

ABSTRACTS OF PAPERS PRESENTED AT THE 2006 MEETING OF THE TENNESSEE  
ACADEMY OF SCIENCE

## BOTANY SECTION

CLAUDE BAILEY, CHAIR

DEVELOPMENT AND APPLICATIONS OF GEOREFERENCED HERBARIUM SPECIMENS. *Ryan Miller, Andrew Carroll, and Joey Shaw, University of Tennessee, Chattanooga, Chattanooga, Tennessee.* Recent advances in Geographic Information Systems (GIS) allow for new methods of conservation, restoration, and general biological inquiry, especially if data from natural history collections are utilized. Currently, we are databasing and georeferencing the approximately 11,000 plant specimens of the University of Tennessee, Chattanooga Herbarium. The primary focus of this research is to create online, interactive county distribution maps for each plant species. The database will include over 50 searchable characteristic fields based on the proposed Darwin Core 2 format Global Positioning System (GPS) coordinates, date collected, locality description, and reproductive state. Other applications of our research include identifying areas of high plant diversity, highlighting areas of endemism, tracking the spread of invasive species, determining locations in need of additional collecting efforts, and studying flowering times in relation to geographic location. However, the full potential of these and other unnamed applications is predicated on the progress of SERNEC's effort to link and share data among southeastern herbaria.

ALL TAXA BIODIVERSITY INVENTORY AT EDGAR EVINS STATE PARK, DEKALB COUNTY, TENNESSEE. *Rex R. Barber, Volunteer State Community College, Gallatin, Tennessee.* In correlation with the protocol established by the Tennessee State Parks All Taxa Biodiversity Inventory (ATBI), two additional permanent plots were established at Edgar Evins State Park in the spring of 2006. The total is ten established 50 m by 20 m permanent plots. Forest composition of the two new plots was surveyed during the summer of 2006, and the original eight plots were surveyed during the growing season of 2005. Also during the summer of 2006, woody shrubs and saplings were surveyed on all ten plots. Plot number nine, located across Center Hill Lake from the park proper near Indian Creek, is dominated by *Acer saccharum*, *Ailanthus altissima*, and *Sassafras albidum*. Plot number ten, located near the lake edge on Hale's Branch Point, is dominated by *Juniperus virginiana*, *Liquidambar styraciflua*, *Quercus muehlenbergii*, *Diospyros virginiana*, and *Quercus rubra*. A summary of forest composition of the original eight plots, as well as physiography, topography, locations, and survey data of the new plots will be presented. Although recent historical anthropogenic factors may be affecting normal forest succession, the park exists with some notable deciduous forest diversity.

EFFECT OF INTER- AND INTRA-SPECIFIC COMPETITION ON GROWTH AND FECUNDITY OF *MICROSTEGIUM VIMINEUM*. *Scott B. Franklin and Christopher A. Henson\*, University of Memphis, Memphis, Tennessee.* One factor that can greatly influence the success of an invasive species lies in its ability to produce a viable population size in a relatively short period of time. The effects of intraspecific and interspecific competition on growth and fecundity in *Microstegium vimineum* were examined in situ to determine the degree to which manipulation within separate population parameters would influence reproductive output and resource allocation. A strong increase was observed in both growth and reproductive effort upon removal of intraspecific competitive pressure whereas the degree to which the growth and reproduction of the individuals affected by interspecific competition was less conspicuous. The greater increase in growth and reproductive effort upon the removal of intraspecific pressure in respect to the removal of interspecific competition exhibits one major aspect of the success of *Microstegium vimineum* as an invasive species.

FITNESS CONSEQUENCES OF VARYING CROSSING SCHEMES IN *HELIANTHUS VERTICILLATUS*. *Jennifer R. Ellis, Vanderbilt University, Nashville, Tennessee.* Conservation biologists are often interested in the influence of population size and geographic proximity of populations on fitness. Frequently, studies find there is increased fitness or heterosis in the F<sub>1</sub> generation when gene flow is from a large to small population or in crosses between populations separated by large distances. However, increased fitness may not carry through to later generations because of a disruption of positive epistatic interactions among parental alleles due to recombination during and beyond the F<sub>2</sub> generations. Thus, immigration of genetically divergent individuals into a population also can lead to a decrease in fitness owing to dilution of local adaptations or disruption of gene combinations. I present the first generation data of a crossing study of the rare sunflower, *Helianthus verticillatus*, and find that two types of intrapopulation crosses were the most fit and least fit respectively while the interpopulation crosses were intermediate.

THE STATUS OF *PRENANTHES BARBATA*, BARBED RATTLESNAKE ROOT, IN KENTUCKY AND TENNESSEE. *Edward W. Chester, Austin Peay State University, Clarksville, Tennessee.* *Prenanthes barbata* (Torrey and Gray) Milstead (Asteraceae), Barbed Rattlesnake Root, is a rare, short-lived perennial known from eight southern states (AL, ARK, GA, KY, LA, MISS, TN, TX). It is regarded as a species of concern in all states with known occurrences. It is known from one county in Kentucky (Trigg) and from 10 counties in Tennessee, mostly on the Western Highland Rim. Literature reports indicate that plants from west of the Mississippi River are most often found on

\*Student author

floodplains, while those eastward are most often found on drier, upland sites, especially barrens and prairies. Studies on the northwestern Highland Rim of Tennessee and Kentucky showed that the species is usually found in barrens, thickets, or open oak woods surrounding barrens. The number of stems is always small and fluctuates yearly, with or without burning or other disturbance. However, disturbance appears to provide the open habitat where best growth occurs.

#### THE DISCOVERY AND STATUS OF *QUERCUS MARGARETTA* (SAND POST OAK) IN SOUTHWEST TENNESSEE.

**Claude J. Bailey**, Jackson State Community College, Jackson, Tennessee. In 2004 several specimens of *Quercus margaretta* (Sand Post Oak) were collected along sandy hill bluffs of the Wolf River in Fayette County, Tennessee. This is the first report of Sand Post Oak from Tennessee. The habitat and current range of Sand Post Oak includes deep sands and gravels of the Gulf and Atlantic Coastal plains historically from New York to Central Texas and north into northern Mississippi and Alabama. The closest known locality to Tennessee occurrence is ca. 100 km to the south in Calhoun County, Mississippi. Currently, no collections are known from neighboring county of Benton in Mississippi. The Tennessee occurrence is the northern-most occurrence known to date and represents a range extension for the species.

#### ECOLOGY OF AMERICAN CHESTNUT AT MAMMOTH CAVE NATIONAL PARK, AN UPDATE.

**Louis J. Schibig, Jeramie Tinsley\*, Anne M. Osborn\*, and Lloyd Fly\***, Volunteer State Community College, Gallatin, Tennessee. The purpose of this study was to continue the inventory of native populations of *Castanea dentata* at Mammoth Cave National Park. This entailed the gathering of these data: coordinates for each *C. dentata* specimen, site conditions, measurements of stem diameter at breast height (dbh) and height, blight status, flowering status, and associated tree and shrub species. All data were entered into an Excel spreadsheet and analyzed to determine size class distributions, site preferences, and the incidence of blight and flowering. From 2003 to 2005, 1381 American chestnut trees were inventoried in the Park. During the summer of 2006, over 300 new specimens were recorded. Most were blight-free, less than 2.5 cm dbh and under 3 m in height, and many were growing on dry, acidic, sandstone soils on upper south to west-facing slopes in association with *Acer rubrum*, *Oxydendrum arboreum*, *Quercus velutina*, *Quercus coccinea*, *Carya spp.*, *Vaccinium spp.*, and *Kalmia latifolia*.

#### ECOLOGY OF FLOWERING AMERICAN CHESTNUT TREES IN KENTUCKY AND TENNESSEE.

**Louis J. Schibig**, Volunteer State Community College, Gallatin, Tennessee. From 2002 to 2005 data were recorded on 59 native flowering American chestnut trees in Kentucky and Tennessee. Three were found in the Unaka Mountains, 1 in the Ridge and Valley region, 4 in the Cumberland Plateau and Cumberland Mountains region, 2 in the Knobs region, 32 on the Eastern Highland Rim, 11 on the Western Highland Rim, 3 in the Western Coal Fields, 2 on the West Tennessee Uplands, and 1 on the Coastal Plain. The flowering trees represented only 2 % of the 2067 chestnut trees recorded. Eighty percent of the flowering trees were on relatively dry sites (south to west-facing slopes and ridges). Most (75 %) of the flowering trees were blighted. Many of these have been pollinated using hybrid pollen from The

American Chestnut Foundation. The progeny will be used to develop blight-resistant American chestnut trees adapted to various regions of Kentucky and Tennessee.

#### MONITORING RARE PLANT SPECIES IN TENNESSEE.

**David A. Lincicome**, Tennessee Department of Environment and Conservation, Division of Natural Areas, Nashville, Tennessee. The Tennessee Department of Environment and Conservation, Division of Natural Areas houses the state's Rare Plant Protection Program. This program is responsible for accomplishing the recovery of plants listed on the Federal Endangered Species Act of 1973. A key component of this program's recovery efforts is the monitoring of rare plants. Monitoring, to various degrees, is conducted on twenty-five rare plant species. Examples of monitoring efforts include intense demographic monitoring for *Astragalus bibullatus*; population size/condition monitoring for *Lesquerella stonensis*, *Pityopsis ruthii*, *Conradina verticillata* and *Lesquerella perforata*; and presence/absence monitoring for *Arabis perstellata* and *Spiraea virginiana*. Generally six monitoring projects are completed for rare plants each year. Routine monitoring of rare plant populations aids resource managers in making recovery decisions. Management actions are often implemented or modified in response to trends revealed by monitoring results. Monitoring will continue to be an integral component of the Rare Plant Protection Program's recovery efforts.

DETERMINATION OF SOIL NUTRIENTS, MICROBIAL DIVERSITY, AND LEVELS OF HERBIVORY TO ASSESS THE IMPACT OF *VINCA* ON A GOLDENSEAL POPULATION. **Amanda Simpson\* and A. Darlene Panvini**, Belmont University, Nashville, Tennessee. Exotic plants compete with native species, altering native communities. *Vinca*, an exotic vine, is found throughout the Warner Parks in Nashville, Tennessee, including areas where the native and threatened *Hydrastis canadensis*, goldenseal, occurs. The number, height, and width of goldenseal plants were compared with percent cover of *Vinca*. To determine if *Vinca* changes the ecosystem dynamics where goldenseal grows, leaf herbivory, light variation, soil nutrients, and soil functional microbial diversity were assessed. Goldenseal is more prevalent in areas with minimal *Vinca*, and shows significant levels of herbivory compared to *Vinca*. The amount of Fe in the soil is positively correlated to the percent cover of *Vinca*. The percent cover of *Vinca* was greatest in areas with reduced light levels. Understanding how *Vinca* changes the ecosystem and impacts goldenseal populations might help prevent the demise of goldenseal in Warner Parks and aid in the preservation of native ecosystems.

ECOLOGICAL IMPACT OF *LONICERA MAACKII* AS DETERMINED BY SOIL NUTRIENTS, FUNCTIONAL MICROBIAL DIVERSITY, LIGHT, AND HERBIVORY. **Neeley Osteen\* and A. Darlene Panvini**, Belmont University, Nashville, Tennessee. While we know that invasive exotic plants alter native plant communities, less is known about the impact of exotics on ecosystems. *Lonicera maackii*, bush honeysuckle, can be found throughout the Warner Parks in Nashville, Tennessee. Thirty areas, representing high, medium, and low densities of honeysuckle, were assessed for soil functional microbial diversity, soil nutrients, and light levels. Levels of herbivory on honeysuckle leaves were compared to leaf herbivory on native species. Areas with fewer honeysuckles had greater levels of soil functional

microbial diversity and less shade. Differences in Fe were noted in areas with high densities of honeysuckle compared to less dense areas. More herbivory was found on native leaves than on honeysuckle leaves. Our understanding of the impact of exotic species on native plant communities is enhanced when we know whether or not honeysuckle changes ecosystem dynamics.

**CORRELATION OF *LONICERA MAACKII* DENSITY WITH SOIL NUTRIENTS, MICROBIAL DIVERSITY, LIGHT, HERBIVORY, AND POPULATION GROWTH.** *Rejana Wells\* and A. Darlene Panvini, Belmont University, Nashville, Tennessee.* *Lonicera maackii*, bush honeysuckle, is an invasive exotic plant found in the Warner Parks in Nashville, Tennessee, including a parcel referred to as the Northwest Reserve. This study examined the population growth of honeysuckle over a one year period in this reserve, as well as several factors to assess the ecological impact of honeysuckle on the ecosystem. The number of honeysuckle plants and dbh were determined in twelve 10 m<sup>2</sup> plots in 2005 and 2006. Herbivory, soil functional microbial diversity, soil nutrients, and shading were analyzed in 2006. The number of recruits increased significantly in the southern and western plots, which contained the greatest number of honeysuckle. The levels of Fe and Mn in the soil were correlated to the quantity of honeysuckle in each plot. Honeysuckle exhibited less leaf herbivory than native species. These data suggest the presence of exotic species like honeysuckle can change the ecology of ecosystems.

**CAN FESCUE OR ZUCCHINI BE EMPLOYED EFFECTIVELY TO PHYTOREMEDIATE POLYCYCLIC AROMATIC HYDROCARBONS FROM THE FLOOD PLAINS OF THE CHATTANOOGA CREEK?** *Joseph Frelle Simpson\*, Eric Matthew Cohen\*, David S. Percy\*, and Stephen Julius Halperin, University of Tennessee, Chattanooga, Chattanooga, Tennessee.* Polycyclic aromatic hydrocarbons are a major toxicant in the floodplain of Chattanooga Creek, and there is great interest at the federal, state and local levels for clean up of this contaminated site. We are testing two possible candidates for phytoremediation: zucchini (*Cucurbita pepo*) and tall fescue (*Festuca arundinacea*). Plants of either species were grown in six window boxes; three window boxes contained pyrene-enriched soil and three contained untreated soil. Multiple soil samples were taken from each window box before the seeds were added and then two weeks after planting. Pyrene was extracted from the soil samples and analyzed via reverse-phase HPLC. Tall fescue caused a significant reduction in pyrene in the soil whereas zucchini did not. This suggests that tall fescue may be suitable for use in the phytoremediation of the floodplains of Chattanooga Creek.

**GENETIC VARIABILITY OF THE RARE CEDAR GLADE ENDEMIC *ASTRAGALUS BIBULLATUS*: COMPARING ESTIMATES BASED ON AMPLIFIED FRAGMENT LENGTH POLYMORPHISM MARKERS AND ISOZYMES.** *Carol J. Baskauf and John M. Burke, Austin Peay State University, Clarksville, Tennessee and University of Georgia, Athens, Georgia.* Amplified fragment length polymorphism (AFLP) markers were used to investigate the population genetics of the endangered plant *Astragalus bibullatus* (Fabaceae), endemic to limestone cedar glades in Tennessee. Estimates based on 143 AFLP markers indicate that populations of this species are genetically very similar, with genetic identity values between 0.971–0.990.

The  $F_{ST}$  estimate indicates that about 12% of the total genetic variability of the species is due to differences among the seven sites sampled. Averaging across populations, about 40% of the AFLP markers are polymorphic, and mean expected heterozygosity is estimated to be 0.125. These estimates based on AFLP markers are compared with an earlier study of this same species based on 15 isozyme loci in which populations were genetically similar to each other (genetic identities of 0.981 to 1.000,  $F_{ST}$  of 0.089) but genetic variability estimates were lower (25.6% polymorphic loci, 0.063 for expected heterozygosity).

