During periods of runoff, salinity was low on the east side of Station Road and extremely high where the tributary draining campus surfaces entered the stream. Although salinity was below levels generally considered lethal for most stream organisms, the levels approached that of seawater (2,500 mg/L) and are cause for concern.

Isolation and Characterization of an Unknown Gene from Potato

Nathan D. Polansky (Michael Campbell), Penn State Behrend, School of Science – Biology

Complete genomes are being sequenced for various organisms, such as humans, fruit flies, and thale cress (*Arabidopsis thaliana*). However, these large sequencing projects have created a new field in biology. Genes are now isolated but no known function can be assigned to them. A unique but uncharacterized gene has been isolated from a potato cDNA library. This gene shows a strong sequence similarity to a putative coding region isolated by the *Arabidopsis thaliana* genome sequencing project. Current sequencing of the potato gene shows it as approximately 1,500 base pairs in length. The putative translation product from the *Arabidopsis thaliana* was analyzed using PSORT, TargetP, and Predotar in order to deduce cellular localization. Results from these programs show the putative product is found in the mitochondria. The largest reading frame found thus far in the unknown potato gene appears to code for a protein also found in the mitochondria. It appears that this gene codes for a unique mitochondrial protein.

Peroxidases and Selective Resistance of *Brassica rapa* against *Pieris rapae*

Hillary L. Pranga (Catharina Coenen), Allegheny College – Biology

Over evolutionary time plants have differentiated and developed a variety of specific and general defense mechanisms. In the case of herbivory, plants have developed a wide range of strategies including induced defenses, which allow plants to change their physical nature after infestation to prevent or reduce the damage of future attacks. Peroxidases have been found to be involved in induced defenses increasing cell wall strength and protecting cells against cytotoxicity of peroxides and free radicals. This study examined the effects of herbivory on the strength and presence of different peroxidases in *Brassica rapa* fed upon by the larvae of the butterfly *Pieris rapae*. Peroxidase isoenzymes with the isoelectric points 10.1 and 8.9 were consistently found in the herbivore-damaged experimental group but rarely in the control group and were used as a basis to select for a breeding population of plants with high defense-related peroxidase expression. The second generation experimental seeds have failed to germinate so investigation is not complete; however, the presence and activity levels of herbivore-induced peroxidase isoenzymes will permit a detailed correlative analysis of the connection between herbivore-induced damage and peroxidase expression.

Analysis of the Mature Astrocyte Marker GFAP in Zebrafish

Jennine Rozanski (James Warren, Jr.), Penn State Behrend, School of Science – Biology

Glial Fibrillary Acidic Protein (GFAP) is a molecular marker for mature astrocytes, glial cells that get their name from their star-like appearance. GFAP is a protein that positively identifies and distinguishes normal astrocytes from other types by being present when there is normal activity in the central nervous system. The gene for GFAP has recently been cloned in zebrafish (*Danio rerio*). A partial DNA sequence of the gene has been obtained and the remainder of the gene will be sequenced. The role of the gene, GFAP, in the development of the central nervous system of the zebrafish will be determined by analyzing the expression patterns of this gene. Whole mount mRNA in situ hybridization will be used to determine where and at what developmental stages the GFAP gene is expressed in zebrafish. The role of GFAP in the normal development of the zebrafish will be analyzed. The results of the expression of GFAP in normal development will lay the groundwork for the analysis of GFAP in mutant lines of zebrafish and in regeneration experiments.

Avian Population/Habitat Assessment for the Lake Pleasant Wetlands

Dana J. Sailer (Lisa Mangel), Penn State Behrend, School of Science – Biology

An introductory avian population/habitat assessment is being conducted at the Lake Pleasant wetlands. This is the first official avian assessment done at Lake Pleasant, making this research a precursor to conservation in this wetland area. This study will allow us to combine the little-known past history, current information, and the information done during this assessment. Research was done in two stages, fall and spring. During the fall, a summary of the habitat of the target bird species was taken. The habitat sites were picked randomly using game commission protocols. This included producing playback tapes of wetland birds, placing point counts in selected wetland habitat, and designing wetland area maps using GIS standards. The spring stage will include inventories during the 2002 nesting season of the avian nesting birds to the extent that resources permit. The spring survey is being conducted between March 1 and July 1. All data will lead to a geo-reference historic and new avian species database using GIS standards. All field activities are documented in detail and coordinated with Western Pennsylvania Conservancy personnel prior to any activity on-site.

The Effects of Stream Substrate on *Psephenus herricki* Populations

SuzAnne Sisak (J. Michael Campbell), Mercyhurst College – Biology

The water penny, *Psephenus herricki*, is considered intolerant of pollution. Larvae cling to stones in fast riffles of streams. Pupae need an exposed rocky shore for protection to transform into the adult, which spends most of its short adult life on wet rocks protruding from the riffles of streams. Thus, the water penny needs a rather specific substrate in order to survive. In Mercyhurst College's ongoing study of the streams in Presque Isle Bay, we have found water pennies at five of eleven locations sampled on Mill Creek. However, sampling at Twenty Mile, Sixteen Mile, Walnut, and Elk Creeks has produced water pennies at most locations. This research will compare substrate characteristics that are known to be important for water penny development and reproduction among sites with varying population densities of water penny larvae. It is expected that water penny populations will be positively correlated with availability of cobble and boulder-sized rocks in and adjacent to the stream channel.

High Rotifer Abundance in Liverwort Plants Lacking Sexual Structures Suggests that Rotifers May Prefer Younger Plant Tissue

John J. Skinner (Mary Puterbaugh Mulcahy), Allegheny Institute of Natural History, University of Pittsburgh at Bradford, Division of Natural Science – Biology

We counted rotifers that live within lobular-shaped leaves of an epiphytic liverwort (*Frullania eboracensis*). In the summer 2001, portions of marked plants growing near Olean, New York, were examined microscopically. Of the 81 plants, 44 were female, 17 male, and 20 plants lacked sexual structures (sex unknown). Plants lacking sexual structures were significantly smaller than sex-expressing plants, and the ratio of rotifers to lobules was significantly higher in the former than in the latter (mean ratio \pm 1 standard error of 0.83 \pm 0.15 and 0.38 \pm 0.04 rotifers:lobules, respectively). The fact that the plants lacking sexual structures were smallest led us to believe they were younger than sex-expressing plants and that rotifers were preferentially living within younger plant tissue. To test this, we returned to the field and sampled the interior and exterior of 14 plants, knowing that within a plant the exterior tissue is likely to be younger than the interior tissue. The mean rotifer:lobule ratio in the younger exterior parts of the plants was 0.67 (\pm 0.11) and significantly higher than the ratio in the older interior parts of the plants (0.22 \pm 0.05). We hypothesize that older plant tissue is less hospitable for rotifers than younger plant tissue.

