Simulators for modeling the creation of caverns are not a new idea; however, few if any of these models are able to model a three-dimensional environment. The aim of my research was to create a cavern simulator using the known equations for modeling the dissolution of limestone-based rock, in order to allow geologists to better understand how caves form by speeding up the change from a hairline fracture to a full-size cave. Developing the simulator in Python, an open-source language, my work was in establishing an efficient and scientifically correct basis for the simulation; the simulation itself was designed as a three-dimensional grid of fractures which would widen depending on the flow rate and calcium concentration of the water moving through them. Future versions of the simulation will incorporate distributed computing (processing using multiple machines in tandem) or supercomputer processing in order to further accelerate the rate at which we can model cave formation.

Ceramic ovenware industry coatings and colors are mainly limited to white or off-white hues. To test ovenware coatings and colors, clay body and glaze formulas were developed. Molds were designed to create multiple forms for the ovenware. Three clay body formulas were tested for hardness, shrinkage, and absorption. Twenty-seven glaze formulas were tested for color and crazing. Two glazes were chosen and applied to the ovenware pieces. Glazed ovenware test tiles were electroformed with copper to test copper adhesion to the glaze. The copper failed to form a stable interface with the glaze. The electroform bath was found to destroy the glaze coating on the ovenware. Food safe and oven safe methods for electroforming were difficult to perform. Electroforming was not found to be the correct technique for coating glazed ceramic ovenware with copper. Further research will be performed involving metal embedded in the ceramic ovenware and using metallic glazes.
Throughout this Muskie Fellow position, I gained experience in various areas. Each of these experiences prepared me to reach my goal of becoming a successful Physician Assistant. My first priority was to review primary journal articles and synthesize this information and primary data into two journal manuscripts. To support these efforts I utilized the reference software Endnote and was able to extract pertinent information from scientific articles efficiently. Beyond these efforts, I also organized an excel spreadsheet to allow me to compare various Physician Assistant programs. The research skills I developed will be critical for my career in the changing field of medicine. In addition, I prepared a detailed two year plan to achieve my short term goal of entrance into Physician Assistant program.

A reclaimed surface mine is one form of an altered habitat. In this way, the original habitat has been changed based on certain reclamation efforts. This influences the type of habitat found throughout a reclaimed surface mine, particularly the density of woody vegetation on a grassland area. In this study, the effects of microhabitat on the reproductive success of grassland birds, as well as the biodiversity of bird species, have been examined. Many nests of multiple bird species were located and identified. The presence and number of eggs and/or chicks were noted, as well as the species. These nests were then marked with flags to note their position. Return visits were made to each of the nests every three days to record the status of the nest. Once the nesting period had ended and the chicks had fledged the nest, a series of vegetation measurements were obtained for each nest. Some of these indicators included the presence of certain plants, as well as the nest’s proximity to woody vegetation. In addition, vegetation heights surrounding the nests were measured. This data was analyzed to determine the effects microhabitat vegetation has on the reproductive success of grassland birds, as well as the biodiversity of bird species.
WATER QUALITY RESEARCH IN THE SALT CREEK WATERSHED  
Kenneth B. Poland  
Environmental Science Program

Over the summer of 2009, the Salt Creek Watershed was analyzed for overall water quality. Thirty-two sites within the watershed were sampled and tested. All sites were analyzed using the Water Quality Index system from the National Sanitation Foundation, which includes a total of nine factors. After analysis, the nine-factor data was compared to data using six factors from previous research on the Watershed; this comparison showed that nine-factor data and six-factor data were statistically the same (null hypothesis confirmed) at the 95% confidence interval utilizing a t-test. Once all sites were analyzed, no strong temporal trends were observed.

THE WILDS SUMMER INTERNSHIP  
Kelley Crater  
Department of Biology

From early May through late June I interned at The Wilds in Cumberland, Ohio. I assisted with veterinary procedures; monitoring anesthesia, running blood work, administering vaccinations, preparing medicine, and collecting fecal samples. I also assisted with research projects such as collecting and analyzing wild snake semen. The types of animals that I worked with at The Wilds included takin, cheetah, giraffe, rhino, antelope species, zebra, Przewalski’s wild horses, and Persian onagers. I worked forty hours a week for seven weeks.

AUDUBON NATURE INSTITUTE’S CENTER FOR RESEARCH OF ENDANGERED SPECIES (ACRES): SSC ANIMAL DEPARTMENT INTERN  
Erin Lycans  
Department of Biology