**PHOTOINHIBITION-INDUCED HETEROGENEITY OF QUINONE-B REDUCTION IN PHOTOSYSTEM II.** *Jefferson G. Lebkuecher and Brittany N. Hopkins\*, Austin Peay State University, Clarksville, Tennessee.* Reduced photosynthetic capacity following exposure to bright light results from damage to photosystem II and/or dissipation of excitation energy by photoprotective mechanisms. To determine the effects of short-term, full-sunlight exposure the green alga *Chorella vulgaris* commonly experiences due to sunflecks and/or changes of location in the water column, cells cultured at 200  $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  were exposed to 30 min of 2000  $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ . Electron-transport dynamics and photoprotective transduction of excitation energy to heat via the xanthophyll cycle of bright-light treated and control cells were investigated using chlorophyll fluorescence. The results demonstrate that exposure to 30 min of 2000  $\mu\text{mol photons}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  overwhelmed the xanthophyll photoprotective mechanism, inhibited electron transport from quinone<sub>A</sub> to quinone<sub>B</sub>, and damaged the water-oxidation apparatus. Nonsignificant differences in the photochemical quenching coefficient indicates charge recombination between pigment<sub>680</sub><sup>+1</sup> and pheophytin<sup>-1</sup> in photoinhibited photosystem II allows for continuous quenching of excitation energy by repeated P<sub>680</sub> oxidation.

**A PRELIMINARY FLORA OF THE NORTH CHICKAMAUGA CREEK GORGE STATE NATURAL AREA.** *Stacy Huskins and Joey Shaw, University of Tennessee, Chattanooga, Chattanooga, Tennessee.* The North Chickamauga Creek Gorge State Natural Area (NCCG) consists of 4,864 acres and is located in Hamilton and Sequatchie counties in eastern Tennessee. The NCCG is on the eastern edge of the Cumberland Plateau and is bordered by the Ridge and Valley physiographic province. Broadly defined habitat types support a diverse assemblage of plants on the NCCG's upper plateau surface, gorge slopes, stream banks, and ruderal areas. Floras of nearby areas comprised of similar habitat types have reported over 1,000 species. Ten species with either a state or federal listing are known to occur in the NCCG: *Scutellaria montana*, *Spiraea virginiana*, *Nestronia umbellula*, *Pheperanthus mengesii*, *Sabatia capitata*, *Diervilla sessilifolia* var. *rivularis*, *Lonicera dioica*, *Panax quinquefolius*, *Viola tripartita* and *Glyceria acutifolia*. Nineteen collecting trips were made during the spring and early summer of 2006 and 180 species of vascular plants in 72 families were documented, including several populations of *Scutellaria montana*.

**ASSESSING THE MIGRATORY VIGOR OF *LOLIUM ARUNDINACEUM* IN ASSOCIATION WITH A NOVEL ENDOPHYTIC SYMBIONT USING MICROSATELLITE MARKERS.** *Sheri M. Mersch\*, Middle Tennessee State University, Murfreesboro, Tennessee.* Tall fescue toxicity in livestock caused

by the endophyte *Neotyphodium coenophialum* has been managed by the introduction of *Lolium arundinaceum* varieties with novel endophyte associations, such as MaxQ<sup>®</sup>. This research effort seeks to determine how steadfast this variety of fescue will be on a long-term basis in areas dominated by local endophyte infected *L. arundinaceum* by tracking the population with microsatellite molecular markers. Primers for PCR genotyping were obtained from published studies on similar species with the goal of finding a genetic polymorphism between local varieties (Ky-31) and MaxQ<sup>®</sup>. One such primer set has revealed a polymorphism that has allowed the MaxQ<sup>®</sup> endophyte to be distinguished from the local endophyte molecularly. Fescue samples collected from recently renovated MaxQ<sup>®</sup> paddocks at the Agribusiness/Agriscience Miller Center at Middle Tennessee State University are currently being genotyped with consistent results, making this methodology useful for better understanding the population dynamics of these fescue varieties.

## CELL AND MOLECULAR BIOLOGY

D. GRANT WILLHITE, CHAIR

**DEMONSTRATION OF CELL PROLIFERATION IN ESTROGEN RECEPTOR POSITIVE HUMAN BREAST CANCER CELL LINE T47D BY SYNTHETIC FOOD COLORANTS.** *Payel Datta\** and *Sarah Lundin-Schiller*, *Austin Peay State University, Clarksville, Tennessee*. Breast cancer may be induced by exposure to estrogen and xenoestrogens. These compounds stimulate proliferation of estrogen responsive breast cancer through nuclear-hormone pathway. This study evaluated synthetic food colorants, Sudan 1 (Solvent Orange R) and Tartrazine (FD&C Yellow 5), as potential xenoestrogens. T47D cells, an estrogen responsive breast cancer cell line, were treated with various concentrations of estradiol-17 $\beta$ , Sudan 1, and Tartrazine (0, 0.001, 0.01, 0.1, 1, and 10 nM) for 96h. Cell proliferation was quantified by determining total protein (Bradford Assay). Each concentration was tested in quadruplicate and each experiment was performed in triplicate. Data were analyzed by two-way ANOVA followed by post-hoc Tukey HSD ( $P < 0.05$ ). Results show that the colorants induced significant cell proliferation similar to that seen with estradiol-17 $\beta$ . Future studies will focus on mechanism of action. This is the first study to our knowledge linking these colorants to endocrine disruption and breast cancer cell proliferation.

**INCORPORATION OF HEMAGGLUTININ INTO H5N1 VACCINE VIRUS IS INDEPENDENT OF MATRIX GENE ORIGIN.** *Sheharyar Minhas\** and *Richard Webby*, *Christian Brothers University, Memphis, Tennessee and St. Jude Children's Research Hospital, Memphis, Tennessee*. The manufacture of effective H5N1 influenza vaccine in fertilized chicken eggs has so far been disappointing with manufacturers obtaining only 25% of the yield typically experienced with H1N1 and H3N2 strains. The molecular basis of the poor yield of H5N1 hemagglutinin (HA) was examined in this study by using reverse genetics technology. Specifically, we addressed how the origin of matrix (M1) protein might impact HA yields in a H5N1 vaccine strain targeting A/Vietnam/1203/04. In conventional vaccine seed strains the internal viral proteins, including M1, are supplied by a high growth strain, A/PR/8/34. To assess the impact of M1

origin we created an alternative seed virus, rg-xSAM, in which we replaced the M1 of A/PR/8/34 with that of the A/Vietnam/1203/04 strain itself. The amount of HA incorporated into the conventional and alternative viruses was compared using polyacrylamide gel electrophoresis (PAGE). Our results showed that the inclusion of M1 protein of the A/VN/1203/04 virus did not increase the amount of HA present on the viral envelope. Thus, the study demonstrated that the origin of the M1 protein has little to no effect on the amount of HA incorporated into influenza virions. (Supported by 5R25CA023944 and P30 CA-21765 from the National Cancer Institute)

**CHARACTERIZATION OF THE LYSOPHOSPHATIDIC ACID 3 RECEPTOR VIA COMPUTATIONALLY-GUIDED SITE-SPECIFIC MUTAGENESIS.** *Sana Mujahid\**, *Yuko Fujiwara*, *William J. Valentine*, and *Gabor J. Tigyi*, *Christian Brothers University, Memphis, Tennessee (SM) and University of Tennessee, Memphis, Memphis, Tennessee (YF, WJV, GJT)*. Although they have a high degree of sequence homology, the lysophosphatidic acid (LPA) receptor LPA3, but not LPA2, binds the LPA-receptor antagonist dioctanoyl glycerol phosphate (DGPP). The purpose of this study was to identify the amino acid residues in LPA3 that mediate binding to DGPP. Computational modeling utilizing a validated molecular model of LPA3 was used to evaluate the interaction with DGPP by docking the compound into the LPA-binding pocket. Site-directed mutagenesis was performed on LPA2 and LPA3 to mutate residues predicted to be critical for binding to DGPP. Rat hepatoma 77777 cells were transfected with the mutated receptors and treated with LPA and DGPP, and the calcium response was measured. These preliminary studies have determined that K95, R36, R114, N172 and L281 LPA3 residues are critical for antagonist activity.

**MYOGENIC REGULATORY FACTOR 4: THE SKELETAL MUSCLE TRANSCRIPTION FACTOR WITH POTENTIAL.** *Amy L. Thompson*, *Austin Peay State University, Clarksville, Tennessee*. Myogenic regulatory factor 4, one of four basic helix-loop-helix transcription factors expressed in skeletal muscle, regulates a subset of skeletal muscle genes and has therapeutic potential in treating diseases such as muscular dystrophy. My research shows that MRF4 selectively regulates the adult skeletal muscle Na<sub>v</sub> 1.4 Na<sup>+</sup> channel using several techniques, including Western blotting, immunocytochemistry, and electrophysiological recording. By all methods, Na<sup>+</sup> channel expression was reduced in the absence of MRF4. Additionally, Na<sup>+</sup> channel-associated proteins dystrophin, nNOS, ankyrin<sub>G</sub>, and  $\beta$ -actin were also changed, indicating that MRF4 also plays a role in regulating these genes. Expression of other skeletal muscle genes remained unchanged including the acetylcholine receptor, syntrophin, and the Ca<sub>v</sub> 1.2 Ca<sup>2+</sup> channel. Although transcription factor myogenin partially compensated in MRF4's absence, it could not fully maintain gene expression. Future studies using MRF4 adenovirus will determine the ability of MRF4 to rescue this phenotype and address its therapeutic potential in skeletal muscle disease.

**ALTERED LIPID COMPOSITION AFFECTS THE MEMBRANE DISTRIBUTION OF A MODEL G-PROTEIN COUPLED RECEPTOR, STE2P, IN *SACCHAROMYCES CEREVISIAE*.** *Stacey M. Morgan\**, *Jennifer L. Phillips\**, and *D. Grant Willhite*, *Tennessee Wesleyan College, Athens, Tennessee*. Yeast

cells reproduce sexually by signaling the opposite mating type through the release of pheromone. These signals are received through G-protein coupled receptors (GPCRs) on the cell surface. The effect of changes in the plasma membrane lipid environment on the membrane distribution of the Ste2p receptor was examined. Ergosterol and sphingolipid concentrations were altered by drug treatment or through mutation in the synthesis pathways for the respective lipid. Distribution was determined through isolation of detergent resistant raft fractions via gradient ultracentrifugation and subsequent analysis. Results indicated that some Ste2p receptors are associated with raft fractions, and this association is disrupted by reduction in ergosterol levels. As GPCRs are important receptors in many human cells, this association of Ste2p with rafts has implications for both understanding the function of these receptors and for human health.

**HIGHER ORDER ORGANIZATION OF THE IFNG GENE IN FUNCTIONALLY DIFFERENT CD4+ T-HELPER CELL SUBSETS.** *Elvira R. Eivazova and Yegor S. Vassetzky, Vanderbilt University School of Medicine, Nashville, Tennessee and UMR-8126 Institut Gustave Roussy, 39, rue Camille-Desmoulins, 94805 Villejuif, France.* Using chromosome conformation capture approach we analyzed spatial organization of the Ifng gene in unactivated and activated CD4+ T helper (Th) cells. This approach was combined with analysis of nuclear matrix attachment regions (MARs) by DNA array technique to assess the relationship between the spatial loop conformation and matrix attachment organization in the Ifng gene. We found that the Ifng gene in unactivated cells displayed a linear conformation, but in T cell receptor activated cells it adopted a loop conformation. The spatial gene organization is supported by MARs that characteristically define the Ifng gene in different cell subsets. Selective MARs dynamically changed in parallel with the Ifng gene conformation in T helper cells during their activation and differentiation. We conclude that such structural dynamics provide the means for transcriptional regulation of the Ifng gene during activation and differentiation of CD4+Th cells.

**PREPARATORY STEPS FOR DAUCUS CAROTA TRANSFORMATION WITH AN O-ANTIGEN GENE FROM SHIGELLA SONNEI FOR POSSIBLE VACCINE USE.** *Richard M. Sharpe and A. Bruce Cahoon, Middle Tennessee State University, Murfreesboro, Tennessee.* A transgenic plant is needed to provide a cheap readily available vaccine for diarrheal diseases afflicting children in third world countries. We are working toward transforming the common carrot, *Daucus carota*, with antigenic properties from *Shigella sonnei* to meet this need. Transgenic plant technology for the production of vaccines is a maturing technology. *Shigella sonnei* attacks the gastrointestinal tract causing diarrhea and, if left untreated, can result in death. The work of Joung et al. (2004) suggests it is possible to initiate immune responses in mice via presentation of antigens to the mucosal system by ingestion of transgenic potatoes expressing antigenic genes of hepatitis B. Introduction of a DNA fragment from a bacterium into a plant via transformation by *Agrobacterium tumefaciens* or biolistic methods, transcription, and the subsequent translation and expression of the antigen protein by the plant has already been shown to be viable (Lee, 2004). Introduction of the *S. sonnei* O-antigen *wzz* gene into *D. carota* would provide a palatable edible plant vaccine. We present the completion of the first step and the ongoing work for the

completion of this long term goal. Producing viable antigenic proteins in a plant ready to eat, such as the carrot, is a logical next step.

**q(RT)<sub>2</sub>PCR FOR RELATIVE EXPRESSION OF SELECTED GENES ALONG THE LENGTH OF A ZEA MAYS LEAF.** *Richard M. Sharpe and A. Bruce Cahoon, Middle Tennessee State University, Murfreesboro, Tennessee.* Development of fully functional photosynthetic plant cells requires the interplay of thousands of genes found in three different cellular compartments—the nucleus, chloroplasts, and mitochondria. New genomic technologies and plant genome sequencing is making the discovery and analysis of these genes a possibility. We used corn (*Zea mays*) leaves as a model to study the expression of several of these genes during different stages of development. Quantitative Reverse Transcriptase Real Time Polymerase Chain Reaction (PCR) measures gene expression, and thus genetic products, by quantifying messenger RNA (mRNA) via logarithmic replication. This is accomplished using a viral enzyme, Reverse Transcriptase, to synthesize complimentary DNA (cDNA) from the available mRNA. Once the cDNA has been produced the gene under investigation is amplified allowing for the relative quantification of the mRNA present in the original sample. This is accomplished several ways; labeling nucleotides via radioactivity or dyes which fluoresce upon intercalating into a DNA helix are two commonly used methods. The method presented used the intercalating dye SYBR<sup>®</sup>Green to quantify DNA via fluorescence after each round of PCR. Plotting the amount of fluorescence detected against the PCR cycle number allows for relative comparative analysis during the log phase of amplification.

## CHEMISTRY

MARTIN STEWART, CHAIR

**REGIOSELECTIVITY IN THE COUPLING OF POLYHALO-HETEROAROMATICS.** *Scott T. Handy, Diyar M. Mayi\*, and Alexander T. Piala\*, Middle Tennessee State University, Murfreesboro, Tennessee.* Polysubstituted heteroaromatics are at the core of a wide variety of useful materials, including numerous pharmaceutical agents. Although there are many routes to such compounds, traditional condensation approaches are seriously limited in terms of the range of substitution pattern and substituent that can be accessed. Cross-coupling methods offer much greater versatility, but require more steps for the preparation of polysubstituted compounds. One method of addressing this limitation is to employ sequential couplings of polyhaloheteroaromatics. To render such an approach feasible, the first step is the ability to predict the site and order of such couplings. Research in our group has developed a simple model that addresses this regioselectivity question for virtually every example that has been reported to date. The details of this model and some limitations will be discussed.

**REGIOSELECTIVE DOUBLE COUPLINGS OF DIHALO-HETEROAROMATICS.** *Thomas H. Wilson,\* and Scott T. Handy, Middle Tennessee State University, Murfreesboro, Tennessee.* A one-step, one-pot procedure leading to disubstituted pyridines from the starting dibromopyridines will be described. Key

features include the ability to couple a range of aryl and even alkenylboronic acids at the 2,3 and/or 2,5 positions with excellent regiocontrol under a standard set of conditions. Further, isolated yields are greatly improved by the use of neutral alumina in place of silica for product purification. Finally, the intrinsic electronic bias of the pyridine ring can be overcome by using a bromoiodopyridine. These studies set the stage for further applications of this procedure in the synthesis of biologically interesting compounds and also for extension to trihalopyridines.