Use of Bioluminescent *E. coli* as an Indicator of Triclosan Detoxification

Beth A. Snyder and Rebecca L. Waddell (Maura Meade), Allegheny College – Biology

Triclosan is an antibacterial agent found in hundreds of household products including dish detergents. In previous studies several bacteria have been identified that are resistant to triclosan through detoxification and can make antibacterial surfaces more habitable to other susceptible microbes. Bioluminescent organisms have been used as indicators of environmental impacts, and bacteria transformed with the lux reporter systems have been used to determine the effectiveness of antibiotics in several experimental systems. This experiment was designed to test the utility of using bioluminescent *E. coli* transformed with the lux reporter system as a bioindicator of triclosan detoxification in liquid media and commercial products. In nutrient broth supplemented with triclosan, the growth of *E. coli* alone and when coinoculated with triclosan-resistant environmental bacteria was effectively monitored with a luminometer. However, the commercial products proved too dense to utilize this system effectively without dilution. A 1:10 dilution made in sterile distilled water was necessary to measure the presence of *E. coli* with this method. The necessity of a dilution prohibits using bioluminescent *E. coli* to measure triclosan activity in standard commercial products.

Isolation and Characterization of an Unknown Gene Using an *Arabidopsis thaliana* Knockout Mutant

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

NDP, a previously unknown and uncharacterized gene, was isolated from a dormant potato meristem poly-a selected cDNA library. Our goal is to characterize this unknown gene and its expression. Through blast analysis it was shown to have homology to a single copy putative gene on the *Arabidopsis* genome. Additionally, est sequences from tomato and pepper exhibit a high degree of sequence similarity to NDP. In order to assign a function to the NDP gene we have collaborated with the Gene Knockout facility at the University of Wisconsin and Syngenta Corporation to characterize NDP mutants in *Arabidopsis*. The mutant isolation involved the screening of 72,960 *Arabidopsis* strains for a T-DNA insert within the NDP gene. The mutants will provide a powerful tool for observing phenotypic expression of the NDP gene and will also prove a useful comparison against each other. These results and other phenotypic aberrations will be discussed.

Improving Search Efficiency on Feature Vectors

Andreas Lesjak (Meng Su), Penn State Behrend, School of Science – Computer Science

At this moment there are many ways for searching for similar images from an image database. Transforming images into so-called feature vectors that store the most important features of an image, and then storing them in a tree-like structure makes searching for the most similar image easier based on the content of the image. I am investigating different efficient ways to store the feature vectors in a tree-like data structure and performing a nearest neighbor (NN) query to find the most similar images. This search algorithm is based on the well-known RKV algorithm for NN queries. I am further studying how different metrics and distance models (e.g. Euclidean, Manhattan, etc.) improve efficiency. The results of the research are being tested on a Web page we have set up to find the most similar images to a randomly selected image out of a database of several hundred.

Towards Building an Efficient Image Retrieval System: Image Recognition

Zack Rusin (Meng Su), Penn State Behrend, School of Science – Computer Science

Image recognition is one of the most underdeveloped fields in computer science. One of the big problems in this particular field stems from the fact that researchers view image recognition as a process that can be inverted without any loss of information. This assumption forces researchers to use huge and highly complicated data structures, on which operations are highly CPU intensive. The purpose of my research was to study a conversion algorithm allowing to represent images as N-dimensional vectors. The results produced a unique image recognition architecture which puts the burden of internally representing images onto the conversion algorithm, not the data structure.

Brain Drain in Erie County

James A. Washburn and Hazel G. Sadiarin (James Kurre), Penn State Behrend, School of Business – Economics

In order for cities, states, and countries to be successful, they must find ways to attract and retain the best and brightest workers. Does Erie attract people who will help the county prosper, or is Erie losing a valuable resource that will hinder its long-run competitiveness? This loss of valuable intelligence is known as Brain Drain. This study attempts to measure Brain Drain in Erie using three approaches: age and migration data, IRS income data, and total migration data for the county.

Parametric Analysis of Balance Control in Normal Children and Children with Cerebral Palsy

Jennifer Bradford, John Lanager, and George Morales, (Mohammed Ferdjallah), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering

Stable control of balance is imperative for children with cerebral palsy. Means to assess posture by constructing metrics that reliably identify stable control is therefore warranted. The purpose of this study is to design an autoregressive model for standing balance control using the center-of-pressure signal. Center of pressure (COP) is defined as the projection of the center of gravity into the ground and is an indirect measure of body sway. In this study, balance control is quantified using time, frequency, and parametric analyses. The COP data were collected using a dual force platform to measure the forces and moments about the x, y, and z-axes. Ten normal subjects and 50 cerebral palsy subjects were asked to stand (with eyes open and closed) on the platforms for two trials of thirty seconds. In the time and frequency analysis, metrics such as mean frequency, path length, sway area and COP velocity were calculated to quantify the differences in the groups of children, which resulted in noticeable differences in metrics between the normal children and children with cerebral palsy. The parametric analysis models the human body as an inverted pendulum control system. An adaptive autoregressive algorithm will estimate the biomechanical parameters of the model. Future implications of this study include use of the center of pressure to estimate movement of the center of mass and to develop new therapy techniques to help children with cerebral palsy improve balance control.

Evaluation of Design and Processing Parameters for Extrusion Blow Mold Pinch-Off Design

Cody Green, Ian Laskowitz, and John McConnell (Jon Meckley), Penn State Behrend, School of Engineering and Engineering Technology – Plastics Engineering Technology

Pinch-off weld line strength is crucial in extrusion blow molding. This experiment is intended to determine and quantify the processing parameters and design parameters that will produce the strongest weld line strength. Using a three-level Design of Experiment (DOE) for making the test specimens, the specimens were tested for tensile strength. These data were then used as a guide for producing quality pinch-off weld lines with less guesswork. It was found that Flash Pocket Depth had the largest effect on weld line strength. It was also found that cooling had an effect, but only at low levels of Flash Pocket Depth and a high level of cooling. The higher temperature did not have a larger weld line when compared to the lower temperature. It was also concluded that Angle 1, Angle 2, and Distance to Second Angle did not have a major effect. Future studies are being planned to isolate these factors by keeping Flash Pocket Depth and cooling at a constant level. Further analyses are also being planned to test the impact strength of the pinch-off area.

Condition-Based Maintenance - What It Does and How It Works

Thomas Hauser (Robert Gray), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering Technology

Condition-Based Maintenance (CBM) can be used for many purposes including preventive maintenance. Preventive maintenance is that type of maintenance that tries to prevent a failure before it becomes a catastrophic failure. For example, for humans, an x-ray may be used as a preventive maintenance to detect a possible life-threatening disease. As the reader is aware, depending on what specific disease the physician is most interested in detecting, a specific technology is chosen to help detection. The same is true in the maintenance field for transportation systems: there are different types of technology available for employing preventive maintenance of specific systems. Some technology detector-sensors being utilized in the transportation maintenance field include: ultrasound, x-ray, or infrared thermography. For example, fan blade cracks in aircraft engines or wing fractures on aircraft have been found by use of x-rays. As an introduction to CBM, this presentation will discuss related CBM undergraduate research work made possible by a grant provided by PSU Erie and GE Transportation Systems. It is important to note that once a commercial, off-the-shelf technology is chosen to help find a potential failure, the post-processing of the data (analysis) is critical. For many CBM initiatives, analysis of the data requires advanced statistical processing. When CBM is successful in preventive maintenance initiatives, the results can save time and money. Preventive maintenance practices are implemented to increase the reliability of a system or process and increase customer product satisfaction. Additional reasons for using CBM are to decrease system downtime and repair cost and to increase the reliability and service life of the product.