The mission of ACRES (Audubon Nature Institute’s Center for Research of Endangered Species) is to safeguard endangered animals for future generations through innovative scientific programs that accelerate reproduction and preserve the earth’s genetic heritage. Located on the West Bank of New Orleans, LA., this facility is designed to house scientists whose research programs include studies in reproductive physiology, endocrinology, genetics, embryo transfer, and the expansion of a “frozen zoo” to ensure the future of endangered species through the banking of genetic materials. The knowledge gained through research at the Center will help scientists and conservationists cope with threats to the most seriously endangered species by developing new reproductive technologies and reintroduction techniques necessary to ensure their long-term survival. ACRES offers three different internships: Crane Department Intern, Laboratory Animal Holding Intern (Domestic Cats), and the SSC Animal Department Intern. The SSC (Species Survival Center) internship focuses on a variety of the animals studied including antelope, two species of storks, and wild and domestic cats. Interns gained experience in husbandry, enrichment, diet preparation, monitoring animal behavior, and pen design and maintenance.
WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS) 
POPULATION SIZE ESTIMATION AT DIFFERENT HABITATS AT 
THE WILDS 
Ben Skelley 
Conservation Science Program

In this research, White-tailed deer population size estimation and habitat selection is being studied at the Wilds. Population estimates are being studied in two different seasons. A Spring survey was done from March thru June, 2009, and a fall survey is being done from September thru November 2009. Road survey, deer census are being performed in five different transects throughout the Wilds. The results of this study will produce data that can be used in later studies, including data that can be used to aide in White-tail deer population management.

S. PASTORIANUS OYE SITE W116 MUTAGENESIS AND 
SUBSEQUENT PROTEIN EXPRESSION 
Kristen Fuller 
University of Florida Chemistry REU Program

Old yellow enzyme (OYE) of *Saccharomyces pastorianus* reduces activated C=C into one type of enantiomer, and single amino acid replacements at site W116 of OYE can reverse the stereoselectivity of this catalyzed reaction. Being able to produce pure enantiomers is very useful in industries such as pharmacy, when pure substances are often necessary for proper chemical function. Amino acid replacements were generated at this position (W116) using PCR, electrophoresis, and plasmid preparation to get the mutants, which were then sent off to be sequenced. Replacement of W116 with A, C, G, K, N, R were all successful. Protein was then expressed from these collected DNA samples to be analyzed by UV spectrometry, gas chromatography, and polyacrylamide gel electrophoresis.
From May 26th to August 7th, 2009 the student performed an internship for Math Science Nucleus, a science education non-profit organization in Fremont, California. The intern worked on a long-term project that was being conducted by the City of Fremont and the Math Science Nucleus, completing a total of 226 hours in eleven weeks, averaging 20.5 hours a week. The long-term project consisted of turning a 14.02 acre area of undeveloped land, zoned as a preliminary planned (P) district, into an historic park. Under the supervision of Math Science Nucleus president Dr. Joyce Blueford, the intern produced a trail plan for a proposed interpretive trail for the future historic park. After doing background research on the subject matter and reviewing techniques used in other completed interpretive trails, the intern used maps provided by the City of Fremont GIS Department, background research and various data to design a trail plan for the interpretive trail. The trail plan was used in a concept plan written by Math Science Nucleus earlier this year and received by city council on September 17th, 2009. The concept plan was accepted by city council and is currently being revised.

Grazing has been observed to have a dramatic impact on pasture ecosystems. System composition, structure, and nutrient availability are all important in understanding the entire ecosystem of a grazing community. To provide a greater understanding of grazing impacts, plots were established in four of the five pastures and the data was analyzed after collection. Thirty samples of heavy, medium, and low grazing plots were taken in the four pastures. Plant diversity and plant height were taken in a 1 x 1 meter plot. Plant biomass and nutrition analysis were performed after collection of a central .1 x .1 meter square was taken from each plot. Sample Analysis of Nitrogen Nitrate, Potassium Potash, and Phosphorus were performed on the plant material collected from each plot. Future analyses of the data will provide a greater understanding of the impacts large herbivores have on grassland ecosystems that many captive facilities endure.
MEMORY IDENTIFICATION IN BIPARTITE PAULI CHANNELS
Amy L. Miller
Collaborators: Laura Coffey, Lucas Mentch, and Steven Rubin
Advisor: Michael Frey
Department of Physics and Engineering

The classical communication capacities of quantum Pauli channels with memory are known to exhibit a transition effect. We revisit this phenomenon from the standpoint of the functionally analogous task of channel memory identification. We treat the complete class of Pauli channels with memory and determine the maximum quantum Fisher information achievable both with pure separable channel probe states and with maximally entangled bipartite probe states. These derivations are based on a new, very simple form of the quantum Fisher information that emerges for our "two-use" memory model. A comparison of these Fisher informations reveals four distinct classes of Pauli channels and shows that only those channels that exceed a certain parametric threshold exhibit a transition effect. For those Pauli channels that exhibit this effect, the memory threshold at which it occurs has a simple analytic expression.