**AGING OF PBX 9501: HYDROLYSIS AND FREE-RADICAL OXIDATION.** *Michael R. Salazar, Joel D. Kress, Brian K. Kendrick, Russell T. Pack, Denise K. Pauler, James M. Lightfoot, Wayne A. Rodin, Loreli Woods, and Bobby G. Russell, Union University, Jackson, Tennessee (MRS), Los Alamos National Laboratory, Los Alamos, New Mexico (JDK, BKK, RTP), Cornell University, Ithaca, New York (DKP), BWXT Pantex, LLC, Amarillo, Texas (JML, WAR, LW, BGR).* Estane 5703 is a poly(ester urethane) block copolymer that serves as a glue that binds the crystals of the HMX chemical explosive together. This gives the resulting plastic-bonded explosive (PBX) reduced mechanical sensitivities such that the PBX may be handled and even machined into desired shapes. The urethane units in Estane phase separate into hard domains, while the ester units make up the soft domains of the copolymer. Estane is known to degrade over time by a variety of means and this degradation may alter the mechanical sensitivity of the PBX. Experimental studies have been performed to understand the various means of degradation. In addition, modeling studies have been performed of these experiments that will enable the degradation prediction for a variety of environmental conditions. The results of both the experimental and modeling studies will be reported.

**APPLICATION OF REMOTE ACCESS AND CONTROL OF FTIR SPECTROMETERS FOR TEACHING AND COLLABORATIVE RESEARCH.** *Ngee S. Chong, Beng G. Ooi, Deon T. Miles, and John H. Shibata, Middle Tennessee State University (NSC, BGO), Murfreesboro, Tennessee and University of the South (DTM, JHS), Sewanee, Tennessee.* A collaborative project on the evaluation of methods for remotely accessing and controlling FTIR spectrometers over the Internet was sponsored by NSF's Research Sites for Educators in Chemistry. The goal was to allow the FTIR spectrometers with long path length gas cells and attenuated total reflectance (ATR) accessories to be shared for research and teaching. Two methods for remotely operating spectrometers were shown to be capable of acquiring infrared spectra, searching the spectral database, and carrying out spectral processing tasks. The benefits of this project are the ability to share expensive instrumental resources from different campuses and to provide the opportunity for faculty with complementary interests to collaborate on research over the Internet. In addition, this project demonstrates the feasibility of using remote access of instrumentation to support distance education in analytical chemistry and to bring sophisticated tools of chemical analysis to invigorate interests in chemical education at all levels.

**BLOOMING IN THE CLASSROOM: HOTS IN LOTS OUT.** *Edward L. Brown, Lee University, Cleveland, Tennessee.* Typical science education focuses on delivering chapter content (LOTS) during class time since existing methods for forcing students to acquire course knowledge outside the classroom are largely

ineffective. Classrooms become places where chapter content is regurgitated by a lecturer whereas quizzes and exams seek to determine student proficiency at higher levels of cognitive thinking in Bloom's Taxonomy. This disconnection between knowledge-based lectures and application/analysis-based assessments leads to low test scores, non-engaging classrooms, negative attitudes, and high attrition rates. The solution? Timed/Repetitive Quizzes (TRQs). TRQs are a technologically unique method that delivers course content to all levels of learners in an interactive and fun environment. Proficient learners spend less time on a TRQ, while less proficient learners spend proportionately longer periods of time. The goal is to bring the least proficient learners up to the level of the top learners without creating "busy work" for this latter group. A class proficient at the content and knowledge level of Bloom's Taxonomy is poised and able to engage in Higher Order Thinking Skills (HOTS) and activities inside the classroom.

**USING SPREADSHEET CELL TRANSFER EQUATIONS TO EMULATE DIFFUSION AND THERMAL CONDUCTIVITY.** *Harvey F. Blanck, Austin Peay State University, Clarksville, Tennessee.* Using a spreadsheet to emulate diffusion and thermal conductivity in one-dimensional planar processes by using transfer equations is shown to produce the same results as a plastic model designed by this author, which has previously been discussed and shown to emulate diffusion and thermal conductivity in a variety of situations. Mathematical equations to describe diffusion and thermal conductivity in these various systems are well known and include linear, Gaussian, 1-erf, and Fourier series solutions. The spreadsheet transfer equation approach appears to be equally satisfactory in emulating these transport processes in cylindrical and spherical systems to show the concentration and temperature distribution changes with time. All that is required is to set the initial and boundary conditions and then apply the transfer equations to show the changes that occur with time. The method lends itself well to PowerPoint presentations.

**A COMPUTATIONAL STUDY OF BRIDGED ORGANOSILYL-MAGNESIUM COMPOUNDS.** *William H. Ilesley, Middle Tennessee State University, Murfreesboro, Tennessee.* The HF/6-31g\* structures of several bridged organosilylmagnesium compounds of the type  $[\text{Mg}(\text{SiR}_3)_2]_2$ ,  $\text{R}=\text{H}, \text{Me}, \text{SiH}_3, \text{SiMe}_3$  and  $[\text{R}_3\text{CMgSiR}]_2$ ,  $\text{R} = \text{H}, \text{Me}$  will be discussed. Preliminary results indicate that for the  $[\text{Mg}(\text{SiR}_3)_2]_2$  compounds, the Mg-Si distance and Si-Mg-Si bridge angle decrease in the order  $\text{Si}(\text{SiH}_3)_3 > \text{SiH}_3 > \text{SiMe}_3$ . The molecules are planar except for the  $\text{SiMe}_3$  derivative which adopts a butterfly structure with a dihedral angle of  $22.82^\circ$ . The  $[\text{R}_3\text{CMgSiR}]_2$  molecules also adopt a butterfly structure in which the Mg-Mg distance as well as the energy decrease as the number of carbon bridges increases.

**COMPARISON OF GC-MS RESPONSE FACTORS WITH BOTH EXPERIMENTAL AND CALCULATED GC-FID RESPONSE FACTORS FOR DIMERS AND TRIMERS FORMED DURING THE ALDOL CONDENSATION OF ACETONE.** *Thomas M. Thorburn\* and Martin V. Stewart, Middle Tennessee State University, Murfreesboro, Tennessee.* The aldol condensation of acetone affords a variety of dimers such as diacetone alcohol and mesityl oxide and trimers including phorone, isophorone, semiphorone, triacetone alcohol, 2,2,6,6-tetramethyltetrahydropyran-4-one, and mesitylene. The components

of mixtures of these substances and derivatives of them have been identified and quantified in gas chromatograms using a mass-selective detector (GC-MS). The GC-MS response factors relative to a *m*-xylene internal standard were measured for most of these compounds, and a linear relationship with molecular weight was obtained. Similar chromatograms acquired with a flame-ionization detector (GC-FID) showed no such linear correlation; however, good agreement was observed between measured response factors and those calculated from the effective carbon number. This suggests that an exhaustive library of calibration standards is unnecessary for routine quantitative analysis of product distributions. Furthermore, consistent values for GC-FID response factors relative to *m*-xylene were observed over a period of three years on a shared departmental instrument.

**HIGH-THROUGHPUT DETECTION AND CHARACTERIZATION OF GLYCOPEPTIDES AND GLYCOPROTEINS USING ADVANCED STRUCTURAL MASS SPECTROMETRY.** *Larissa S. Fenn\** and *John A. McLean, Vanderbilt University, Nashville, Tennessee.* Contemporary proteomics methods are largely based on mass spectrometry (MS) approaches for peptide and protein identification. However, it remains a considerable challenge to rapidly characterize post-translationally modified (PTM, phosphorylated, glycosylated, etc.) peptides and proteins directly from complex biological samples. Characterization of glycosylation sites is particularly difficult due to the heterogeneity, branching, and large size of carbohydrate moieties which makes them less amenable to conventional proteomic methods (peptide mass mapping and sequencing by MS). The specific aim of this work is to develop intelligent strategies for characterization of glycoconjugates using rapid (us-ms) structural separation by ion mobility (IM) and subsequent identification by MS (IM-MS). Ion mobility separates ions based on their collision cross section (apparent surface area) which is dictated by their intrinsic gas-phase packing efficiencies. This report focuses on defining the mobility-mass correlation for glycopeptides and exploring the utility of IM-MS for rapid characterization of PTMs.

**CATALYSTS FOR THE PREPARATION OF BIODIESEL. PART 1.** *Jia Zhu\*, Sally Millsap, Cassandra N. Boller\*, N. Tyler Walker\*, and Scott T. Handy, Middle Tennessee State University, Murfreesboro, Tennessee.* With the rising costs of petroleum and the questions associated with its availability, there is a great deal of interest in the development of non-petroleum based fuels. One of these alternatives is biodiesel, a diesel fuel that is prepared from vegetable oils. The key reaction in this preparation is a transesterification reaction that takes the triglycerides in the vegetable oil and turns them into simple methyl or ethyl esters. This reaction requires the presence of a catalyst. Most typically, bases are used, especially sodium hydroxide. We examined several other types of catalysts in an effort to compare the efficiencies of each and hopefully identify new catalysts that might be more active.

**CATALYSTS FOR THE PREPARATION OF BIODIESEL. PART 2.** *Sally Millsap, Cassandra N. Boller\*, N. Tyler Walker\*, Jia Zhu\*, and Scott Handy, Middle Tennessee State University, Murfreesboro, Tennessee.* The preparation of biodiesel involves the transesterification of the triglycerides present in vegetable oils with a simple alcohol such as methanol or ethanol to form

methyl or ethyl esters and glycerol. A catalyst is required, with the most typical catalyst being sodium hydroxide. While effective, sodium hydroxide creates problems in the purification and use of the biodiesel fuel since it must first be separated by washing the product layer with water and then this water layer must be disposed of. An attractive alternative would be the use of a heterogeneous catalyst that can be separated by simple filtration and then reused numerous times, thereby making the reaction less expensive and generating less waste. Several heterogeneous, or supported, catalysts have been studied and compared to simple homogeneous catalysts.

**USE OF THE GLYCEROL BY-PRODUCT FROM BIODIESEL PREPARATION IN FINE CHEMICAL SYNTHESIS.** *N. Tyler Walker\*, Jia Zhu\*, Sally Millsap, Cassandra N. Boller\*, and Scott T. Handy, Middle Tennessee State University, Murfreesboro, Tennessee.* Glycerol is formed as a by-product of the preparation of biodiesel from vegetable oils. Although glycerol has many potential uses, one aspect that has received little attention is its application as a building block for high value intermediates required in various pharmaceutical applications. For example, antibiotics such as erythromycin are made up of several polyketide subunits. These subunits can be assembled using allylation chemistry in rapid fashion using a protected form of glycerol as the starting material. Further, the prochiral nature of glycerol means that such building blocks also can be prepared in optically pure form and used in the synthesis of numerous biologically important natural and non-natural products.

**PROGRESS TOWARD LAMELLARIN/CAMPTOTHECIN HYBRIDS.** *Cassandra N. Boller\* and Scott T. Handy, Middle Tennessee State University, Murfreesboro, Tennessee.* The lamellarin and camptothecin families of natural products are both interesting potential anti-cancer agents. Camptothecin's mode of action has been clearly established as being due to topoisomerase inhibition, while that of lamellarin is less well established, but likely due in part to topoisomerase inhibition as well. As part of a long term interest in the synthesis and activity of the lamellarins, we have designed a hybrid molecule that combines many of the structural features found in the lamellarins and camptothecin. The synthesis of this molecule will follow the basic approach previously studied in this group leading to the lamellarins, but employing an imidazole ring as the starting point instead of a pyrrole ring. Subsequent halogenation/Suzuki coupling sequences are expected to lead to the final target in less than 10 steps. Our progress to date and future goals will be presented.

**CAFFEINE DETERMINATION OF FOLGERS, MAXWELL HOUSE, AND STARBUCKS COFFEE BY ULTRAVIOLET SPECTROSCOPY: DOES PREPARATION CHANGE THE AMOUNT OF CAFFEINE PRESENT?** *Kelly O. Major\* and Rachel E. Riggsby, Belmont University, Nashville, Tennessee.* Caffeine is an alkaloid found in numerous plants, where it acts as a natural pesticide that paralyzes and kills insects that try and consume the plant. In humans, caffeine acts as an adenosine receptor antagonist in the brain resulting in an increase of dopamine. This increase causes the stimulatory effects of caffeine. The most common plants containing caffeine are coffee, tea, and cocoa. Caffeine content varies widely depending on coffee bean type, brewing method, and grind. On average, one serving of coffee contains 40–100 mg of caffeine. Ultra-Violet

spectroscopy will be used to determine the amount of caffeine present in one serving of both regular and decaf coffee in Maxwell House, Folgers, and Starbucks. Two different methods, auto-drip and French press, will be compared to determine if the brewing method increases the amount of caffeine per serving. It is expected that more caffeine will be present in coffee brewed via the French press.

**LEACHING AND ADSORPTION OF CONTAMINANTS ASSOCIATED WITH FLY ASH AMENDED PERVIOUS CONCRETE.** *Jessie F. Weatherly\*, Heather J. Brown, and John P. DiVincenzo, Middle Tennessee State University, Murfreesboro, Tennessee.* Fly ash contains high quantities of heavy metals and PAHs produced at the high temperatures in the furnaces. This research was performed to determine the leaching and adsorption characteristics of a permeable pavement that has fly ash included in the cement mix. Solid phase and solvent extractions were used to prepare samples for HPLC with coupled UV-Vis and fluorescence detectors, ICP and GC-FID analysis. Low level PAHs were observed leaching from a block made from 40% fly ash. Cr, Pb and Se were observed in leachate from all blocks in ppb levels. Cr and Pb were observed in the highest concentrations in the 40% fly ash block while Se was observed at the same level in all blocks. Preliminary results of the hydrocarbon adsorption/desorption experiment indicate that as the fly ash concentration increases, the adsorption rate of motor oil increases and the desorption rate decreases.

**SYNTHESIS AND CHARACTERIZATION OF AIR-SENSITIVE MANGANESE COMPLEXES.** *Mary C. Clay\* and Rebecca M. Jones, Austin Peay State University, Clarksville, Tennessee.* The synthesis and analysis methods for two manganese (III) dimers,  $[\text{Mn}^{\text{III}}(\text{SALPN})(\text{OCH}_3)_2]$  and  $[\text{Mn}^{\text{III}}_2(\text{SALPN})_3]$ , were developed for incorporation into an existing undergraduate inorganic chemistry laboratory series centering around manganese complexes. The synthesis parameters of the  $[\text{Mn}^{\text{III}}(\text{SALPN})(\text{OCH}_3)_2]$  and  $[\text{Mn}^{\text{III}}_2(\text{SALPN})_3]$  were then reconditioned for the synthesis of the manganese (II) equivalent complexes,  $[\text{Mn}^{\text{II}}(\text{SALPN})(\text{OCH}_3)_2]$  and  $[\text{Mn}^{\text{II}}_2(\text{SALPN})_3]$ , which are theoretically air sensitive. The  $[\text{Mn}^{\text{II}}_2(\text{SALPN})_3]$  product was a distinctive metallic dandelion yellow microcrystalline solid, which upon exposure to air became dark metallic hunter green. Spectral analysis of the oxidized  $[\text{Mn}^{\text{II}}_2(\text{SALPN})_3]$  product indicated that the complex had fully oxidized to the manganese (III) equivalent complex. The  $[\text{Mn}^{\text{II}}(\text{SALPN})(\text{OCH}_3)_2]$  product also was a dandelion yellow microcrystalline solid, which upon exposure to air became a very bark brown. Both of the manganese (II) products were confirmed to be air sensitive and oxidation is easily detected by color change. Further analysis of these manganese (II) products will more accurately determine the composition and other physical properties.

**FACILE ROUTE TO C2-SUBSTITUTED IMIDAZOLIUM CATIONS.** *Elliot G. Ennis\* and Scott T. Handy, Middle Tennessee State University, Murfreesboro, Tennessee.* The imidazolium cation has been the focus of much attention in recent years, most notably as a source of N-heterocyclic carbenes, which can be used either as ligands for transition metal catalysts or as catalysts themselves, and as the cationic component of the most popular family of room temperature ionic liquids. Particularly in this later role, the relative acidity of the C2

position of the imidazolium cation can be either advantageous or disadvantageous depending upon the circumstances. In an effort to prepare new room temperature ionic liquids that will avoid any acid/base chemistry at the C2 position, we have explored the direct alkylation of the C2 position of unsubstituted imidazolium cations as a versatile and concise route to substituted compounds. Details regarding the preparation, properties, and potential applications of these materials will be presented.