Laser-Guided Rocket

Jason Kocher (Thomas Hemminger), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering

The turbulent months since our country was attacked have fueled a desire to protect the United States, which is the basis for a research project of this nature. While not unlike laser-guided devices already in use in the military, the circuitry in this rocket was built from the basic theory taught in a digital design course at Behrend. This research project is centered on building a laser guidance system housed inside of a fiberglass rocket prototype. There are no plans for launch as part of this research. Most important is the circuitry (the digital brain) that is responsible for adjusting the rocket's flight. This circuitry will tell the fins how to adjust in order to guide the rocket to its intended target. In practical applications a target is illuminated by an infrared laser; for demonstration purposes a coded visible red laser will be used.

Thanks to Dr. Chris Coulston and Jaimie Skibicki for their assistance on PC board production.

Development of a Residential Renewable Energy System

Timothy S. Meyers (Robert Weissbach), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering Technology

Due to the rising costs of electricity, the desire for environmentally friendly energy generation, and the potential for power system outages, there has been a push to promote renewable energy in this country. Major sources of renewable energy are solar, wind, and hydro-electric. The purpose of this project is to see if a residential house in Erie can be powered solely by wind and solar energy. The author has acquired solar and wind data for the region over a period of five years, and is evaluating the capability of powering a home that is not connected to the power grid. As part of the evaluation, a survey has been conducted which provides information on the critical loads of a residential home in the Erie, Pennsylvania, area. The author can then use these data to help in the design of an environmentally friendly home which minimizes necessary energy consumption to ensure that solar and wind energy will be sufficient to power the home throughout the year.

Hardware Electronics and Software Assembly Language Development towards a Microcontrolled Antenna Stepper Motor Application

Michael J. Skrekla II (Robert Gray), Penn State Behrend, School of Engineering and Engineering Technology – Electrical Engineering Technology

As technology continues to evolve, it is necessary to keep engineering and engineering technology students at Penn State Erie informed of concepts via theory, but also as important, is to allow students to experiment hands-on with the same technology so they can synthesize theory and real-world systems applications. Microcontrollers are being implemented in many systems applications, such as to control a ground-based steerable antenna so that it remains pointed at a distant satellite orbiting the earth. This undergraduate research project was focused on developing software code and hardware electronics that could be used to control a stepper motor by using low-level assembly language programming and a low-cost development trainer board. The low-level programming was based on the Intel 8086, 16-bit microprocessor instruction set. The experiment performed during summer 2001 not only helped the student researcher "solidify" theory taught in several previous electrical engineering technology courses, but an additional outcome was that it provided an additional hands-on lab taught during fall 2001 for new sophomore students preparing to study microprocessors and microcontroller theory. Future student research will focus on continuing to build on this project by developing an antenna azimuth slew control algorithm, which uses signal strength provided by a satellite radio receiver and attitude signals from an external navigation sensor.

Designing Multimedia Software Modules for the Web: The Students' Perspective

Jill Johnson¹, Kathleen Scarpino¹, and Jesse Matola¹ (Kathy Holliday-Darr¹ and Carla Torgerson²), ¹Penn State Behrend, School of Engineering and Engineering Technology – Mechanical Engineering Technology and ²Penn State Behrend – Instructional Design

An interdisciplinary team of students worked with faculty and an instructional designer to develop a set of Web-based modules to teach fundamental concepts in engineering graphics. These modules were developed to address the concepts that in the past gave the students the most difficulty. The modules were programmed in Authorware so that they would have wide accessibility on the Web. Each module contained still and moving images to highlight key ideas. Each module also contained an interactive self-assessment component.

Courseware for Observational Research (COR) and its Redesign: A Student's Perspective

Jonathan Lobaugh¹ and Jacob Cornwell² (Dawn Blasko³, Victoria Kazmerski³, and Carla Torgerson⁴), ¹Penn State Behrend, School of Science – Computer Science; ²Penn State Behrend, School of Business – Management Information Systems; ³Penn State Behrend, School of Humanities and Social Sciences – Psychology; and ⁴Penn State Behrend – Instructional Design

A team of students worked with faculty and an instructional designer to develop an interactive psychology tool to teach and reinforce the methods and procedures of observational research. COR, originally designed in a legacy media system, has been updated to Macromedia Director[®]. With the new implementation, additions to usability and interactivity have been designed to fit with the growing use of broadband and an increased media quality. COR is used to supplement the teachings and lectures of the psychology department and allow dynamic content to be created for teacher-to-teacher use.

A Study of Factors that Influence Students' Calculus I Performance

Patrick Shaughnessy (Pradeep Singh), Penn State Behrend, School of Science – Mathematics

All mathematics majors at Behrend must take Calculus I. There are, however, different paths taken to get to Calculus I. Some students take Calculus in high school, so they are able to test into college Calculus I. Some students may take pre-calculus college courses before taking Calculus I. There are different factors that may affect a student's performance. It is the effect of these factors I wish to study. Knowledge of certain factors that affect students positively or negatively can greatly alter an instructor's perception of a student's academic performance. If an advisor knows in advance what factors may predetermine a student's performance, then he or she may advise a particular student more efficiently. However, administrators can benefit from this knowledge as well. They can use this analysis to fine-tune the strategies to recruit students and improve the student's performance in college. This study will produce results that will reflect a student's performance as a response to various factors other than one's mathematical ability. These factors are important and should be recognized as potential problems or solutions.

Molecular Dynamics Simulation of Reactive Compatibilization in Polymer Blends

Kimberly A. Herrmann (Chuck Yeung), Penn State Behrend, School of Science – Physics

Polymers are long chains of repeated chemical units, monomers, which are useful in industry, especially as plastics. Scientists attempt to blend available polymers to produce composites with the better qualities of 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, a fraction of both types of polymers is end-functionalized so that the otherwise repulsive polymers bind irreversibly at the interface, forming copolymers. Theoretical ideas concerning the reactive compatibilization of polymers have not been thoroughly tested experimentally or numerically. We model the reactive compatibilization of a symmetric binary blend via extensive computer simulations. We study the buildup of the copolymer layer as a function of end-functionalized polymers and as a function of polymer chain length. In the dilute limit, we find the copolymer per area initially grows linearly with time. This regime is predicted theoretically but has not been previously observed. For short chains and large fractions of end-functionalized polymers, we observe the formation of a stretched copolymer layer at the interface and the vanishing of the surface tension.

The Role of Women in the Field of Psychology

Banchiamlack Dessalegn (Clare Porac), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Women have come a long way in the last three to four decades, since the time of the Women's Liberation Movement of the 1960s and the antidiscrimination laws of the 1970s. The number of women in different scientific fields has increased consistently since the late 1970s. In this presentation, I will explore the dichotomous role women play in the field of psychology. Psychology, just like many other scientific fields, had only a few women earning doctorates in the earlier part of the 1900s. For example, from 1920 to 1974, only 22.7 percent of psychology doctorates were awarded to women. This number has increased consistently starting in the early 1980s and has leveled off to the 60 to 70 percent range in the 1990s. Although women seem to be in the majority at the undergraduate and graduate levels, they are still the minority at the governance levels in the profession of psychology. For example, of the 110 individuals who have graced the APA president's office, only nine of them have been women. Several other trends and possible causes for the trends will be discussed. Also, the life of a woman who "cracked the code" will be presented.