SUMMER INTERNSHIP 2009: PHYSICAL THERAPY OBSERVATION
Erik Nesbit
Department of Biology

Physical therapy is a crucial component in today's health care world and is an effective technique to help patients progressively recover to normal human physical functions. In the physical therapy profession, an honorable physical therapist places a patient's needs in front of their own and takes responsibility for their patient. A physical therapist should empower the patient to work at their highest level of function and strive to promote physical fitness. In addition, a physical therapist is caring and is able to set aside individual differences and embrace the patient's emotional and psychological aspects while in the clinical setting. The process of becoming a physical therapist, while extensive, can be quite rewarding. Approximately, a range of 40 to 100 hours of observation must be obtained prior to applying to physical therapy schools. Hospitals, and other health care facilities are wonderful settings for observation. The internship experience was made possible by contacting various physical therapy departments via email or by phone. One hundred and twenty total hours were acquired from four different physical therapy facilities round northeast Ohio throughout the summer.
COGNITIVE PROCESSING DIFFERENCES BETWEEN COCAINE EXPOSED AND CONTROL ADOLESCENTS
J.N. Parrish, D.A. Winiarski, K.N. Garrod, G.S. Starkey, L.C. Mayes, & D.L. Molfese
Neuroscience Program

This study investigated the effects of prenatal cocaine exposure on preliminary cognitive processing during an executive functioning task. A 128-electrode net was used to record brain wave data while the subjects performed the Stroop task, which tests executive functioning. The results showed that CE adolescents had a stronger activation in the lingual gyrus and in frontal areas. Intervention for CE adolescents should include tasks that engage frontal brain areas. Future research should focus on cognitive processing when CE adolescents are performing a visual paradigm. This project was completed in the Developmental Neuroscience Laboratory in Louisville, KY under the direction of Dr. Dennis Molfese.

 STELLAR SURFACE IMAGING OF LO PEGASI VIA LIGHT-CURVE INVERSION
Andrea Richard
Ohio Wesleyan University
Department of Physics and Astronomy
Muskingum University
Department of Physics and Engineering

LO Pegasi or star HIP 106231 was observed for the purpose of mapping its starspots. An eight-inch Meade Schmidt-Cassegrain Telescope was used in conjunction with a Santa Barbara Instruments Group ST-8XE CCD Camera in order to obtain digital images of LO Pegasi and its surrounding sky region. Observation of the star occurred during the months of May, June, and July. Starspots, analogous to sunspots, on the surface of the star are caused by intense magnetic fields. Aperture photometry was performed on the images of LO Pegasi using Mirametrics Mira Pro 7 in order to determine the magnitude of the star. From the photometry, light curves could be produced using the brightness of the star versus its rotational phase. The light curves were then analyzed by the use of Matrix Light Curve Inversion, which is an algorithm that produces an image of the surface of the star and its starspots based on the changes in the brightness of the star as it rotates in and out of the field of view of the telescope.
DEVELOPMENT OF PEPTIDE CAPTURE ELEMENTS AGAINST THE COGNITIVE PROTEIN S6K1
Joseph S. Castle and Wanda J. Lyon Ph.D.
Muskingum University: Dept. of Chemistry, Dept. of MACS 711 HPW AFRL/RHPB, Wright-Patterson Air Force Base, Dayton, Ohio

Detection of cognitive-related proteins could prove vital in detection of memory formation and enhancement of short and long term memory. The S6K1 protein is an effector of the mTOR (mammalian target of rapamycin) pathway and plays a key role in intra-cell functions and signaling. The phosphorylation of S6K1 drives the biological process of transforming short term memory into long term memory. Research findings have concluded that the mTOR cascade can activate this neurological pathway of memory formation when combined with glucose because of its memory enhancing effects. Peptide Phage Display was used to select peptide binding phage against a target protein, S6K1. The M13 phage had been genetically engineered to contain different peptide sequences on their binding surface. Once phage were bound to the S6K1 protein they were pH eluted from the protein and were used to infect a strain of Escherichia coli ER 2738 which subsequently amplified the phage pool. After several rounds of selection and amplification, the phage DNA has isolated for sequencing. After sequencing a representative number of phage, the results were compiled and peptide amino acid consensuses were determined.

AN ETHOGRAM OF DHOLES (Cuon alpinus) IN LARGE ENCLOSURES AT THE WILDS
Traci Watts
Department of Biology

The dhole is a rare, social dog native to southern Asia that has been studied very little and not much is known about this species social behavior. This study has looked into the behavior of two dholes being housed at The Wilds in Cumberland, Ohio. The goal of this study was to observe and record specific behaviors of the dholes by using a modified ethogram that was previously used for maned wolves. Behaviors were recorded every 30 seconds in a 70.41 hour observation period. The data obtained from this study will help others better care for captive dholes in the future.

TEMPERATURE DEPENDENCE OF THE DIFFUSION COEFFICIENTS OF M(BPY)X IN NAFION
Melissa Mull
Department of Chemistry

The goal of this project is to examine the temperature effect on the kinetics and mass transport of different transition-metal bipyridine ligand complex redox probes in Nafion. The temperatures explored are in the ranges of 1-50 degrees Celsius. The solution examined is Ruthenium(II) tris-bipyridine with NaCl as a supporting electrolyte. To study the mass transport and kinetics, cyclic voltammetry (CV) data have been collected, and UV data will be collected. Using the Nicholson and Shain method to look at the kinetics as well as the Randall-Sevick equation to look at mass transport, a k°D1/2 value is calculated at a specific temperature. k° values can also be calculated. As the temperature of the solution increases, the k°D1/2 value was found to increase.