**THE LIGHTSTICKS, THEY ARE A-CHANGIN'.** *Tobey J. Schultz\* and Gary D. White, Middle Tennessee State University, Murfreesboro, Tennessee.* Light sticks have a variety of uses including fishing, scuba diving, and most notably as children's toys. Recently, color-changing light sticks have been developed. We examined two different color changing light sticks, one from orange to yellow to green, and another from pink to purple to blue. The chemiluminescence was resolved using a Hitachi F-4500 Fluorescence Spectrophotometer. We correlate the different spectral features with the visually observed color changes. Rate constants were obtained for the different spectral features by performing a fixed wavelength time scan. The rate constants suggest that the different light sticks operate using different mechanisms.

**IT'S EASY BEING GREEN.** *Ryan Parsons\*, Taylor Barnes\*, Samantha Chesak\*, Matthew Brandon\*, and MTSU Chemistry Club, Middle Tennessee State University, Murfreesboro, Tennessee.* The purpose of the poster is to educate peers about the green chemistry movement, a type of chemistry geared towards reactions and conditions that limit unneeded waste and exposure to toxins in an effort to practice more eco-friendly research. The core fundamentals of green chemistry will be divulged and a specific example of green chemistry research will be cited, namely work done in ionic liquids. These ionic liquids are being used as less hazardous reaction solvents in a number of useful and necessary experiments and are being researched by chemists in the region as well as at Middle Tennessee State University, making the topic highly applicable to the audience. By presenting both the fundamentals of green chemistry as well as information on ionic liquids, chemists can get a sense of the scope of the green chemistry movement and its application in the lab as well as in industry.

**RAPID METHODS OF DETECTING FLAVONOIDS IN WINE USING RAMAN AND INFRARED SPECTROSCOPY.** *Beng G. Ooi, Lijie Zhao\*, Laura E. Wanamaker\*, Tony V. Johnston, and Ngee-Sing Chong, Middle Tennessee State University, Murfreesboro, Tennessee.* The flavonoid compounds in wines include anthocyanidins, anthocyanins, flavonols, and flavanols that are responsible for the color, texture, and flavor of wines. During the aging of wines, many of these flavonoids undergo chemical condensation and eventually result in precipitation of the polymeric compounds along with changes in color and flavor. Hence, the ability to analyze individual flavonoid compounds would allow the study of factors influencing the aging process. Techniques based on surface-enhanced Raman Scattering (SERS) and infrared spectroscopy (IR) using silver nanoparticles were developed for the characterization of the flavonoid compounds. The analytical results show that closely related flavonoid compounds can be distinguished by their SERS and IR spectra. However, the enhancement of spectral signals is highly dependent on the morphological properties of the silver



nanoparticles. Furthermore, the type of substrate materials coated with silver nanoparticles for signal enhancement is capable of influencing the spectral features of the flavonoid compounds.

**CHEMICAL COMBINATIONS FOR CURING OF MARINE MUSSEL ADHESIVES.** *Lauren Hight\**, *Alison Moore*, and *Jonathan Wilker*, *Belmont University, Nashville, Tennessee (LH, AM)* and *Purdue University, West Lafayette, Indiana (JW)*. The common blue mussel produces and cross-links a protein based adhesive to affix itself to a surface. These proteins contain the unusual amino acid 3,4-dihydroxyphenylalanine (DOPA) which is believed to be the site of cross-linking. Previous research has found that transition metal ions and non-metal oxidants bring about optimum curing of the adhesive. To investigate the possibility of a synergistic effect on cross-linking between metals ( $\text{Fe}^{3+}$ ,  $\text{Cr}_2\text{O}_7^{2-}$ ) and non-metal oxidants ( $\text{H}_2\text{O}_2$ ,  $\text{IO}_4^-$ ), we performed a study in which extracted protein precursor was cured with a variety of transition metal and simple oxidant combinations. The results show increased levels of curing when certain combinations of metals and oxidants are used to cross-link the adhesive ( $\text{Fe}^{3+}$  and  $\text{IO}_4^-$ ). We conclude that blue mussels may incorporate the synergistic effects of transition metals and simple oxidants for protein cross-linking and adhesive curing.

**SYNTHESIS OF PEPTIDOMIMETICS OF D-ALA-D-ALA.** *Norma K. Dunlap*, *Trey A. Pegram\**, *Larry Waldrop\**, and *Jeff Lamb\**, *Middle Tennessee State University, Murfreesboro, Tennessee*. The  $\beta$ -lactam family of antibacterial agents acts by inhibition of D-D-peptidase enzymes, which catalyze formation of cross-links in the bacterial cell wall. The enzymes catalyze cleavage of the terminal D-ala-D-ala unit of a peptidoglycan strand. A series of peptidomimetics of the enzyme substrate D-alanyl-D-alanine have been designed as potential antibacterial agents. The analogs contain a hydroxyethylene isostere as a replacement for the amide bond. A protected form of the target molecule has been synthesized, and progress has been made on the preparation of a tetrazole analog of the peptidomimetic. A rigid analog containing a cyclopropyl ring has also been synthesized. Both the linear tetrazole and cyclopropyl analogs proceed through a common synthetic strategy starting with D-alanine.

**OVERLOADING OF THE CE(IV)/ $\text{SiO}_2$  SOLID-SUPPORTED REAGENT.** *Kristy J. Stanislav\**, *Anthony L. Newsome*, and *Martin V. Stewart*, *Middle Tennessee State University, Murfreesboro, Tennessee*. Adsorbing an inorganic compound onto a porous surface can produce a solid-supported reagent that often exhibits faster rates under milder conditions with improved selectivity and yield. Previous results of our continuing project to better characterize these materials demonstrated that depositing ceric ammonium nitrate onto the surface of silica gel affords a genuine example of a solid-supported reagent, Ce(IV)/ $\text{SiO}_2$  that functions in chemical reactions as an oxidizing agent. More recently, conditions were proposed that promote crystallization of the inorganic reagent on the surface of the silica gel, an occurrence which renders the system chemically unreactive. This hypothesis was confirmed through direct observations with optical microscopy, including both brightfield and darkfield images, and diagnostic experiments involving the interaction of the solid-supported reagent with both polar and nonpolar

liquids. (Supported by the Undergraduate Research Council of the College of Basic and Applied Sciences)

**SUPPORTED NUCLEOPHILIC CATALYSTS.** *Kevin L. Porter\** and *Scott T. Handy*, *Middle Tennessee State University, Murfreesboro, Tennessee*. In recent years, nucleophilic catalysis has witnessed a revival in interest and utility in Organic synthesis. Countless reactions have been performed using a wide range of soluble nucleophiles, including aldol condensations, Michael additions, homoenolate reactions, pericyclic reactions, and transesterification reactions. Due to our specific interest in this last reaction, we were interested in developing a readily separable and recyclable catalyst. Interestingly, there are few examples of heterogeneous or supported nucleophilic catalysts. The focus of our attention has been on the preparation of imidazolium salts that can either be linked to existing polymeric supports or directly polymerized themselves. While the salts can be prepared in straightforward fashion, linking them to supports has proven to be a challenge, likely due to the steric bulk of these large cations. Direct polymerization may be more successful, but tether length appears to be a critical feature in the utility of such catalyst precursors.

**SYNTHESIS OF 1-AMINO-2,3,4-BUTANETRIOL.** *Norma K. Dunlap*, *Andrea Martin\**, and *John Drake\**, *Middle Tennessee State University, Murfreesboro, Tennessee*. 1,3-Butadiene (BD) is a petrochemical with numerous industrial uses. It is also a significant pollutant in automobile exhaust, cigarette smoke and gasoline. Inhaled BD has been proven to be carcinogenic in rodents, and is a potential carcinogen in humans. The genotoxicity arises from formation of DNA adducts with the oxygenated metabolic products of BD. Of these, the *meso*-diepoxide is the most cytotoxic of the three isomeric diepoxides. It would be useful to have access to stereoisomerically pure nucleoside adducts of these metabolites for identification of *in vivo* DNA adducts and for assessment of mutagenic potential. The R,R and S,S adducts of guanine N<sup>2</sup> and adenine N<sup>6</sup> have been prepared previously. However, adducts derived from the *meso*-diepoxide have not been prepared in stereochemically pure form. A synthesis of 2S,3R and 2R,3S-1-amino-2,3,4-butane-triols is reported here. The aminotriols have been synthesized from either D- or L-glucose via oxidative cleavage of the 4,6-O-benzylidene.

**SURFACE MORPHOLOGY AND ELECTRICAL PROPERTIES ON SILICON CARBIDE OXIDIZED AT 1400 °C WITH OXYGEN AND CARBON DIOXIDE.** *Tatijana Radmilovich\**, *India Cartmen\**, *Tiffany Crenshaw*, and *Weijie Lu*, *Trevecca Nazarene University, Nashville, Tennessee (TR)*, and *Fisk University, Nashville, Tennessee (TR, IC, TC, WL)*. The purpose of this research is to investigate the mechanism of carbon nanotubes (CNTs) and carbon nanostructure growth by silicon carbide (SiC) thermal decomposition. Using Atomic Force Microscopy (AFM), the initial growth of carbon nanostructures is investigated. The samples were prepared that silicon carbide (SiC) is oxidized in furnace at a temperature of 1400°C with a pressure of  $10^{-5}$  torr in high vacuum using two different gases such as carbon dioxide ( $\text{CO}_2$ ) and oxygen ( $\text{O}_2$ ). The nanostructural morphological features using AFM on surface sample are observed and the nanoscale current-voltage measurement is used to determine the conductivity. The results have shown that surface nanostructures are grown on both samples at 1400 °C,

and the nanostructures are electrically conductive with a rectifying contact with SiC substrate.

#### OXIDATION OF SILICON CARBIDE BY CARBON DIOXIDE.

**Darlene Gunther\***, **Calissia Britton**, **Stephanie Turner**, **Senthil Sambandam**, and **Weijie Lu**, *Austin Peay State University, Clarksville, Tennessee (DG) and Fisk University, Nashville, Tennessee (DG, CB, ST, SS, WL)*. Well aligned, low defect, metal-free carbon nanotubes (CNTs) are grown by SiC thermal decomposition under a low pressure oxygen between 1400–1800°C. Previous experiments reveal oxygen interaction in the formation of carbon nanotubes. This experiment attempts to exploit this role and explored new growth processes. Samples of 4H-SiC wafers, c-face were annealed in low pressure carbon dioxide at 1300 and 1400°C. With a continuous flow of CO<sub>2</sub>, X-ray Photoelectron Spectroscopy (XPS) measurements are performed to analyze the surface composition. A layer of carbon is formed as well as the presence of SiO<sub>2</sub>. Previous studies have found temperature, pressure and random oxygen molecules to be the influencing factors in the surface decomposition growth process. The current results show the formation of carbon nanostructures, and suggest that a decrease of CO<sub>2</sub> pressure is necessary in favor of the formation of carbon nanostructures.

### ENGINEERING AND ENGINEERING TECHNOLOGY

CHIN-ZUE CHEN, CHAIR

**HYDROLOGIC IMPACTS FROM A LANDSLIDE IN THE TENNESSEE COAL FIELDS.** **Robert G. Liddle**, *United States Department of the Interior, Office of Surface Mining, Knoxville, Tennessee*. On January 27, 2005, a 24-acre landslide occurred at High Point Mountain in Scott County, Tennessee approximately 750 feet from Smoky Creek, a tributary to New River. The purpose of this investigation was to assess the hydrologic impacts of the landslide. The objective was to study the quality and quantity of water in the tributaries below the landslide. Results showed a minor short-term increase in streamflow due to dewatering of adjacent coal mines; the water was not acid or toxic forming but dissolved solids increased slightly. Sedimentation rates from the landslide were measured, modeled, and compared with other land uses. Average wash load was 5,000 mg/L and sand-size bedload was 19,000 mg/L. A regionalized model developed in the 1960's (LOAD-I) compared well with the data. In conclusion, the landslide resulted in an intense short-term release of sediments similar to a construction site, which subsided in about 3 months.

**A RECONSTITUTED AND IMPROVED HYDROLOGIC ENGINEERING CENTER-RIVER ANALYSIS SYSTEM MODEL OF CANE CREEK, MARTIN, TENNESSEE.** **Gregory H. Nail** and **Brian H. White\***, *University of Tennessee, Martin, Tennessee*. This paper reports on the successful recovery of a pre-existing Hydrologic Engineering Center-2 (HEC-2) hydraulic model and conversion to a modern Hydrologic Engineering Center-River Analysis System (HEC-RAS) model. The purpose of this effort was to support a bridge redesign and replacement project on a tributary of Cane Creek, located within the Brian Brown Memorial Greenway in Martin, Tennessee. The technical data underlying a previous (1980's) Federal Emergency

Management Agency (FEMA) Flood Insurance Study (FIS), using the HEC-2 software, was obtained by the City of Martin. These FEMA HEC-2 data were used to develop a modern HEC-RAS model of the same channel. The HEC-RAS results are essentially identical to the previous HEC-2 results, as reported in the FIS. However, potential applications for the HEC-RAS model go beyond the original bridge redesign. The enhanced features and additional capabilities of the HEC-RAS software make it an effective educational and analytical tool.

**AUTOMATED METHOD FOR THE MEASUREMENT OF CEREBRAL PIAL ARTERIOLAR DIAMETER.** **B. Hamilton\*** and **M. L. Daley**, *The University of Memphis, Memphis, Tennessee*. The computer can be a powerful tool in the analysis to many problems; tedious measurements can be automated through the use of computers. This paper discusses development of a computer program designed to automate the measurement of changes in arteriolar diameter as a function of time. The development of the program was preformed using Microsoft Visual Studio C++.Net (VS.Net). VS.Net was chosen because VS.Net allows developers to create a rich graphical user interface that can enable multiple image processing settings to be selected. VS.Net also has an extensive code library and support system. The explored solution for the stated problem involved defining a logical method for measuring the diameter of an arteriole. The method, once defined, was then translated into a set of algorithms that were then coded into C++. The developed program combines many image processing functions in order to obtain quality measurements of multiple target arterioles.

**REGULATION OF CEREBRAL BLOOD FLOW IN STROKE PATIENTS WITH SUBARACHNOID HEMORRHAGE.** **N. Narayanan\*** and **M. L. Daley**, *The University of Memphis, Memphis, Tennessee*. Loss of autoregulation of cerebral blood flow (CBF), the brain's ability to autoregulate blood flow, can be impaired by stroke subarachnoid hemorrhage (SAH). The purpose of this observational study was to functionally assess autoregulation of CBF based on recordings of arterial blood pressure (ABP) and intracranial pressure (ICP) in a group of stroke patients with SAH. Historical records were used to evaluate a group of 20 patients on an hourly basis using three indices of autoregulation of CBF: 1) correlation pressure reactivity index, PrX; 2) pressure reactivity index (PRI); and 3) highest modal frequency index (HMFx). Assessment of regulation was based on agreement of at least 2 of the indices over a majority of the monitoring period. The findings of this study determined that 70% (14/20) had impaired regulation of CBF during the monitoring period.

**DESIGN OF FLUID PERCUSSION DEVICE FOR STUDIES ON HEAD-INJURY.** **O. Furxhi\*** and **M. L. Daley**, *The University of Memphis, Memphis, Tennessee*. In laboratory animals, controlled fluid percussion devices can be used to induce head injuries. The purpose of such experiments is to create a model of cerebral autoregulation behavior in humans after a head injury. Cerebral autoregulation is the ability of the brain to regulate cerebral blood flow during changes in arterial blood pressure or intracranial pressure. Previous work has shown that fluid percussion injury at 60 psi abolishes cerebral autoregulation. The proposed design of the fluid percussion device allows for the accurate setting and continuous measurement of cortical impact pressure. The development of the

proposed controlled fluid percussion device will enable the study of cerebral autoregulation in mild and moderate laboratory models of head-injury.