Eating Disorders and Ethnicity

Destiny Dudenhoeffler and Melinda Duckett (Victoria Kazmerski and Charisse Nixon), Penn State Behrend, School of Humanities and Social Sciences – Psychology

This study examined the relationships of self-esteem, body ideals, parenting styles, weight and height, socioeconomic status, the desire to lose weight, and ethnicity with eating attitudes. Females, who were 18 years of age, completed the EAT, the MSEI, an ideal body selection picture scale, the Kid's Child Feeding Questionnaire revised for adults, and demographic questionnaire. Actual heights and weights of each participant were recorded. The results support that the desire to lose weight, ideal body choice and self-esteem had effects on the development of an eating disorder. Ideal body choice was found to be a predictor of the likelihood of developing an eating disorder. Body functioning and self-concept, subcomponents of self-esteem, and ideal body choice were found to be predictors of the desire to lose weight. The results also support previous research showing relationships between low self-esteem and high EAT scores.

Integrating Teaching and Research: Training Spatial Skills on the Web

Jessica M. Turos, Amy L. Johnson, and Jennifer R. Enas (Dawn Blasko), Penn State Behrend, School of Humanities and Social Sciences – Psychology

The Web is a valuable resource for both teaching and research. Although the Web has clear applications for improved teaching, we have found that data collection on the Web using tools like Authorware® can also produce research-quality data. In the present work, we report several studies that looked at characteristics of the user (e.g., gender) and characteristics of the task (e.g., site usability) to predict spatial performance. For example, we asked whether students asked to self-train using the Web would improve as much as those who trained in the classroom. We also discuss the benefits and challenges of Web-based research.

The Effect Heavy Metals Have on *Arabidopsis thaliana* Gene Expression

Melissa S. Feile and Erica N. Kalb (Michael Campbell), Penn State Behrend, School of Science – Biology

Presque Isle Bay on Lake Erie in Pennsylvania is contaminated with heavy metals, which consequently have an effect on the development and survival of nearby plants. *Arabidopsis thaliana* was chosen as the model plant to detect gene expression changes in response to the environmental toxins. In this study, *A. thaliana* was grown in soil treated with lead, nickel, zinc, and copper contaminants found in the bay. Soil was treated at known probable effect concentration (PEC) levels: 250 mg/kg (dry weight) for lead, 49 mg/kg for nickel, 600 mg/kg for zinc, and 175 mg/kg for copper. Total RNA was isolated from 22-day-old plants. RNA was labeled and hybridized to an array containing over 9,000 gene sequences. Data analysis demonstrates that over 1,200 genes have altered levels of expression in response to metal exposure. Our goal is to use these gene sequences as markers for detecting metal contamination in the environment.

Genetic Characterization of an *Ambystoma maculatum* Population Inhabiting Penn State Behrend Campus

Jeana Ferilla (Michael Campbell), Penn State Behrend, School of Science – Biology

Amphibian populations are declining worldwide but it is not clear if this decline is associated with a reduction in genetic diversity. This study is being completed in order to examine the impact of human disturbance on the genetic diversity of the spotted salamander (*Ambystoma maculatum*) in northwestern Pennsylvania. Using PCR we have amplified a 240-base-pair region of the mitochondrial genome from spotted salamander eggs collected from a series of ponds located on the Penn State Behrend campus. Previously, other students in the biology program at Behrend have shown that salamanders on the north side of the campus contain a unique mitochondrial genetic profile, which includes a series of deletions within the amplified region. This project is being expanded to include the use of microsatellite markers as a genetic tool. Microsatellites are more informative genetic markers, which will allow us to map more finely the genetic diversity of salamander populations on the Penn State Behrend campus. Construction of an athletic complex and a highway will result in wetlands mitigation that will greatly alter the breeding environment for the population of spotted salamanders containing the mitochondrial deletion and microsatellite sequences. Data from the previous mitochondrial analysis and the proposed microsatellite experiments will result in the characterization of salamander populations before and after highway construction.

Localization and Characterization of Triclosan Resistance in *Pseudomonas putida* TriRY

Ryan D. George and Rebecca L. Waddell (Maura Meade-Callahan), Allegheny College – Biology

Triclosan is used as an antimicrobial ingredient in hundreds of commercial and household products including soaps, oral care products, plastics, and fabrics. Previous research indicates that triclosan resistance of *Pseudomonas putida* strain TriRY is linked to a degradative or detoxification pathway. There were three main goals of this study. First, localization of triclosan resistance genes to plasmid or chromosomal elements was investigated through curing plasmids from TriRY and evaluating the resistance responses of wild type “cured” bacterial strains. Second, a genomic DNA cosmid library was constructed of experimental strain RDG2 and transformed into *E. coli*. Resultant transformants were screened for acquired triclosan resistance. Third, RDG2 was subjected to UV mutagenesis and mutants with altered resistance to triclosan were selected and characterized. Finally, primers were designed to common motifs of catechol dioxygenase genes from other *Pseudomonas spp.* Dioxygenases are enzymes involved in the degradation of other halogenated aromatic compounds. A 1 kb PCR product was amplified and sequenced. The results of these experiments provide a basis for elucidating the molecular mechanisms of triclosan detoxification by *Pseudomonas putida* TriRY.

Determining the Genetic Composition of Grass of Parnassus

Matthew L. Hillwig (Michael Campbell), Penn State Behrend, School of Science – Biology

Grass of Parnassus (*Parnassia glauca*) is a threatened plant species in Pennsylvania that grows in the Wintergreen Gorge located on the Penn State Erie campus in Erie, Pennsylvania. Grass of Parnassus is a unique calciphyte needing specific conditions to survive: constant moisture and high soil pH. Therefore, habitat loss is a major concern for this species. The plant is a perennial with unique flowers, but little biological and genetic information is available for this species or any species in the genera of *Parnassia*. Therefore, any information generated for this plant would be a contribution to the scientific community. Nuclei were isolated and stained from *Parnassia glauca* tissue for genome size analysis using flow cytometry in collaboration with the Associated Clinical Labs in Erie, Pennsylvania. Based on comparison to *Arabidopsis thaliana* nuclei of a known genome size of approximately 117 Mb (AGI), the size of the *Parnassia glauca* genome was determined to be 162 Mb. A cDNA library will be produced for *Parnassia glauca* in the late spring semester of 2002. The gene library will be used as an educational tool in the undergraduate molecular biology class. Students will isolate, sequence, and compare individual cDNAs to known plant genomes.

Identification of an Unknown Gene in *Arabidopsis thaliana* and *Solanum tuberosum*

Nathan David Polansky and Lee Thomas Szkotnicki (Michael Campbell), Penn State Behrend, School of Science – Biology

Complete genomes are being sequenced for various organisms, such as humans, fruit flies, and thale cress (*Arabidopsis thaliana*). However, these large sequencing projects have created a new field in biology. Genes are now isolated but no known function can be assigned to them. NDP, a previously unknown and uncharacterized gene, was isolated from a dormant potato meristem cDNA library. Blast analysis has shown that NDP has homology to a single copy putative gene on the *Arabidopsis* genome. Our goal is to characterize this unknown gene and its expression in both potato and *Arabidopsis*. Additionally, est sequences from tomato and pepper exhibit a high degree of sequence similarity to NDP. In order to assign a function to the NDP gene we have collaborated with the Gene Knockout facility at the University of Wisconsin and Syngenta Corporation to characterize NDP mutants in *Arabidopsis*. The mutants will provide a powerful tool for observing phenotypic responses in the plants lacking a functional NDP gene. These results and other expression changes will be discussed.