**GAS DIFFUSION IN POLYSTYRENE FOAM: A MULTI-SCALE APPROACH.** *David M. Kirby\**, *Pravin Kannan\**, *Joseph J. Biernacki*, and *Donald P. Visco*, *Tennessee Technological University, Cookeville, Tennessee*. Surprisingly little is known about diffusion of even common gasses in polystyrene. The rate of transfer of blowing agents, for example, and the effect of gas exchange in foamed polystyrene cells and concomitant property changes depend on reliable prediction of diffusion through the bulk solid and its foamed counterparts. A simple diffusion apparatus was designed and experiments were conducted to provide data on gas diffusion in solid films. Various models were developed and used to interpret the experimental results for both steady and transient diffusion. Diffusion of Ar, He, and N<sub>2</sub> has been investigated. For the multi-scale approach, a cellular automaton was built. The cellular automaton based model uses experimentally determined diffusion coefficient and microstructure data as inputs. Predicted data were compared to observed data for various inert molecules.

**CHANGES IN SERVICE REQUIREMENTS AS EVIDENCE OF IMPROVEMENTS IN DESIGN OF AUTOMOTIVE SYSTEMS.** *John W. Blake*, *Austin Peay State University, Clarksville, Tennessee*. Over time, the maintenance requirements for automobiles have changed. Where service was once required at regular intervals, either the intervals have been greatly extended or the requirements have disappeared altogether. It is of interest to examine these changes over time. Automotive operating and service literature, such as owner's and service manuals, give details of service intervals and requirements. These documents allow us to track the changes in requirements over time. The focus of this paper will be to collect information and document the changes in service requirements and intervals. This paper will draw from vehicle owner's and service manuals and other literature. Where possible, the author will speculate about specific advances in automotive engineering that contributed to these changes. The study will compare available information across the 20<sup>th</sup> century. While the study's focus is on North American manufacturers, it should give a broad picture of changes across the industry.

**SENIOR CAPSTONE DESIGN EXPERIENCES FOR UNDERGRADUATE ELECTRICAL AND COMPUTER ENGINEERING EDUCATION.** *Adel Salama and Ashraf Saad*, *Austin Peay State University, Clarksville, Tennessee and Armstrong Atlantic State University, Savannah, Georgia*. We present our experience over several years of advising undergraduate electronics engineering technology and electrical and computer engineering students for their capstone design project. We focus on the integrative and project management aspects of such projects and present our experiences and lessons learned. We also give examples of capstone projects from recent years.

**WEB-BASED TOOLS FOR ONLINE CONFERENCING.** *Ashraf Saad and Adel Salama*, *Armstrong Atlantic State University, Savannah, Georgia and Austin Peay State University, Clarksville, Tennessee*. Current web-based technologies have made it viable to organize world-class conferences online. We present our experiences for organizing such a conference in 2006. We present

the various Web-based services that are requisites for organizing the entire life cycle of such conferences and share our experiences and lessons learned.

**WEB-BASED COLLABORATIVE DESIGN AND RAPID PROTOTYPING.** *Chin-Zue Chen*, *Austin Peay State University, Clarksville, Tennessee*. The consumer market demands various products in small quantities, thus new models of products are being pushed out onto the market all the time. Behind this, besides applying the flexible manufacturing system (FMS) for batch production, an efficient collaborative product design with a concurrent engineering approach is a key to success. The members of a collaborative design team can be in different divisions of the company or in supplier companies and separated by a great distance. Web conferencing tools can provide audio, video and interactive graphical "whiteboard" functions to allow team members to discuss and modify designs remotely. Rapid prototyping can provide models quickly for evaluation. Web tools and rapid prototyping can both result in a more economical and more productive collaborative design. A case study on web-based collaborative design and rapid prototyping will be discussed.

**CHANGES IN PIAL ARTERIOLAR RESISTANCE DURING VASOCONSTRICTIVE AND VASODILATORY CHALLENGE.** *S. W. Richardson\**, *T. Vu\**, *L. Washington\**, and *M. L. Daley*, *The University of Memphis, Memphis, Tennessee*. Vasodilatory challenge can be induced by increasing the concentration of carbon dioxide in the blood which is known to lower pH and cause cerebral vasodilation by relaxation of vascular tone. A vasoconstrictive challenge can be induced by increasing the arterial blood pressure. By analysis of video recordings of cerebral pial arterioles obtained before, during, and following vasodilatory and vasoconstrictive challenges, longitudinal changes in arteriolar resistance were examined to test the hypothesis that during vasodilation resistance changes are descending along the arteriolar tree; whereas, during vasoconstriction resistance changes are ascending. Video recordings obtained from a piglet equipped with a cranial window during vasoconstrictive and vasodilatory manipulations were analyzed. During vasodilatory challenge 85.7% (6/7) of preparations demonstrated that the larger arterioles dilated before the smaller ones. In contrast, during vasoconstrictive challenge the smaller arterioles appear to constrict before the larger ones.

## HISTORY OF SCIENCE

BROTHER KEVIN RYAN, CHAIR

AND

## GEOLOGY AND GEOGRAPHY SECTION

PETER LI, CHAIR

**EVOLUTION VISITS TENNESSEE, 1873–1878.** *George E. Webb*, *Tennessee Technological University, Cookeville, Tennessee*. A half century before the Scopes Trial, Tennessee witnessed another period of controversy concerning the concept of biological evolution. The topic emerged briefly during the early efforts to establish Vanderbilt University and appeared again in 1876 when Thomas Huxley visited Nashville. The following year,

noted paleontologist O. C. Marsh delivered the major address at the Nashville meeting of the American Association for the Advancement of Science, discussing in detail the fossil evidence for evolution. In 1878, Vanderbilt geologist Alexander Winchell, who enjoyed a national reputation and who clearly accepted many evolutionary arguments, was informed that his services were no longer required. Although these few years were not marked by the drama that surrounded the later Scopes Trial, the four episodes examined provide intriguing insight concerning early efforts to come to terms with evolution.

**KEPLERIAN MOTION.** *Brother Kevin Ryan, Christian Brothers University, Memphis, Tennessee.* German astronomer Johannes Kepler (1571–1630) is well known for his three laws of planetary motion. What is not so well known is the method he developed to calculate the position of a planet starting from his laws. It will be shown that one needs to use three angles to obtain the location of a planet for some time in the future.

**GEOLOGY TEXTBOOK WAR 1873–1881.** *Richard G. Stearns and James X. Corgan, Vanderbilt University, Nashville, Tennessee and Austin Peay State University, Clarksville, Tennessee.* An 1873 Act of the Tennessee Legislature mandated that “Elementary Geology of Tennessee” be taught in Public Schools. Two books competed for this niche. An 1875 text by McAdoo and White was written for the obsolete recitation style of teaching with questions at the bottom of each page. Its content was minimal and it discussed Tennessee geology by using New York formational names. McAdoo and White lived in Georgia where McAdoo was a judge and White was a chemist. An 1876 text by Safford and Killebrew, two Tennesseans, used Tennessee names and avoided recitation style. Safford was State Geologist and a geology professor. Killebrew wrote books on Tennessee’s natural resources. In 1881 McAdoo and White offered a second edition with no changes. It was not reprinted. A second edition of Safford and Killebrew in 1900 was printed at least until 1909. They won the Textbook War.

**PATHOLOGIC GEOLOGY OF TENNESSEE. J. C. SHAPARD’S RESEARCH IN THE 1850S.** *James X. Corgan, Austin Peay State University, Clarksville, Tennessee.* When the word geology entered the English language in 1787 it was in a medical text. Before Germ Theory, an interdisciplinary field, medical topography, blended medical science with earth science. In many regions the earliest geological observations are preserved in medical topography texts. They are easily overlooked. When the first geological map of Tennessee appeared in 1854, J. C. Shapard, a Tennessean, used the map to explain the state-wide distribution of disease. He felt malarial diseases went with the soft sediments of West Tennessee; tuberculosis was rare on well-lithified sandstones of the Cumberland Plateau, etc. Pathologic Geology was the term Shapard used for his state-level version of medical topography. He published his concept in a Tennessee medical journal in 1859, just before war stressed American culture. Apparently no other researcher used Shapard’s concept, which has touches of validity.

**ANALYSIS OF URBAN SPRAWL IN COOKEVILLE, TENNESSEE USING GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY.** *Brian Whitworth, Tennessee Technological University, Cookeville, Tennessee.* The growth of cities throughout the state is continuously occurring and Cookeville, Tennessee

is one of these cities. Aerial photographs from 1997 and 2005 were compared to determine this growth. An area of five miles, with the courthouse as the central location was used as the study area. GIS was used to place road and structure layers on the photos to determine the amount of growth. The amount of growth was shown during this period of time, and it was used to project the amount of future growth. It was determined that the growth of Cookeville, Tennessee is continuing and would increase at an estimated 25–30% over the next 8–10 years.

**EFFECT OF LAND USE ON WATER CHEMISTRY AND MACROINVERTEBRATES IN THREE WATERSHEDS.** *Richard C. Lee, Christine W. Li, Peter Li, John J. Harwood, and S. Bradley Cook, Cookeville High School, Cookeville, Tennessee (RCL), Harvard University, Boston, Massachusetts (CWL), and Tennessee Technological University, Cookeville, Tennessee (PL, JJH, SBC).* Three watersheds in Cookeville, Tennessee area were selected to conduct chemical and biological assessment of watershed quality. Streams from 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> orders were chosen to compare the effect of urbanization on water quality. The ion chromatograph was used to analyze chloride, nitrate, sulfate and phosphate in water samples, and macroinvertebrate samples were collected from three watersheds. More than 100 analytical and biological samples were processed, integrated, analyzed and presented in the study. Duplicates and replicates were collected and analyzed to ensure quality assurance and quality control. Results show that a higher level of dissolved oxygen were found in urbanized watershed, while other indicators such as total dissolved solids, nitrate and chloride were also found with higher concentration in urban area. Sulfate was found in all 1<sup>st</sup> order streams. That suggests that naturally occurring element may play a role in water measurements. It is hypothesized that sulfate may come from geology sources. Analysis of variances (ANOVA) showed that three watersheds had different water quality in terms of dissolved oxygen, turbidity, chloride and nitrate. The biotic index score (BIS), integrated from individual macroinvertebrate BIS number, shows a negative correlation of turbidity, nitrate, chloride and a positive correlation with dissolved oxygen. Compared with EPA’s nutrient regional measurement, turbidity, sulfate, nitrogen, and conductivity level found in these three watersheds are much higher. This suggests that water quality from these three watersheds does not meet current ambient water quality measurements from EPA’s database. Percent oligochaetes and chironomids (%OC) and percent EPT were found to have positive and negative correlation, respectively, with percent urban area. One urban watershed was found to have deteriorated water quality after compared diversity and population of macroinvertebrates community.

**WHAT IS THE TITLE OF THIS TALK? GLOBAL AWARENESS: WHERE IS IRAQ?** *P. Li, Tennessee Technological University, Cookeville, Tennessee.* Data from survey of 197 samples shows college students’ geographical awareness in recent years. Students identified countries from a printed world map and answered questions about their major, grade, years and geography education. The results show that students who took geography in high school identified more countries than those who didn’t. Students aged between 30 and 40 years-old had little knowledge about countries compared to other age groups. Sophomore students performed best while other classes had fewer countries identified. Out of various majors, such as

engineering, social sciences, math/natural sciences, business and education, students from math/sciences majors did the best, followed by social science and engineering. Students from Education College had lowest scores. This phenomena needs to be noticed since most of these students will eventually teach at K-12 and their lack of knowledge about the world will be a problem for our education system. The A students could identify 16 countries compared to less than 12 for students with other grades. It shows academic excellence is correlated with knowledge of geography. Similar results were found for students with lottery scholarships. They had higher scores than those who did not. One of the final findings suggest the majority of college students still couldn't identify the location of Iraq on a map. A total of 15 students, 7.6%, found the exact location of Iraq on the map. This result shows that geography awareness and world view from our next generation, college students, is limited.

**WASTE WATER TREATMENT PLANT SITE ANALYSIS ALONG CANE CREEK IN PUTNAM COUNTY.** *Mark Ziska, Tennessee Technological University, Cookeville, Tennessee.* The purpose of this project is to find the most ideal spot for a waste water treatment plant site outside of a city the size of about 30,000 people. The community is growing fast and so is the need for additional water. Many variables had to be considered in locating an appropriate spot. Many different types of data needed to be collected. Census, stream, and road data all had to be collected and analyzed in order to choose six different sites along a particular stream that could handle the output of the plant. Then these six sites were given scores based on the analyzed data. The site with the lowest score would be the most appropriate site for a new water treatment plant. The main purpose of this project is to show how useful Geographic Information Systems can be in making a quick and efficient way to plan for new city projects.

**ANALYSIS OF MICROCRACK DENSITY IN FOLDED QUARTZ ARENITE NEAR KEYSER, WEST VIRGINIA.** *Brian Whitworth, Tennessee Technological University, Cookeville, Tennessee.* Nine samples of quartz arenite were collected from parasitic folds on the Wills Mountain anticline to determine the influence of grain size, open porosity, and cement on microcrack density. Thin-section point counting and cathodoluminescence photomicrographs were used to assess the abundance of microcracks. Preliminary results suggest that the density of microcracks increases as cement increases, and to a lesser extent, as open porosity increases. Grain size had no appreciable effect on the microcrack density.

## HEALTH AND MEDICAL SCIENCE SECTION

J. MICHAEL REDDING, CHAIR

**FOOD SECURITY AND THE UTILIZATION OF LEFTOVER RICE.** *L. Girsch\*, C. Webb\*, R. Bolton\*, A. Johnson\*, L. Owen\*, A. Richmond\*, and T. Smith, The University of Memphis, Memphis, Tennessee.* Food security is an issue that may be minimized with the utilization of leftover food such as cooked rice. To improve food security, undergraduate researchers developed recipes to determine whether a difference can be

detected between 0 day old cooked rice and 1 day old cooked rice as a food ingredient. The student researchers selected 1 type of rice for use in the study by completing a paired-comparison test between 2 brands of rice. The research team recruited university students ( $n = 14$ ) to serve as sensory evaluation panelists and perform both triangle and paired-comparison tests. The panelists were unable to detect a difference between recipes made with 0 day old cooked rice and 1 day old cooked rice. The undergraduate research team recommends that food service establishments consider donating 1 day old cooked rice to food banks in order to address food security needs in local areas.

## MATHEMATICS AND COMPUTER SCIENCE SECTION

MATT JONES, CHAIR

**EULER'S METHOD AND TRUNCATION ERROR.** *Adrian D. Parker\*, Jason S. Kinnard\*, Jessica A. Travieso\*, and Samuel N. Jator, Austin Peay State University, Clarksville, Tennessee.* In this paper, we discuss Euler's method and the Error Analysis. The truncation error to the Euler's method is derived to demonstrate the magnitude of error related to this method. We give a short review of the limitations of the Euler's method and how it is modified in practice using the concept of the arithmetic mean. We are then motivated by this concept to seek an improvement to the Euler's method using the concept of the geometric mean. Numerical examples are solved with the aid of the Mathematica software to show that the modifications are worthwhile.

**SOLUTION FOR THE TIME-INDEPENDENT SCHRÖDINGER EQUATION USING THE RUNGE-KUTTA METHOD.** *Nicholas A. Lardizabal\*, Chase D. Cox\*, Richard J. Rylee\*, and Samuel N. Jator, Austin Peay State University, Clarksville, Tennessee.* The purpose of this paper is to obtain a solution for a wave equation (Schrödinger's Equation) inside a finite potential well of definite known potentials, inside and outside the well. In particular, we use the Runge-Kutta method with Mathematica as the computational software to obtain a reasonable approximation of the solution for the problem. Comparisons are made between our solution and known solutions using other methods of solving the equation.