The Role of O⁶MEG MTase in Repairing Daunomycin-Induced Mutations in *Salmonella typhimurium*

Natalya Teygart (William Mackay), Edinboro University of Pennsylvania, Department of Biology and Health Services – Biology

Daunomycin is a naturally occurring anthracycline that has been used clinically in the treatment of a variety of cancers. Daunomycin arrests cell growth by interacting with cellular DNA. 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. The objective of this research project was to study the induction of GC to AT transition mutations with daunomycin in wild type (TA 1535) and MTase deficient (*ada ogt*) (YG 7108) *Salmonella typhimurium* strains. In this study, we show the role of MTase activity in repairing daunomycin-induced transition events.

A Computational Study of the Absorption of Hydrogen by Carbon Nanotubes

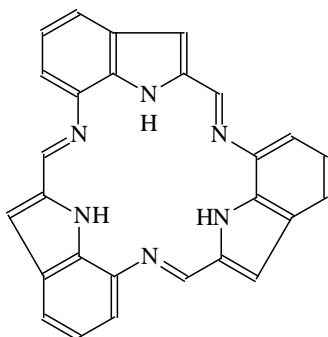
Brett Bentley (Ron Brown), Mercyhurst College – Chemistry

Recent research by Heben and coworkers has suggested that there is a significant uptake of hydrogen by carbon nanotubes that may reach levels applicable for vehicular fuel storage. The levels of absorption shown by Heben have not been able to be reproduced with computational methods, which suggests that either the necessary absorption can not be achieved or inadequacies in the model prevent the interaction from being modeled properly. The purpose of this study was to determine the interaction of hydrogen with the carbon sheet as a function of the curvature. The interaction energy of hydrogen with the carbon nanotube models of various curvatures were calculated. This study was performed using computational methods with the Gaussian 98 *ab initio* software package, and a comparison of the interactions between the hydrogen and the nanotube sheet models over a range of theoretical values.

Synthesis and Characterization of a Potential Magnetic Resonance Imaging Contrast Agent

Brandon Ryan Galan (Alan Jircitano), Penn State Behrend, School of Science – Chemistry

Magnetic resonance imaging (MRI) is an advanced medical technique primarily used to produce high-quality images of the inside of the human body. MRI contrast agents are compounds which are introduced to the body prior to the MRI and which enhance the contrast between healthy and diseased tissues. MRI can also aid in diagnosing various physiological disorders. Complexes of lanthanide(III) ions are effective as MRI contrast agents because of the dispersive effect of their unpaired *f*-electrons on the absorption peaks of water molecules bonded to the metal ion. This research involves a macrocyclic ligand (**I**), which has been designed as a neutral complex when coordinated to various 3+ metal ions. The ligand can be synthesized through a Schiff-base self-condensation reaction of three molecules of 7-amino-2-indole-carboxaldehyde. The first step in making the ligand precursor is the synthesis of a nitro-phenylhydrazone through a diazonium salt intermediate known as the Japp-Klingemann reaction. The hydrazone undergoes a Fischer Indolization forming a nitro-indolecarboxylate. The next step involves reducing the nitro group to the amine, followed by the reduction of the carboxylate group to an alcohol. The alcohol is then oxidized to the 7-amino-2-indole-carboxaldehyde. The ligand precursor has been synthesized as well as a 5-methyl derivative. The synthesis, characterization and progress towards making macrocyclic complexes will be discussed.

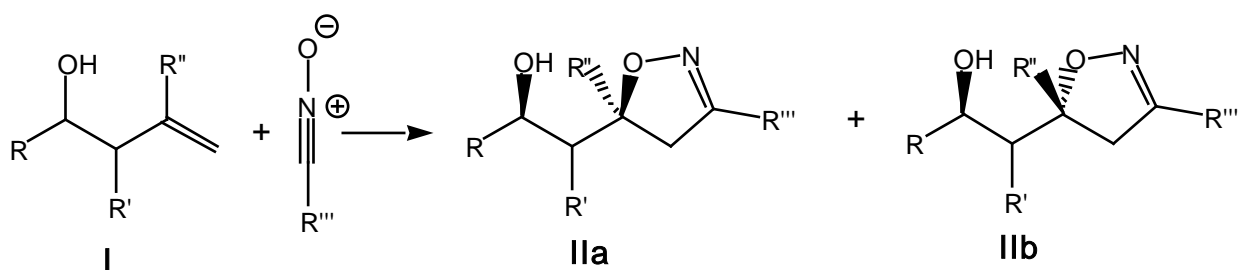


I

Disastereoselective Synthesis of β -Oxy-2-Isoxazolines

Chayanant Hongfa (Martin Kociolek), Penn State Behrend, School of Science – Chemistry

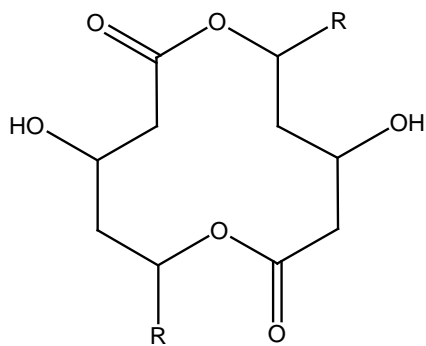
Compounds such as 2-Isoxazolines have been used as versatile synthetic intermediates. While numerous methods for the synthesis of these compounds have appeared in the literature, new stereoselective syntheses of substituted 2-isoxazolines are still highly desired. The stereoselectivity of the reaction of **I** with a variety of nitrile oxides, to give diastereomers **IIa** and **IIb** has been examined. The diastereoselective effect of different substitution on **I** ($R, R', R'' = H$, methyl, or Ph) as well as on the nitrile oxide ($R''' = Br, Ph$ and COOR) will be reported. These 2-isoxazolines (**IIa** and **IIb**) may subsequently be converted to 3,5-dihydroxyamines or 3,5-dihydroxycarbonyl compounds which can serve as precursors to a variety of natural products.



Development of Methods for Synthesis of Verbalactone and Verbalactone Derivatives

Kyle P. Kalbarczyk (Martin Kociolek), Penn State Behrend, School of Science – Chemistry

The macrocyclic dimer lactone (verbalactone) was found by researchers investigating the roots of *Verbascum* plants. This unique 12-membered ring found in nature was shown to possess unique antibacterial activity. This research is focused toward the development of methods for the synthesis of the parent 12-membered ring of verbalactone from substituted isoxazoline precursors. Once these methods are developed for synthesis of the parent ring, they will then be applied to the synthesis of verbalactone itself and related analogues, which may possess interesting antibacterial activity.



Verbalactone
(R =pentyl)

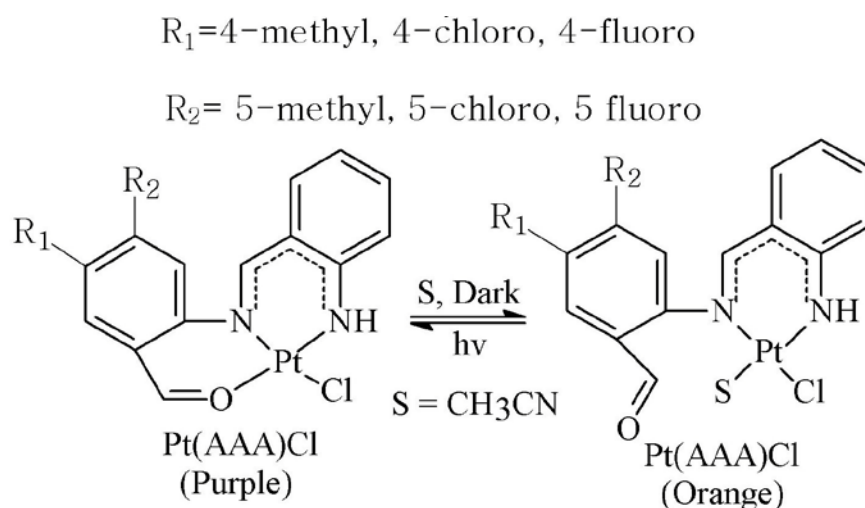
The Characterization of a Digital Micromirror Array for Atomic Absorption Spectroscopy
Jennifer M. Kuntz and Charles K. Utz (Thomas Spudich), Penn State Behrend, School of Science
– Chemistry

In atomic spectroscopy, radiation is converted to an analog signal via a transducer and is preferably stored digitally. With simultaneous, multi-wavelength analysis, spectrometer cost is typically high due to complexity of the acquired signal and large number of detectors. By using a digital micro-mirror array (DMMA) in conjunction with one photomultiplier tube (PMT), multiple wavelengths can be detected simultaneously. Overall spectrometer cost can be lowered, detector sensitivity increased, and high resolution maintained. Current work involves the preliminary characterization of mirror modulation using the video output of an InFocus 425s DMM projector (Wilsonville, Oregon) which contains a 640 by 480 DMMA inside. A photodiode (Radio Shack, # 276-1657) mounted in front of the DMMA acquired the signal while a program modulated the mirrors in quadrants at frequencies of 15, 20, 25, and 35 Hz. A Fourier transform was then performed on all data acquired.

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 non-substituted and mono-substituted platinum (II) compounds of *o*-aminobenzaldehyde. The mono-substituted complexes used for analysis were 4-methyl, 5-methyl, 4-chloro, 5-chloro, 4-fluoro, and 5-fluoro. 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 (hv) 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, FL) measuring the absorbance of the solution over time. Work presented will include replicate analyses using acetonitrile as solvent. A polychromatic test was carried out on the non-substituted platinum complex to test for reproducibility using a UV heat lamp with the absorbance taken every 30 seconds for 10 minutes then every hour after that for a 24 hour time period. The absorbance readings were taken using the UV-VIS spectrophotometer. The test proved that the reaction of the non-substituted platinum complex is reproducible and reversible and should give a rate of reaction for both processes. Further analysis will be needed to determine whether or not if the reaction is photon-specific, wavelength-specific, or even solvent-specific.

Exploring the Emission of Alkali and Alkaline Metals Using the Electric Pickle Demonstration

Michelle Rizzo (Tracy A. Halmi), Penn State Behrend, School of Science – Chemistry

In the past, the electric pickle demonstration has been used to explore the atomic emission of sodium ions. When electrons move from a higher energy level to a lower energy level in an element, a unique color is emitted. This can be demonstrated by electrocuting a pickle. The emission from a pickle is bright orange. Our research explores the emission from metals other than sodium including lithium (Li^+), barium (Ba^{2+}), potassium (K^+), and strontium (Sr^{2+}). Cucumbers were bleached in 30 percent hydrogen peroxide and then pickled in LiCl , BaCl_2 , SrCl_2 , and KCl . Upon electrocution, the pickles glowed pink, yellow, purple, and red/pink respectively. Our results prove that the unique colors emitted from the pickles are from the atomic emission from the alkali and alkaline metals and not from the electric current sent through the pickles as previously suggested.

Identification of the Most Intense Odorants in Persian Lime Juice, *Citrus latafolia* Tanaka

Amie E. Uhal (Mary Chisholm), Penn State Behrend, School of Science – Chemistry

The food and beverage industry uses large quantities of lime products as a key flavoring in soft drinks and many confectionery items. Key lime and Persian lime have different odor profiles. The Key lime odor is described as more harsh and intense, while Persian lime is described as fresh, fruity, and mild. The overall odor activity of Persian lime juice was determined using gas chromatography-olfactometry and the identification of major odorants was achieved using gas chromatography-mass spectrometry. Previous work found that the major odorants responsible for the fresh lime odor in Persian lime oil were 7-methoxycoumarin, linalool, geranial, neral, and other aldehydes. The most intense odorants in Persian lime juice were found to be isocineole, 1,8-cineole, *cis*-linalool oxide, carvone, neryl acetate, geranyl acetate, and 7-methoxycoumarin. Many of the aldehydes that composed the odor of the Persian lime oil were not found in the juice.

Studies of Photochromic Pt(II) Compounds of *o*-Aminobenzaldehyde and Derivatives

Lauren B. Ulrich (Alan Jircitano), Penn State Behrend, School of Science – Chemistry

A platinum(II) complex of a dimeric Schiff-base condensate of *o*-aminobenzaldehyde (oab), Pt(AAA)Cl, has been studied and found to be photochromic. When the compound is dissolved in certain solvents a visible color change is observed when placed in the dark. This is called a photochromic property. Several oab derivatives have been prepared by adding electron-withdrawing and electron-donating groups to different positions of the compound. In past research, electron-withdrawing groups in the one position were suspected to be photochromic while in another they were not. Also, electron-donating groups were suspected not to be photochromic in the one position. Currently, the following compounds have been synthesized: 4-Cl Pt(AAA)Cl, 5-Cl Pt(AAA)Cl, 4-CH₃ Pt(AAA)Cl, 5-CH₃Pt(AAA)Cl, 4-F Pt(AAA)Cl, 5-F Pt(AAA)Cl. The following compounds underwent a visible color change from purple to orange when placed in the dark: 4-F Pt(AAA)Cl, 4-Cl Pt(AAA)Cl, 4-CH₃ Pt(AAA)Cl, and 5-Cl Pt(AAA)Cl. The compounds vary in the degree of color change, some being more intense than others, suggesting that there may be varying degrees of photochromic properties. These properties have been studied with the utilization of ultraviolet/visible spectrometry. The results of these studies will be presented.

Aerodynamic Study of a Dirt Track Race Car

Charles A. Aikins, Bernie Hobi, Nick Adams, Mike Gregory, and Nate Glenn (Robert Edwards), Penn State Behrend, School Engineering and Engineering Technology – Mechanical Engineering Technology

We are currently conducting a project that involves an analysis of a dirt track race car's aerodynamics. There are a variety of tools that we are using to evaluate the aerodynamics of our car. We are first modeling our car in Pro/ENGINEER software (Pro/E) to create a rapid prototype of our car. We are conducting wind tunnel tests on the rapid prototype to measure lift and drag. The Pro/E model is then converted to a solid works file to be evaluated in an air flow program (Flow Works). Once the model is in Flow Works we then apply the same conditions that occurred in the wind tunnel. We are then comparing the Flow Works results to our wind tunnel results to confirm the accuracy of both tests. If the tests coincide with each other, we then know that we have an accurate means of testing. Time permitting, we will make modifications to the roof to increase down force on the spoiler to increase handling around corners.