**NUMERICAL SOLUTIONS OF HIGHER-ORDER DIFFERENTIAL EQUATIONS.** *Daniel J. Purcell\*, Arthur D. Vinson\*, Patrick R. Wilkerson\*, and Samuel N. Jator, Austin Peay State University, Clarksville, Tennessee.* The objective in this paper is to find approximate solutions to higher-order initial-value problems; that is, initial-value problems with orders greater than one. To approximate the solutions of these initial value problems of order  $n$ , we express the  $n$ -order differential equation as a system of  $n$  first-order differential equations, which are then solved using the Euler's and the fourth-order Runge-Kutta methods. We illustrate the efficiency of these methods by applying them to two differential equations, one linear and the other nonlinear. The numerical computations given in this paper are facilitated by the use of the Mathematica software.

REPEATED SAMPLING AND PASCAL'S TRIANGLE. **Jim R. Ridenhour and David R. Grimmer**, *Austin Peay State University, Clarksville, Tennessee*. This article considers repeated sampling from a population of  $N$  members using samples of size  $n$  where the sampling is done without replacement. A formula is given for the probability that all the members will have been sampled in  $k$  samples. Applications are given to situations such as repeated drug testing with random samples and repeated sampling of questions from a test bank. As a result of the formula for the probability that all subjects have been included in at least one sample, a family of identities relating binomial coefficients and Pascal's triangle is given. This yields identities that hold for integers from one to an arbitrarily large integer but not beyond that integer.

LIMITING BEHAVIOR FOR A CLASS OF PARTICLE-SURVIVOR MODELS. **Matthew Jones**, *Austin Peay State University, Clarksville, Tennessee*. We study particle-survivor point process models where particles arrive randomly in space and time, interact, and depart. Of interest is the limiting behavior of the distribution of the particle ensembles as time goes to infinity. Such structures are useful for modeling species competitions and spatial service systems.

SOLVING DIFFERENTIAL EQUATIONS USING PREDICTOR-CORRECTOR METHODS. **Samuel N. Jator**, *Austin Peay State University, Clarksville, Tennessee*. In this paper, we derive the Adams-Bashford-Moulton Methods, herein referred to as ABM, multi-step predictor-corrector method. The Adams-Bashford part is the predictor step, while the Adams-Moulton part is the corrector step. The method is applied to some practical examples. In particular, linear and non-linear problems are used to illustrate how the methods are implemented. Normally a single-step method, such as Runge-Kutta Method is used to compute the initial values and the ABM is then used for the final value. Mathematica, a software application from Wolfram Research Inc., is used to compute the solutions to the problems.

APPROXIMATING SOLUTIONS OF SECOND ORDER BOUNDARY-VALUE PROBLEMS USING FINITE DIFFERENCE AND THE SHOOTING METHODS. **Cameron T. Druryor\***, **Betsy A. Hall\***, **Casey J. Leffel\***, and **Samuel N. Jator**, *Austin Peay State University, Clarksville, Tennessee*. In this paper, we examine how to approximate the solution of a second order boundary value problem. In particular, we discuss how the finite difference and the shooting methods are used to approximate the solution of a boundary value problem. It is shown that the procedures differ from those used for approximating solutions of initial value problems. For instance, the finite difference method is applied directly to solve a second order differential equation that involves finding the electrostatic potential between two concentric spheres without first reducing the equation to a system of first order differential equations. Numerical examples are solved with the aid of the Mathematica software to show the efficiency of the methods.

AN ALTERNATING PROJECTION METHOD FOR COMPUTING THE NEAREST DOUBLY STOCHASTIC MATRIX. **William K. Ghunt**, *Austin Peay State University, Clarksville, Tennessee*. A problem that arises in circuit design is the

approximation of a given data matrix by one with row and column sums equal to one, and having only nonnegative components. An algorithm for solving this problem is presented and computer experiments are described.

## MICROBIOLOGY

MICHAEL THOMPSON, CHAIR

*MATRICARIA RECUTITA* L.: ANTIMICROBIAL AND ALLELOPATHIC PROPERTIES. **Efua O. Adetona\*** and **John M. Zamora**, *Middle Tennessee State University, Murfreesboro, Tennessee*. *Matricaria recutita* L or German chamomile as it is commonly called is a member of the aster family. It is an annual herb native to Europe but is cultivated worldwide. It is often erroneously referred to as roman chamomile. Several of its uses include: relaxant, cosmetic additive, antipyretic as well as conferring protection against ulcers. The purpose of this study was to see if extracts of this plant had antimicrobial, allelopathic, or antiviral activity. Antimicrobial tests were done using alcoholic extracts of chamomile. These extracts were inhibitory to some bacteria. The hot water extract of *Matricaria recutita* inhibited the growth of bean sprouts. This assay is used as a screening test for allelopathy. Statistical analysis showed a significant difference in size. To determine what was occurring microscopically, onion root tip squashes were prepared and fixed onto slides. Altered cell morphology and differences in the number of mitotic cells were observed with the hot water extract. There appears to be allelopathic chemicals in chamomile. Hot water extracts also were tested for antiviral activity against T4 phage. The extracts did not lower the number of plaque forming units per ml thus indicating no antiviral activity.

ANTIMICROBIAL AND ALLELOPATHIC PROPERTIES OF MUSCADINE GRAPE EXTRACT. **Nicholas S. Zeger\*** and **John M. Zamora**, *Middle Tennessee State University, Murfreesboro, Tennessee*. The use of plants in the treatment of disease is as old as folk medicine. Over 1500 antimicrobial and cytotoxic chemicals have been isolated from plants. *Vitis rotundifolia* is commonly called the muscadine grape. The muscadine grape is native to the southeastern United States. Botanically, they differ in significant ways from other grapes. This grape seed and skin is said to be rich in anticancer agents and antioxidants. The purpose of this study was to see if extracts of muscadine grapes had any antimicrobial or allelopathic properties. Antimicrobial tests were done using alcoholic extracts of muscadine grapes. These extracts were inhibitory to Gram-positive and Gram-negative bacteria including *Staphylococcus* sp. and *Bacillus* sp. An allelopathic assay was performed to determine if the hot water extract of muscadine grapes inhibited the growth of mung beans. All of the beans grown in the hot water extract showed a decrease in size compared to the control beans. Statistical analysis indicated that the difference in size was significant. There appears to allelopathic chemicals in muscadine grapes.

ANTIMICROBIAL AND ALLELOPATHIC PROPERTIES OF *YUCCA SCHIDIGERA*. **Andrea Overcast\*** and **John M. Zamora**, *Middle Tennessee State University, Murfreesboro, Tennessee*. There are several species of yucca in the southwest. Many Indian

tribes have used yucca for medicinal purposes. The yucca root and leaves have been used for treatment of inflammation and pain. The purpose of this study was to see if extracts of this plant had antimicrobial, allelopathic, or antiviral activity. Antimicrobial tests were done using alcoholic extracts of yucca. These extracts were inhibitory to bacteria and fungi. The hot water extract of *Yucca* sp. inhibited the growth of bean sprouts. This assay is used as a screening test for allelopathy. Statistical analysis indicated that the difference in size was significant. To determine what was occurring microscopically, onion root tip squashes were prepared and fixed onto slides. Altered cell morphology and differences in the number of mitotic cells were observed in the hot water extract of *Yucca schidigera*. There appear to be allelopathic chemicals in *Yucca schidigera*. Hot water extracts also were tested for antiviral activity against T4 phage. The extracts did not lower the number of plaque forming units per mL. This indicated no antiviral activity.

**ENDEMICITY OF *BORRELIA BURGDORFERI*, THE BACTERIAL AGENT OF LYME DISEASE, IN MIDDLE TENNESSEE.** *DeLacy V. LeBlanc\**, *Jon L. McMahan*, *Joseph W. Vazquez*, and *Chad S. Brooks*, *Austin Peay State University, Clarksville, Tennessee*. Lyme disease is transmitted by the pathogenic bacterium *Borrelia burgdorferi*. *Borrelia burgdorferi* is perpetuated in nature through a complex enzootic life cycle involving ticks of the *Ixodes* complex and various animal hosts. Historically, mice from the *Peromyscus* genus were commonly considered the prevailing host for *B. burgdorferi*. However, recent data indicate that birds play a much larger role than previously appreciated. This study focuses on identifying the true ecological niche of *B. burgdorferi* by surveying both rodents and birds in middle Tennessee. To this end, 175 rodents and 30 song birds were collected from seven counties and analyzed by both DNA-based assays and typical microbial culturing methodologies for *B. burgdorferi* infection. The data revealed that 36.6% of rodents and 46.6% of birds harbored *B. burgdorferi*. These data give new insight to the true endemicity of *B. burgdorferi* in nature and heighten awareness of Lyme disease risk in our community.

**INTERACTION OF TRYPTOPHAN-356 AND ASPARAGINE-362 WITH TYROSINE-244 IN THE PROTEOLYTIC MECHANISM OF *SACCHAROMYCES CEREVISIAE* LEUKOTRIENE A<sub>4</sub> HYDROLASE.** *Erin D. Archer\**, *Rebecca L. Seipelt*, and *Michael W. Thompson*, *Middle Tennessee State University, Murfreesboro, Tennessee*. *Saccharomyces cerevisiae* leukotriene A<sub>4</sub> hydrolase is an unusual bifunctional enzyme with both epoxide hydrolase and zinc metallopeptidase activities. In order to characterize the proteolytic activity, four residues of the enzyme, including Trp<sup>356</sup>, Asn<sup>362</sup>, Trp<sup>365</sup>, and Asp<sup>399</sup>, were altered and the residual protease activity of the mutant enzymes evaluated. While mutation of Trp<sup>365</sup> and Asp<sup>399</sup> had no discernable effect on enzymatic activity, mutation of Trp<sup>356</sup> to leucine (W356L) drastically reduced the  $k_{cat}$  of the enzyme for all substrates tested and altered the pH profile. Thus, Trp<sup>356</sup> likely polarizes Tyr<sup>244</sup> at the active site through a hydrogen bonding or orthogonal interaction. Although altering Asn<sup>362</sup> to leucine inactivated the enzyme, a glutamine substitution rescued the catalytic defect, indicating a probable hydrogen bonding interaction with Tyr<sup>244</sup> due to its proximity. Together, Trp<sup>356</sup> and

Asn<sup>362</sup> likely function to both orient and polarize Tyr<sup>244</sup> for proper interaction with the tetrahedral transition state.

**PRODIGIOSIN-PRODUCTION AND LIPID-DEGRADATION ANALYSIS OF *SERRATIA MARCESCENS* IN THE PRESENCE OF MOTOR OIL.** *Prima Patel\** and *John M. Zamora*, *Middle Tennessee State University, Murfreesboro, Tennessee*. Bioremediation is a recent technology that utilizes microorganisms to naturally degrade toxic compounds. The purpose of this study was to isolate pigmented microorganisms capable of degrading motor oil. *Serratia marcescens*, *Chromobacterium violaceum*, *Micrococcus luteus*, and *Pseudomonas aeruginosa* were plated onto minimal salts motor oil agar to determine the organisms' ability to grow on this media. *Serratia marcescens* was the best at growth and pigment production. *Serratia marcescens* was then streaked for isolation on minimal salts motor oil agar. Forty of the hydrocarbon-degrading colonies that produced a pigment were further isolated by patch plating on individual agar plates. Sixteen of the forty isolates were grown in various concentrations of motor oil broth ranging from 2 to 20% (v:v oil). After an allotted time, the pigment was extracted using petroleum ether for each of the isolates and the optical density was recorded by spectrophotometric analysis. A biometric system analysis was conducted to determine the lipid degradation ability for each strain. Optimum pigment producing and carbon dioxide evolving strains varied among the different concentrations.

***CAENORHABDITIS ELEGANS* AS A MODEL SYSTEM FOR *STREPTOCOCCUS PNEUMONIAE* INFECTION.** *Kristen Sorensen\** and *Nick Ragsdale*, *Belmont University, Nashville, Tennessee*. *Caenorhabditis elegans* exhibit a pathogen specific innate immune response. *Caenorhabditis elegans* are a good model host for the study of bacterial pathogenesis due to a large variety of available knock-out and knock-down mutants. *Caenorhabditis elegans* mutants were utilized to determine if there are conserved factors with the mammalian immune system necessary to combat a gram positive bacterial infection by testing the lifespan of wild type *C. elegans* after exposure to *Streptococcus pneumoniae*. Additionally, the effect of bacterial virulent factors on the life span of wild type *C. elegans* was examined to determine if *S. pneumoniae* requires virulent factors similar to those needed to infect mammals. Initial results suggest that a p38 pathway is conserved in the defense against *S. pneumoniae* infection in both mammals and *C. elegans*. Additionally, *S. pneumoniae* utilizes similar virulence factors to infect both mammals and *C. elegans*.

**A COMPARISON OF THE ANTIMICROBIAL ACTIVITY OF NATURAL AND COMMERCIAL DISINFECTANTS.** *Sana Shaikh\** and *John M. Zamora*, *Middle Tennessee State University, Murfreesboro, Tennessee*. Kitchens and bathrooms contain a large number of microorganisms. Commercial disinfectants are usually very good at eliminating microbes. Recently natural disinfectants are being sold claiming that they are as good as commercial disinfectants and they are more environmentally friendly. The purpose of this study was to compare the efficacy of Soluguard<sup>TM</sup> botanical disinfectant to a 1 percent solution of chlorine bleach and to Lysol<sup>TM</sup> disinfectant cleaner. Antimicrobial tests were done using sterile disks containing disinfectant. The Lysol<sup>TM</sup> and bleach were inhibitory to bacteria. The Soluguard<sup>TM</sup> was not as inhibitory.

THE IDENTIFICATION OF A NOVEL AMOEBA-ASSOCIATED MICROORGANISM BY 16S rDNA SEQUENCING AND IN SITU HYBRIDIZATION. **John M. Lewis\***, **David Olsen**, **Megan Musick**, **Anthony L. Farone**, and **Mary B. Farone**, *Middle Tennessee State University, Murfreesboro, Tennessee*. An amoeba infected with bacteria was isolated from a water supply line. The bacteria are lethal for the amoebal hosts and lyse the host within 48 h. The infection is characterized by rapid movement of the bacteria within vacuoles of the amoeba and loss of amoebal cell ultrastructure. The water sample with the infected amoeba was contaminated by many other bacteria. As the amoeba-associated microorganism (AAM) does not grow on standard laboratory media, isolation of the bacterium has proved difficult because of the contamination. To determine if the AAM was a novel organism, or related to previously identified AAM, bacterial 16S rDNA genes were amplified from the mixture and cloned into plasmid vectors for sequencing. Sequencing results identified a novel gene sequence distinct from previously identified AAM. Because the culture contaminated with the AAM was heavily contaminated, fluorescent *in situ* hybridization using a probe sequence unique to the potential AAM sequence was performed. The hybridization results showed that the probe bound specifically to bacteria located within amoebal vacuoles, confirming the association of the novel sequence with the AAM.

SEQUENCING AND PHYLOGENETIC COMPARISONS OF THE *rpoB* GENE OF A NOVEL BACTERIUM. **Matthew L. Carver\***, **Anthony L. Farone**, and **M. B. Farone**, *Middle Tennessee State University, Murfreesboro, Tennessee*. A novel bacterium that infects the nuclei of both amoebal and human cells was isolated from an infected amoeba of a hot tub. The 16S rRNA gene of the bacterium was sequenced and the results showed that the bacterium had less than 97% homology to sequences in GenBank. Of the sequences in GenBank showing the greatest homology, none of the related organisms had been cultured or isolated but only represent sequences amplified from environmental sources. When compared to related, cultured isolates, the bacterium shows less than 94% homology. To further clarify the relatedness of this novel bacterium to other organisms, sequencing of the *rpoB* subunit gene of the RNA polymerase was undertaken. The results show that phylogenetic classification of this novel bacterium by *rpoB* sequencing follows 16S rDNA phylogenetics.