The International Organization for Standardization's Upcoming Standards for Personal Financial Planning

Leslie D. Coven (Kay Johnson), Penn State Behrend, School of Business – International Business and Finance

The differences in cultural characteristics between people of different countries are vast; however, when concerning aspects in a desirable financial planner, all people want the same basic high quality. The integration of culture and interdependence of markets has stimulated the International Organization for Standardization (ISO) to begin drafting worldwide standards for the financial planning industry.

The area of analysis involves raw research of participating ISO member countries. I had the unique opportunity to assist a member of the United States' Technical Advisory Group (TAG) to see if and where commonalities exist. Australian, Japanese, Swedish, and English guidelines/propositions for personal financial planning were compared on a topic spreadsheet to the United States' own Certified Financial Planning (CFP) standards. The spreadsheet revealed several common topics, which can be used as a reference when drafting the actual standards.

Stability of Satellite Orbits near the Outer Edge of a Circumplanetary Hill Sphere

Justin R. Crepp (Darren Williams), Penn State Behrend, School of Science - Physics

In the search for habitable extra-solar planets or satellites, it is imperative that we understand the long-term dynamics of a satellite's orbit, for the plausibility of harboring life is dependent on the stability of an orbit. If a satellite orbits its host planet chaotically, inconsistencies in climate arise on both the satellite and the planet. Using SWIFT, a fortran orbital integration scheme, we have investigated Lyapounov timescales for three-body problems concerning the Sun/Earth/Moon system and giant gaseous planets orbiting Sun-like stars with fictitious satellites of variable mass.

Results confirm that satellites do not maintain long-term stable orbits much further than approximately one half the Hill Sphere for that particular system. Also, more massive satellites and retrograde orbits are less chaotic further out into the Hill Sphere. There is an important conclusion that can be drawn when one analyzes the rapidity with which Lyapounov timescales fall off as initial semi-major axis increases. If a habitable satellite does orbit a planet, the probabilistic argument can be made that the satellite will remain stable for more than 10^6 years or has already been stable for at least that long.

Gas-Assisted Capture of Earth-Sized Moons around Extrasolar Giant Planets

Brian L. Sands (Darren Williams), Penn State Behrend, School of Science – Physics

Today nearly 20 Jupiter-sized planets are known to orbit within or near the habitable zones of their parent stars. Some of these planets might support life on their moons if their moons are able to form and hold onto sizeable atmospheres. Moons larger than $\sim 0.2 M_{\text{Earth}}$ should have little trouble holding their atmospheres for billions of years. But forming moons of this size through pair-wise accretion of small bodies in low-mass circum-planetary nebulas may be difficult. A more plausible scenario is for giant moons to be captured through collision of an earth-sized planetary body with a gaseous proto-planetary disk around a giant planet, as is thought to have occurred to form Triton around Neptune. Such collisions can remove enormous amounts of energy from the impacting body and often result in a bound satellite on a near-circular orbit. Here we demonstrate that for a reasonable set of nebula parameters, permanent capture of large moons can occur. The effects of initial moon mass and planet mass are considered as well as various impact parameters and local nebula conditions.

Grain Detection in Photoelastic Stress Images

Bruce P. Tepke (G. William Baxter), Penn State Behrend, School of Science – Physics

We have developed a method for finding the centers of all grains in a photoelastic stress image as part of a study of stresses within a two-dimensional granular material. The experimental grains are optical fibers of uniform size, which are placed in a test cell with their optical axes parallel. When the cell is placed between polarizers and illuminated, the light transmission through each fiber grain is determined by the stress at that point in the material and the orientation of the polarizers. All fibers do not transmit light uniformly; some may not transmit light at all, which makes finding the centers of all the grains challenging. Failing to accurately locate even a few fibers out of thousands in a packing can cause our analysis technique to fail. This poster will show how this problem was resolved by using images taken with both reflected and transmitted light and applying image processing techniques such as unsharp masking and circular Hough transforms. We will also describe software used to check the accuracy of the detection process.

Do Males and Females Prefer Symmetrical Faces and Objects?

Jaimi Bonczar, Katie Przepyszny, and Jennifer Plummer (Derek Mace), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Male preferences for symmetrical female faces has been interpreted by evolutionary psychologists as an evolved strategy by which males select healthy and therefore reproductively viable mates. If this is in fact an evolved adaptation or brain module, then males should not prefer non-human symmetrical objects. Using existing methodology we will compare male and female preferences for human and non-human (flowers) symmetrical and asymmetrical forms. If evolutionary modularity is correct, we expect to see no preference between non-human symmetry and asymmetry. If a difference is seen in the direction of male and female preference for symmetry in both faces and non-faces, then a generalized preference for symmetry may be responsible.

Testing Lexical Connections in Bilinguals Using the Picture Naming Paradigm

Claudia Diaz and Amanda Mitchell (Derek Mace), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Currently there are two contrasting views pertaining to the structure and representation of more than one language in memory. One view (fractionated view) proposes that words from each language are stored in separate lexicons and their corresponding concepts are connected at a semantic level. The second view (wholistic view) proposes that words and their concepts are stored in one common supralinguistic memory structure. If knowledge of both languages is activated simultaneously, then there is a possibility that they will interfere with one another and slow processing. In order to measure this we formed four conditions that mixed the bilinguals' two languages (Spanish (L1) and English (L2)) by asking for same language responses and mixed language responses when naming pictures. The subject's response time will be measured. We expect to find a greater delay when the task involves activation of both lexicons, further supporting the fractionated view.

Gender Differences in the Perception of Personality Based on Eye Contact

Julia L. Fennell and Jackie Tetuan (Victoria Kazmerski), Penn State Behrend, School of Humanities and Social Sciences – Psychology

The purpose of this study was to examine the effects that male and female eye contact duration has on how others perceive their personality and thereby examine the differences society has in the perception of personality characteristics between genders. This was achieved by having male and female participants view four video clips varying in eye contact duration and gender conditions and then complete a questionnaire on how they perceived the model's personality immediately following each video clip. The results supported our prediction that females who sustain low eye contact were perceived to have more positive characteristics, while males in the same condition were perceived to have more negative characteristics. However, there was no significant difference between males and females who sustained high eye contact. Awareness of society's tendencies will allow both the interviewer and the interviewee to take precautions in this type of setting.

Gender Comparison of Physiological and Emotional Response to Erotic Reading Material

Miranda Galbreath and Adan Huber (Victoria Kazmerski), Penn State Behrend, School of Humanities and Social Sciences – Psychology

This study compared physiological and emotional responses of males and females to erotic reading material. Questionnaires were administered to each participant to gauge responses to material. Pulse rates were used to measure physiological response. It was hypothesized that males and females would experience more arousal and less guilt and shame in response to erotic material with romantic content than to erotic material without romantic content. Although further research is required, results approached support of this hypothesis. Through this research, we hoped to gain insight into potential methods to improve sexual communication between romantic partners, thereby discovering possible ways to reduce the rate of divorce due to lack of communication in married couples.

Sex Roles and Interpersonal Violence Perceptions among Male and Female College Students

Christina Gritzer, Kara Kaufman, and Danielle Bemis (Victoria Kazmerski), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Perceptions of interpersonal violence and sex role categorization among 119 male and female college students was studied. Each participant was given a test packet containing a demographic survey, Bem Sex Role Inventory (BSRI), Conflict Tactics Scale (CTS), and violence vignettes. Results indicated that perceptions of violence varied depending upon the severity of the violence, the gender of the victim, and the type of abuse. No support was found for the original hypotheses that both males and masculine sex types would rate the vignettes as less serious than females and feminine sex types, respectively. No relationship was found between CTS scores and seriousness ratings, nor was there a relationship between realism and seriousness ratings. These findings may have been a result of college students, as a whole, becoming less tolerant of positive attitudes toward violence.

Concurrent Validity of Self-Report and Observations of Technology Use

Linda M. Kelso (Victoria Kazmerski and Dawn Blasko), Penn State Behrend, School of Humanities and Social Sciences – Psychology

This study tested the ability of a self-report survey to predict actual teacher/student technology use. Seventeen Erie area K-12 teachers completed an online survey designed to measure their technology use, technology attitudes, anxiety levels, and innovativeness. The teachers were then observed to see if the survey was a good predictor of classroom technology use. Results showed low correlations between reported and actual technology use, indicating that self-report was not the most accurate predictor of behavior. The participants also tended to over report use. Although more research is necessary to validate these findings, this study indicates that an observational period could be an important addition when testing educators' attitudes toward technology.

Language and Emotionality in Bilinguals

Alejandra Marroquin, Erica Martire, and Malinda Baez-Sprague (Victoria Kazmerski, Dawn Blasko, and Derek Mace), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Bilinguals are individuals who speak two languages, which have different syntax, speech sound, and meaning. It is hypothesized that bilinguals commonly code-switch (switching from one language to another while speaking) when in an emotional state. We are interested in observing how Spanish-English bilinguals relate language to emotion. This will enable us to understand how language relates to emotionality. In the experiment we will examine if bilinguals have a language preference in relation to emotion. We will acquire a better understanding of the social, cultural, and situational influence bilinguals experience through their first language. Thirty-two native Spanish participants will be run. Eighty topic and vehicle pairs will be shown to participants. They will be asked how related the two-word pairs are using a scale from one to five. They will use a scale of one to five to rate ease of imagery. The participants will have to write down an emotion, if any, related to the word pairs, using a scale one to five participants will rate how emotional they felt in relation to the word pair. This will take place under four conditions: English-English, Spanish-Spanish, English-Spanish, and Spanish-English. Future studies can investigate the relationship between language and emotionality utilizing specific scenarios that will provoke emotions.

Relational Aggression in Middle School Students

Kathleen E. Perry (Charisse Nixon), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Previous research has shown relational aggression to be a form of aggression in which a person uses a relationship to emotionally harm another. This particular form of aggression has been found to be used more often by girls than boys. Relational aggression is often overlooked in the wake of overt (or physical) aggression but more recently some characteristics and correlates of RA have been discovered. The first purpose of the present research was to look closely at the characteristics of the aggressors and the victims of relational aggression in middle school girls in Erie County. Primary emphasis was given to examining the role of normative beliefs as they may relate to RA. The findings of this study will aide in preparation of intervention programs aimed toward reducing relational aggression and victimization in middle school students.

ERP and Behavioral Evidence of Individual Differences in Metaphor Comprehension

Jackie Tetuan, Alejandra Marroquin, Banchiamlack G. Dessalegn, Matt Stevenson, Brooke Springer, and Linda Kelso (Victoria Kazmerski and Dawn Blasko), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Our previous studies have shown that there are differences in the way high and low IQ participants process metaphors. In lower IQ participants, metaphor processing is less automatic than in the high IQ participants. There are several possible explanations for this effect. In this experiment we sought to investigate why such differences occur. Thirty-four undergraduate native-English speakers were asked to rate the familiarity and ease of comprehension for 40 metaphors, and they also wrote their own interpretation of each metaphor. We also measured several aspects of working memory. The low and high IQ groups did not significantly differ on their self-reported ease of comprehension, therefore there wasn't a difference in difficulty of understanding the metaphors between the low and high IQ groups. However, they did differ on the quality of their interpretations; the high IQ group had significantly fewer very poor quality or missing interpretations than the medium or the low groups. Also, a positive correlation between working memory and IQ was found. This is an interesting finding that will enable us to understand why participants with lower IQs have difficulty interpreting the metaphors.

The Relationship between Spirituality and Recovery from Alcoholism

Eddie Thiry III and Adam Gatti (Derek Mace), Penn State Behrend, School of Humanities and Social Sciences – Psychology

Previous research suggests that the spiritual aspect of Alcoholics Anonymous is vital to the success of the treatment program. The basis of recovery in AA is spiritual growth through the practice of certain spiritual principles. The purpose of this study is the further exploration of the relationship between spirituality and recovery from alcoholism. The level of spirituality, the permanence of recovery, and the relationship between these two variables will be assessed by the results of a spirituality/recovery questionnaire, filled out by participants from AA meetings. We expect our findings to reinforce the centrality of spirituality in recovery through AA participation while indicating that alcoholics who experience spiritual growth have a greater likelihood of establishing and maintaining long-term recovery.

Reducing Math and Technology Anxiety in Undergraduate College Students

Jessica M. Turos and Amy L. Johnson (Dawn Blasko, Victoria Kazmerski, and Derek Mace),
Penn State Behrend, School of Humanities and Social Sciences – Psychology

Research suggests that as math anxiety increases, working memory decreases. We measured working memory and anxiety levels. High anxiety participants were identified and then assigned to either a three-session intervention group or a control group. The first session of the intervention focused on introduction of the researcher and the concepts of spatial skills and gender difference in math and spatial skills. The second session of the intervention focused on mathematics and the third session focused on technology. Both the intervention and non-intervention groups had their anxiety levels decreased (math, computer, and clinical). After looking at planned comparisons, the males in the intervention group had their math anxiety level significantly reduced ($p = 0.02$) and the females in the intervention group approached significance ($p = 0.07$). Neither the males nor the females in the non-intervention group achieved this.

Parenting Style and Its Influence on Attachment in College Love Relationships

Heather D. Twining and Maggie M. Skopow (Derek Mace), Penn State Behrend, Humanities and Social Sciences – Psychology

A large amount of research into parenting style and its link to attachment in the parent-child relationship exists. However, the influence of parenting style on later patterns of romantic attachment has not been as thoroughly examined. Our research will investigate the correlation between the three different parenting styles (Authoritative, Authoritarian, and Permissive) and the three different patterns of attachment (Secure, Avoidant, and Anxious/Ambivalent), using Buri's Parental Authority Questionnaire (1991), Hazan and Shaver's Three Category Measure of Attachment (1987), and Hazan and Shaver's Love Experience Questionnaire (1987). Based on existing research, we expect Authoritative parenting to be correlated with Secure attachment, because authoritative parenting most often provides the secure child-parent attachment.

Working Memory and Dual Task Interference

Nicole M. White and Ryan M. Maddock (Derek Mace), Penn State Behrend, School of Humanities and Social Sciences – Psychology

The standard conceptualization of Baddeley's (1998) working memory model is a tripartite model that consists of a central executive subserved by two buffers: the phonological loop and the visuo-spatial sketch pad. Some studies have suggested a model that consists of many buffer systems; the multiple component model of working memory. Using the dual task procedure we will assess the tripartite model by pairing two different memory tasks together. The first group will be given the Operational Span Task (OPT span). The second group will be given the OPT span with an additional verbal task. The third group will be given a star-tracing exercise and the OPT span to assess the model by pairing these tasks together. If interference occurs in the third condition then the buffer system will be supported.