HYDROGEN PRODUCTION BY PURPLE NONSULFUR BACTERIUM IN A HOLLOW-FIBER BIOREACTOR. **Sergei A. Markov**, *Austin Peay State University, Clarksville, Tennessee*. A laboratory-scale hollow-fiber bioreactor was constructed for the production of H<sub>2</sub> by the immobilized purple bacterium *Rubrivivax gelatinosus*. The bioreactor employed a unique type of hydrogenase activity found in some photosynthetic bacteria that functions in darkness to shift CO (and H<sub>2</sub>O) into H<sub>2</sub> (and CO<sub>2</sub>). Mass transport of gaseous CO into an aqueous bacterial suspension is the rate-limiting step and the main challenge for bioreactor design. A simple method using hollow-fiber technology to enhance mass transfer of CO has proven effective. The bioreactor was designed such that both a growth medium and CO (10% in N<sub>2</sub>) passes from the inside of the fibers to the outside within the bioreactor. Bacteria were immobilized to the outer surface of the hollow fibers. Hydrogen production from CO at an average rate of 125 ml · g cdw<sup>-1</sup> · h<sup>-1</sup> (maximum rate of 700 ml · g cdw<sup>-1</sup> · h<sup>-1</sup>) was observed for more than 8 months.

## SCIENCE AND MATHEMATICS TEACHING SECTION

KIM CLEARY SADLER, CHAIR

CHANGES IN ELEMENTARY STUDENT KNOWLEDGE AND ATTITUDE ABOUT THE PROCESS OF SCIENCE AND THE ENVIRONMENT THROUGH AN ECOLOGICAL FIELD STUDY OF THE CEDAR GLADES. **K. Metius-House\*** and **K. Cleary Sadler**, *Middle Tennessee State University, Murfreesboro, Tennessee*. At Middle Tennessee State University's laboratory school, two second grade and two fifth grade classes were introduced to the cedar glades through engaging lecture and classroom activities conducted by science specialists; second and fifth graders formed cross age partnerships to work on inquiry-based lessons together. To determine the impact of additional interactive field experiences beyond classroom inquiry, one second grade and one fifth grade class visited the glades several times. Student teams collected measurements for five plant species, two of which are endemic to glades: Nashville Breadroot (*Pediomelum subacaulis* - endemic), Nashville Mustard (*Leavenworthia stylosa* - endemic), Blue-eyed Grass (*Sisyrinchium albidum*), Shooting-Star (*Dodecatheon meadia*), and Star-Grass (*Hypoxis hirsuta*). Using simple sampling instruments, abiotic parameters (temperature, soil depth, available sunlight, and soil moisture) were used to determine relationships between plant distribution and abiotic factors. Student knowledge and attitudes about both the cedar glades and the scientific method were measured through pre- and post-test design.

ENGAGING STUDENTS IN ACTIVE LEARNING WITH TACTILE TEACHING TOOLS. **Margaret A. Franzen**, **David S. Goodsell**, and **Tim Herman**, *Pellissippi State Technical Community College, Knoxville, Tennessee (MAF)*, *The Scripps Research Institute, La Jolla, California (DSG)*, and *Milwaukee School of Engineering, Milwaukee, Wisconsin (MAF, TH)*. Educators face multiple challenges in training students: 1) Students often learn course content as a series of disjointed facts, rather than an interrelated group of concepts. 2) Many students lack higher order reasoning skills. 3) They tend to be kinesthetic learners in an oral-based learning environment. 4) Students often fail to 'engage' in learning because it is not relevant to their lives. In order to address these needs, we have developed tactile learning activities focused on the enzyme acetylcholinesterase, including multiple representations (physical models, bioinformatics and computer visualizations using Jmol) to engage different learning styles. This enzyme is used to illustrate the concepts of protein structure, enzyme active sites, competitive inhibition, drug resistance, silent mutation, natural selection, phylogenetics, transmembrane proteins and multiple splice sites, allowing it to serve as 'anchor points' in the curriculum. These concepts are conveyed in the context of insecticide resistance as students 'rediscover' recent research findings.

SERVICE-LEARNING IN UNDERGRADUATE BIOLOGY COURSES. **A. Darlene Panvini**, *Belmont University, Nashville, Tennessee*. Service-learning, a form of community service with local partners, is an instructional approach that provides opportunities for students to mesh theory with practice, especially in the sciences. Additional benefits are that students learn civic responsibility and meet community leaders. The goals of most science courses fit well with the key elements of service-learning: the activities meet a real community need, the work is connected to



the course objectives, and students have opportunities for reflection on their work. Students in several majors and non-majors science courses (Environmental Studies, Botany, Environmental Biology) at Belmont University have engaged in service-learning projects with local non-profit organizations in Nashville, Tennessee. Students keep journals and write reflective essays on their experiences. The organizational structure of these projects, challenges of managing them, reflective exercises, and student responses suggest that faculty workload is manageable and student learning is enhanced when effective partnerships are developed.

**TEACHING UNDERGRADUATES HOW TO READ SCIENTIFIC ARTICLES: A STEPWISE APPROACH.** *Jennifer T. Thomas, Belmont University, Nashville, Tennessee.* Reading scientific articles can be a daunting exercise for even the most gifted students. Beyond the difficulty of understanding the rationale and findings of the research, the style and format of these articles is unfamiliar territory. By introducing students to the structure of articles, including descriptions of sections such as "Materials and Methods" and the use of figures and tables, students can slowly gain confidence in how to read a paper, regardless of the research being presented. I will present the exercises and worksheets I have developed in my courses to help students develop the skills needed to read scientific articles. I will then offer suggestions of how to introduce this material throughout a course and then build on it in subsequent courses. Given the correct tools, students can learn to successfully read scientific articles and, consequently, practice their analytical skills, experience the rewards of conquering difficult material, and participate in the excitement of scientific discovery.

**FROM BENCH TO BEDSIDE: MOLECULAR STORIES OF RESEARCH-BASED HEALTH CARE.** *Shannon Colton, Ann Batiza, Margaret Franzen, and Tim Herman, Milwaukee School of Engineering, Milwaukee, Wisconsin.* The MSOE Center for BioMolecular Modeling (CBM) uses rapid prototyping technologies to produce accurate physical models of molecular structures. These models serve as 'thinking tools' for researchers, teachers and students. When used with other innovative instructional materials, these models make the molecular world come alive for students. Through its outreach programs, the CBM engages both teachers and students in the exploration of molecular structure and function. Participants utilize proprietary modeling software to design physical models of molecular structures being investigated in structural biology research labs. Programs include professional development courses in molecular structure and modeling, Science Olympiad modeling events, and SMART teams (Students Modeling A Research Topic), in which teams of students work with researchers in nearby laboratories to create physical models of proteins. These programs bridge the gap between the classroom and the laboratory, exposing teachers and students to the 'real world of science' in active research laboratories.

## ZOOLOGY SECTION

H. DAWN WILKINS, CHAIR

CINDY L. TAYLOR, CHAIR

**WOODPECKER COMMUNITY STRUCTURE IN A BOT-TOMLAND HARDWOOD FOREST IN NORTHWEST TENNESSEE.** *Josh M. Mathenia\* and H. Dawn Wilkins, University of*

*Tennessee, Martin, Martin, Tennessee.* The competitive exclusion theory states that no two organisms can have exactly the same niche. Woodpeckers belong to the bark foraging guild and are known to partition resources, possibly to reduce competition. The goal of this study was to determine how niche breadth and niche overlap change with the arrival of migratory woodpeckers during the winter. Observations of woodpecker location and behavior were taken every thirty seconds for fifteen min. We constructed time budgets and calculated niche breadth and overlap for two migratory and two resident species. Aggression was observed between residents and migrants suggesting that competitive interactions may be occurring. Niche overlap was observed for some niche aspects, but other niche characteristics showed partitioning. While preliminary observations suggest some overlap between residents and migrants, future studies will attempt to determine if this overlap is due to competitive interactions or is the result of similar foraging strategies.

**BIODIVERSITY MEASURES OF SMALL MAMMALS IN INDUCED EDGE HABITAT: IS THERE AN EDGE EFFECT?** *Heidi L. LaMountain\*, Heidi L. Hopkins, and Michael L. Kennedy, Department of the Interior, Bureau of Land Management., Winnemucca, Nevada (HLH), and The University of Memphis, Memphis, Tennessee (HLL, MLK).* Biodiversity measures of small mammals were studied across a forest-field-induced edge landscape at the Milan Army Ammunition Plant located in Gibson and Carroll counties, Tennessee, from November 1999 to October 2003. Thirty transects consisting of 10 Sherman live traps each were placed in forest, field, and induced-edge habitats. Traps were spaced at approximately 10–15 m intervals, baited with rolled oats, and checked daily for 3 days during the fall. Eleven species were captured. There were no edge effects associated with induced edge habitat and small mammal populations. Considerable annual variability was noted in all measures of biodiversity within each habitat type. Correlations in biodiversity measures associated with forest, field, and induced edge were observed.

**ASSOCIATION OF SELECTED CLIMATIC VARIABLES AND CAPTURE SUCCESS OF *DIDELPHIS VIRGINIANA* IN WESTERN TENNESSEE.** *James B. Akins\*, Rodger A. Baldwin, Allen E. Houston, and Michael L. Kennedy, The University of Memphis, Memphis, Tennessee (JBA, MLK), New Mexico State University, Las Cruces, New Mexico (RAB), and Ames Plantation, The University of Tennessee, Grand Junction, Tennessee (AEH).* The association of daily climatic variables and capture of Virginia opossums (*Didelphis virginiana*) was assessed from 2000 to 2005 during fall and winter trapping sessions at the Ames Plantation (Ames) in Fayette County, Tennessee, and Meeman Biological Station (Meeman) in Shelby County, Tennessee. Individuals were live trapped on five 8 by 8 grids over a period of 32 nights at Ames and on one 5 by 10 grid over a period of 40 nights at Meeman. Sampling resulted in approximately 71,440 trap nights (1 trap night = 1 trap set for 1 night). A total of 13 climatic variables that reflected temperature, precipitation, and wind speed were measured. The association of Virginia opossums to climatic variables was assessed using a Pearson product-moment correlation coefficient. Results indicated a significant association between capture of Virginia opossums and select climatic variables.

**AN ESTIMATE OF POPULATION ABUNDANCE OF WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) UTILIZING INFRARED-TRIGGERED CAMERAS.** *Anna K. Featherston\*,*

**Michael L. Kennedy, and Steven W. Stephenson, The University of Memphis (AKF, MLK), and Milan Army Ammunition Plant, Milan, Tennessee (SWS).** Population abundance of white-tailed deer (*Odocoileus virginianus*) was assessed at the Milan Army Ammunition Plant in Carroll and Gibson counties in western Tennessee. The study was conducted utilizing infrared-triggered cameras on a 4 by 5 grid with 20 quadrants measuring 60.7 ha (150 acres) each. A single camera was placed at the center point of each quadrant. Total area of effect was determined as 1,439 ha (3,550 acres). Density was estimated from photographs taken with the cameras. Pre-hunt density (fall 2005) was appraised as 1 deer per 5.9 ha (14.5 acres) and post-hunt density (winter 2006) was estimated as 1 deer per 6.7 ha (16.5 acres). Results are discussed in light of previous density estimates at this site.

**AN ESTIMATE OF WINTER DENSITY FOR WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) IN WESTERN TENNESSEE. Amber N. McBride\* and Michael L. Kennedy, The University of Memphis, Memphis, Tennessee.** Infrared-triggered cameras were used to study population parameters of white-tailed deer (*Odocoileus virginianus*) at Presidents Island Wildlife Management Area, Shelby County, Tennessee. The investigation was conducted during the winter of 2006 and was focused primarily on males. A single camera was placed at the middle point of 16 quadrants, which were 60.7 ha (150 acres) in size. A bait pile consisting of whole-kernel corn was placed approximately 3 m from the cameras. Animals were recorded as they appeared at the bait pile. Cameras were frequently checked, and film was collected from cameras routinely. Photographs were examined and deer identified as to male, female, or fawn. Results indicated the presence of males at 10 of the 16 sites, and number of occurrences was greater in forested habitats as compared to field.

**GEOGRAPHIC VARIATION IN THE BLACK BEAR (*URSUS AMERICANUS*) IN WESTERN NORTH AMERICA. J. Erin Fender\*, Michael L. Kennedy, and Phyllis K. Kennedy, The University of Memphis, Memphis, Tennessee.** Geographic variation in 47 cranial characters of the black bear (*Ursus americanus*) was examined at 11 localities in North America. Measurements were recorded to the nearest 0.01 mm (using digital calipers) from 264 (144 male; 120 female) adult specimens. Univariate and multivariate analyses were used to analyze data. A matrix of correlation among characters was computed, and the first three principle components were extracted. A three-dimensional projection of localities onto the first three principal components for males and females revealed a pattern of morphologic variation that reflected similarity among bears from locations in geographic proximity. Results are discussed in light of patterns of morphologic variability reported for black bears in eastern United States.

**THE EFFECTS OF A TRANSMISSION LINE RIGHT-OF-WAY ON THE RELATIVE DISTRIBUTIONS OF MAMMALIAN PREDATORS (ORDERS CARNIVORA AND DIDELPHIMORPHIA). Matthew B. Smith\*, Timothy J. Gaudin, and David A. Aborn, University of Tennessee, Chattanooga, Chattanooga, Tennessee.** The effects of a transmission line right-of-way (TROW) on the relative distributions of mammalian predators were studied in the North Chickamauga Creek State Natural Area by placing track plates in a grid around the TROW. Larger mammalian carnivores were predicted to be more concentrated in the TROW, whereas small to medium-sized mammalian predators (mesopredators) were predicted to be more concen-

trated in the adjacent forests. A total of 50 tracks were detected. The large mammalian carnivores exhibited a strong preference for the TROW ( $P < 0.005$ ). In contrast, the mesopredators were distributed more uniformly, yielding no significant differences in their distributions ( $P \geq 0.250$ ). The TROW likely facilitates the travel of the larger carnivores by offering an area that is relatively free from obstruction. The higher-than-expected occurrence of mesopredators in the TROW may have been the result of temporal variations caused by dietary enhancements available at particular times of the year.

**MONITORING OF SITE FIDELITY OF *PIPISTRELLUS SUBFLAVUS* AND OTHER BAT SPECIES: TRENDS AND CURRENT STATUS IN DUNBAR CAVE STATE NATURAL AREA, MONTGOMERY COUNTY, TENNESSEE. Sarah Jo Jenkins\* and Andrew N. Barrass, Austin Peay State University, Clarksville, Tennessee.** Site fidelity of *Pipistrellus subflavus*, *Eptesicus fuscus*, and *Myotis lucifugus* were monitored at Dunbar Cave throughout winter and spring seasons to determine spacing or aggregation within cave chambers. Chamber specific marking techniques were used to observe seasonal variation of site fidelity throughout the winter hibernacula and spring emergence periods. Spatial dispersion and roosting site relationships of various species were monitored using GIS mapping. Species richness varied little among the chambers within the cave. Aggregations of individuals were found in the majority of chambers throughout the cave. Roost switching by marked individuals suggests a strategy to maintain a balance between human interaction and available habitat. During spring emergence, roost switching demonstrates cooperative social behaviors among occupied chambers. Some chambers however, remain void of bats, perhaps related to contaminant residue on the limestone surfaces. Historically, population levels of bats have varied due to lengthy and ongoing human impacts on cave habitat.

**USING MACROINVERTEBRATES TO DETERMINE IMPACTS OF NONPOINT SOURCE POLLUTION ON TWELVE WETLANDS IN TENNESSEE AND KENTUCKY. Laura D. Mills,\* Steven W. Hamilton, and Joseph R. Schiller, Austin Peay State University, Clarksville, Tennessee.** At the 2004 TAS meeting we reported on efforts to identify biological measures of wetland health. Twelve wetlands were surveyed in north-central Tennessee and south-central Kentucky, six impacted by row crop agriculture and six unimpacted. Aquatic macroinvertebrates were collected using 10.2 cm clear PVC pipe funnel traps and wire minnow traps. Seven samples were collected from each site between May 19 and August 8, 2004. Water quality parameters measured included dissolved oxygen, pH, temperature, specific conductance, and turbidity. Macroinvertebrates were identified, when possible, to genus. Habitat metrics were developed from water quality parameters and physical site characteristics. Six biological metrics were identified for classifying impacts to the wetlands. When reported 2004, chironomid midges, a dominant taxon, had not been identified below family and thus were counted as a single taxon among the 56 identified. With midges identified to genus, we find they add important elements to the wetland assessment metrics such as increased diversity and evenness.

**RECONSIDERING PHYLOGENY WITHIN SPHYRIIDAE (*SIPHONOSTOMATOIDA*, COPEPODA). Andrew McElwain\* and George W. Benz, Middle Tennessee State University, Murfreesboro, Tennessee.** Sphyriidae (Siphonostomatoida, Co-

pepoda) contains 9 genera and 16 species whose transformed adult females are highly modified mesoparasites of fishes. The only published phylogeny for these copepods appeared well supported by morphological data, implied a pattern of coevolution between these parasites and their hosts, and has been widely accepted. Reconsideration of that analysis prompted us to reject those results in favor of more conservative and ambiguous set of results that do not support any definitive conclusions regarding sphyriid (Sphyriidae) coevolution or historical ecology. Based on our analysis we conclude that because the highly transformed habitus of sphyriids befuddles some considerations of homology and results in a paucity of morphological data that can support a phylogenetic analysis, we must await the results of molecular studies to provide a robust phylogeny for these parasites.

**HATCHING STRATEGIES IN TELEOST FISHES.** *Judith Shardo, Middle Tennessee State University, Murfreesboro, Tennessee.* Hatching separates the embryonic phase from the yolk-sac phase of development in teleost fishes. But hatching occurs at different points along the developmental sequence in different species so there is no set developmental level for hatching in teleosts. American shad spawn medium-sized, demersal eggs in rivers in the spring. At hatching the larvae have an open mouth, an unarticulated lower jaw, pigmented eyes, and pectoral fin buds. Atlantic salmon spawn large eggs in gravel mounds in cold streams in late fall. They delay hatching until the embryos have an open mouth, an articulated lower jaw, pigmented eyes, and small pectoral fins. Red snapper spawn batches of small, pelagic eggs in the summer. These marine larvae lack an open mouth, jaws, eye pigmentation, and pectoral fin buds at hatching. Regardless of developmental level at hatching, all yolk-sac larvae develop functional jaws, eyes, and fins before their stored yolk is depleted.

**EFFECTS OF CONFINEMENT ON PLASMA LEVELS OF CORTICOSTERONE IN THE NORTHERN WATERSNAKE (NERODIA SIPEDON).** *Kyle L. Sykes\* and Matthew Klukowski, Middle Tennessee State University, Murfreesboro, Tennessee.* In reptiles, the typical response to stress is an increase in plasma levels of corticosterone. Since few experiments have been done on snakes and their response to stress, the major objectives of the project were to: 1) describe seasonal changes in baseline corticosterone levels, and 2) describe the corticosterone response to one hour of confinement stress. Potential correlations between body temperature, body mass, sex and plasma corticosterone levels also were examined. In two years, Northern watersnakes (*Nerodia sipedon*) were caught and bled immediately to determine baseline levels of plasma corticosterone. A second blood sample was taken after one hour of confinement in a cloth bag to determine effects of short-term capture stress on plasma corticosterone levels. Corticosterone levels were determined via enzyme-linked immunosorbant assay. In both sexes, there was a robust corticosterone response to confinement with mean levels increasing 5-7 fold.

**OVER-WINTER SURVIVAL RATES OF FOUR LITTERS OF TIMBER RATTLESNAKE, CROTALUS HORRIDUS, FROM AN ARTIFICIAL HIBERNACULUM.** *Danny L. Bryan, Cumberland University, Lebanon, Tennessee.* The Timber Rattlesnake, *Crotalus horridus*, is declining throughout much of its natural range. One possible contributing factor to this decline is

the low over-wintering survival rates by young of the species. Four litters of Timber Rattlesnake, two litters of two year old snakes ( $n = 18$ ) and two litters of young of year 2005 ( $n = 19$ ), were placed in an artificial hibernaculum to determine over-wintering survival rates. Minimum and maximum temperatures inside the structure were recorded from 22 December 2005 through 31 March 2006. Surviving snakes were counted and weighed on 02 April 2006. All snakes used in the study survived and mass loss per litter ranged from 0.17-5.56%. Provided that young snakes locate adequate hibernacula, this study indicates over-wintering survival success should be relatively high in Middle Tennessee.

**RECENT INVASION OF THE GREEN TREEFROG, Hyla CINEREA, INTO UPLAND REGIONS OF SOUTHEASTERN UNITED STATES.** *Nathan L. Parker\* and A. Floyd Scott, Austin Peay State University, Clarksville, Tennessee.* The distribution of the Green Treefrog, *Hyla cinerea*, has historically been considered closely tied to the Atlantic and Gulf Coastal plains of the southeastern United States. Surveys of sites in the Tennessee and Cumberland River drainages conducted from June to October of 2006, combined with historical data, indicate that this species has been progressively invading upland ecoregions adjacent to the Coastal Plain in the period 1980-present, with much of the expansion occurring in the last 10 years. Range expansions have previously been documented in the Piedmont, indicating this trend may be range-wide. Efforts are made to describe the probable historic and current ranges of the species, to distinguish between actual and apparent range expansion, and to suggest possible reasons for its recent range expansion.

**OCCURRENCE RECORDS FOR REPTILES IN TENNESSEE: SOURCES, HISTORICAL DEVELOPMENT, AND GEOGRAPHIC DISTRIBUTION.** *A. Floyd Scott and William H. Redmond, Austin Peay State University, Clarksville, Tennessee and Dog Hill Farm, Maury City, Tennessee.* Occurrence data for reptiles in Tennessee were obtained and verified on visits to 25 museum collections throughout eastern United States. Additional information was gathered from personal field work and a thorough search of the literature (including the gray literature and abstracts only) dating from 1835. Museum records and personal collections totaled 9827, representing 10,738 specimens; the literature search identified 412 documents that included 2851 references to reptiles in the state. Reports of 64 species of extant reptiles in Tennessee appear in the literature, but only 56 are considered native. The other eight likely are based on encounters with escaped exotics, misidentified specimens, or corrupted locality data. Museum specimens with Tennessee locality data date back to 1855 and represent 58 species, two of which are questionable. Numbers of records and species per county appear related to the proximity of accessible public lands and/or institutions of higher learning. Funding for this project came from three sources: Austin Peay State University's Center for Field Biology, the Tennessee Wildlife Resources Agency (CARA funds), and the Tennessee Herpetology Society.

**STREAM SALAMANDER DIVERSITY AND ABUNDANCE IN URBAN AND RURAL STREAMS: A PRELIMINARY STUDY.** *David C. Henley\*, James R. Mawhinney\*, and Cindy L. Taylor, Austin Peay State University, Clarksville, Tennessee.* Stream salamanders have recently been employed as biological

indicators of water quality and stream health. The objective of this ongoing study was to compare stream salamander diversity and abundance in an urban stream and a rural stream in Montgomery County, Tennessee. To inventory the streams for salamanders we used artificial refugia (leaf litterbags). Leaf litterbags are effective in the capture of stream salamanders without negatively altering the habitat. Preliminary analyses of the data indicate there are differences in species composition between the urban and rural streams. In previous studies, the salamander that was designated as "tolerant" was the most predominant species sampled at all sites. In our study, *Eurycea cirrigera* was the most abundant salamander and was collected in both streams. Therefore, we designate *E. cirrigera* as the "tolerant" species. Salamander diversity was higher in the rural stream relative to the urban stream, as *Desmognathus conanti*, *Pseudotriton ruber*, *Eurycea longicauda* and *E. cirrigera* were all collected in the rural stream.

**A STUDY OF AMPHIBIAN POPULATIONS INSIDE AND OUTSIDE A COMBINED SEWAGE OVERFLOW DRAINAGE IN MONTGOMERY COUNTY, TENNESSEE.** *Joshua L. Maloney\** and *A. Floyd Scott*, *Austin Peay State University, Clarksville, Tennessee*. Combined Sewer Overflows (CSOs) carry both sanitary sewage and storm-water runoff. When the carrying capacity of the system is exceeded some of the mixture of sewage and water may overflow and find its way into streams and other bodies of water in the surrounding drainage basin. This study looked at the amphibian fauna along a first-order stream in a CSO drainage basin of Clarksville, Tennessee and compared it with that of two other streams of similar size and character: 1) another urban stream in an adjacent drainage of Clarksville that had separate sewage and storm-water systems, and 2) an Environmental Protection Agency reference stream in a rural setting 20 km to the southeast. Sampling involved time constrained searches that were conducted in spring, summer and fall at three sample sites along each stream from October 2004 through July 2006. Species richness of salamanders was lowest in the CSO drainage and highest in the reference stream but no significant difference was detected between or among any of the sites. Frogs were absent in both of the urban streams, but were numerous in the reference stream, representing 6 species. Abundance of individuals (excluding frogs) was lowest in the CSO drainage, somewhat greater in the adjacent urban stream, and highest in the rural reference stream. Results indicate that amphibian abundance in an urban setting is lower in streams with CSOs than in those where sewage and storm water are conveyed separately. Also suggested is a richer and more abundant amphibian fauna in rural versus urban drainages. (Supported by Austin Peay State University's Center for Field Biology)

**IS THERE A GOLDEN TOAD IN TENNESSEE'S FUTURE?** *Betsie B. Rothermel*, *Austin Peay State University, Clarksville, Tennessee*. A decade after the extinction of golden toads (*Bufo periglenes*), scientists discovered a new species of pathogenic chytrid fungus, *Batrachochytrium dendrobatidis*. Although chytridiomycosis has been implicated in global declines of amphibians, few cases of infection were confirmed in the Southeastern United States prior to 2004. In 2005-2006, I surveyed for chytrid in Congaree National Park in South Carolina and the Chattahoochee River National Recreation Area and upper Tallulah River watershed in Georgia. Swab samples of amphibians were tested via PCR assay. Seventy-six percent of pickerel

frogs (*Rana palustris*) at Congaree and 25% of ranids at Chattahoochee were infected, though none showed signs of disease. At Tallulah River, 70% of newts (*Notophthalmus viridescens*), one pickerel frog, and one dead wood frog (*R. sylvatica*) tested positive. These results suggest *B. dendrobatidis* is probably widespread in the Southeast. Of particular concern is the threat this pathogen may pose to salamanders in the Southern Appalachians.

**A PRELIMINARY SURVEY OF AMPHIBIANS IN MIDDLE TENNESSEE FOR THE CHYTRID FUNGUS.** *Jonathan L. McMahan\**, *Delacy V. LeBlanc\**, *Chad S. Brooks*, *Cindy L. Taylor*, and *Betsie B. Rothermel*, *Austin Peay State University, Clarksville, Tennessee*. Certain species of frogs have been declining due to a chytrid fungus, *Batrachochytrium dendrobatidis*, which infects keratinized skin of amphibians causing chytridiomycosis. Chytridiomycosis is a highly infectious and fatal disease for some amphibians, especially those in Central America. The encroachment of this fungus is of interest because its presence could potentially devastate already fragile amphibian populations. We conducted a preliminary survey to determine if the fungus is present in lentic water systems of Middle Tennessee. We captured four species of amphibians and dissected certain regions of the body for analysis of tissues by a polymerase chain reaction-based assay. Primers were used in this assay to amplify specifically sequenced genes for the chytrid fungus to determine its presence. Our data suggest that *B. dendrobatidis* was not present in our amphibian samples. However, it could also be that chytrid prevalence is low during this warm part of the year. We will continue to sample amphibian populations to ascertain if chytrid prevalence in Middle Tennessee is correlated with season.

**DIFFERENCES IN MUSCLE ALIGNMENT AFFECT MOBILITY IN QUADRUPEDAL AND BIPEDAL MAMMALS.** *Jason Hailey\** and *Judith Shardo*, *Middle Tennessee State University, Murfreesboro, Tennessee*. The purpose of this project was to compare the gross structure and function of the knee extensor muscles, the vastus medialis, rectus femoris, and vastus lateralis, and the knee flexor muscle, the semitendinosus, in the hindlimb of the rat and the leg of the human. Muscle homology would suggest a similarity in structure and function exists. We examined the structural organization of these muscles, their attachments on the bones, and the actions of these muscles when they contract. We performed several dissections of these muscles on different rat specimens and compared our analysis to the corresponding muscles in the human. Information on human muscles was obtained from the literature. The greatest difference in structure and function occurs in the semitendinosus. The point of insertion and the relative length of the semitendinosus limit the knee extension in the rat and contribute to its bent leg posture.

**COMPARATIVE ANALYSIS OF PASTURED VERSUS FORESTED SOIL WITH RESPECT TO SOIL FAUNA, NUTRIENTS, AND ABIOTIC FACTORS.** *Optimum B. Robinson\**, *Kelvin L. Pollard II\**, and *Willodean D. S. Burton*, *Austin Peay State University, Clarksville, Tennessee*. In early spring 2005 and mid-Fall 2006, the forested and pastured ecosystems of the Austin Peay State University Farm were studied to derive comparative analysis of the soil. The forested ecosystem contains a clumped arrangement of trees, narrow sunlight; whereas, the pastured ecosystem undergoes agricultural practices, grazing from farm animals and has no sunlight discrepancies such as tree

canopies. To provide concrete support in the analysis of both terrestrial ecosystems, various measurements and soil samples were obtained to determine abiotic factors, nutrient content and microfauna classifications. Results indicate: 1) 16:1 ratio of microfauna in pastured area relative to forested area, 2) relative indistinguishable pH, abiotic factors and nutrient content measurements during both seasons in both terrestrial ecosystems. This work implies that the two different ecosystems demonstrate many similarities; however, pastured ecosystems possess the ability to support microfauna life more efficiently.

**THE BIODIVERSITY OF THE LEAF LITTER AT AUSTIN PEAY STATE UNIVERSITY ENVIRONMENTAL EDUCATION CENTER CAVE.** *Jennifer Leach\**, *Lisa Reynolds\**, *Willodean D. S. Burton*, and *Don Sudbrink*, *Austin Peay State University, Clarksville, Tennessee*. The Austin Peay State University Environmental Education Center possesses an abundance of ecological study sites, which include forests, streams and caves. This study was conducted to determine the diversity of arthropodic organisms within the cave system. Six leaf litter samples were collected from the cave rim and interior spaces to compare the biodiversity between the two sites. Samples were placed in Berlese funnels and examined after one week. Thirteen orders of arthropoda and one order of mollusca were collected from the cave rim, while only six orders of arthropoda and one

order of mollusca were collected from the cave interior. These data suggest that conditions within the cave do not support the same level of biodiversity found on the rim of the cave.

**THE EFFECTS OF AGRICULTURAL LAND CLEARING ON THE VIABILITY AND DIET OF THE MANED WOLF, *CHRYSOCYON BRACHYURUS*.** *L. N. Anglin*, *A. B. Ragsdale*, and *C. Vynne*, *Christian Brothers University, Memphis, Tennessee*, *University of Memphis, Memphis, Tennessee*, and *University of Washington, Seattle, Washington*. The maned wolf, *Chrysocyon brachyurus*, dwells in the Cerrado of central South America. Emas National Park (ENP) is the largest patch of natural habitat left in central Brazil. The influence of agricultural land clearing of the wolves' natural habitat around ENP, however, is not clearly understood and needs to be examined. Seven different types of habitat were studied in and around ENP. Specially trained dogs were used to find maned wolf scat samples. These samples were collected over a period of twelve weeks, and the contents were observed and categorized for a diet study to determine the diet differences inside versus outside ENP. Inside ENP, there were a higher percentage of birds and some native fruits in the diet. Outside ENP, the diets consisted more of lobeira (wolf fruit) and other animals. With these data, it was determined there are differences in diet based on location inside and outside ENP.