

## ABSTRACTS OF PAPERS PRESENTED AT THE SPRING 1997 COLLEGIATE MEETINGS

## EASTERN REGION

THE UNIVERSITY OF TENNESSEE AT CHATTANOOGA  
CHATTANOOGA, TENNESSEE

DETERMINATION OF DIGESTIVE RATE AND ASSIMILATION EFFICIENCY IN THE SNAKE SPECIES *ELAPHE GUTTATA GUTTATA*. **Benjamin Batchelor**, *Maryville College, Maryville, Tennessee*. Digestive rate and assimilation efficiency were determined for the snake species *Elaphe guttata guttata* during a 3-week study period in summer 1996. Digestive rate was measured in five 1-year-old individuals by periodically inserting an indigestible marker into their food and examining their feces until it was passed. Mean digestive rate was 5 days, comparable to digestive rates reported for other reptiles. To determine assimilation efficiency, two 5-to-10-year-old individuals were fed nine subadult mice each. The caloric value of their food intake and fecal output were determined in a Parr 1341 plain oxygen bomb calorimeter. The digestive efficiency of these snakes was calculated as 95.5%, a value comparable with those reported for other reptiles.

A PHYLOGENETIC ANALYSIS OF THE FAMILY MYRMECOPHAGIDAE. **Daniel Branham and Timothy Gaudin**, *The University of Tennessee at Chattanooga, Chattanooga, Tennessee*. This study was conducted to determine the genealogical relationships of anteaters which belong to the family Myrmecophagidae, in the mammalian order Xenarthra. Myrmecophagidae is composed of six undisputed genera: three extinct; three extant. The following project is the first designed to produce a definitive anteater phylogeny by using phylogenetic methodology with an ample number of cranial and postcranial characters chosen specifically for this purpose. The character list for this study was assembled by surveying the primary literature on Myrmecophagidae, through direct examination of different weighting and ordering schemes. While all analyses resulted in the same tree topology, an analysis using ordered characters in which all character states were weighted equally was found to have the best support. This resulted in a single most parsimonious tree with a length of 152 steps, a consistency index of 0.671, and a retention index of 0.645. This tree depicted *Cyclopes* and *Palaeomyrmidon* as sister groups and this assembly as a sister group to *Tamandua* and *Myrmecophaga*, who in turn represented sister groups. The grouping of *Cyclopes* and *Palaeomyrmidon* was the weakest node with only three unique and unequivocal synapomorphies, and the node joining *Myrmecophaga* was the most strongly supported, possessing 23 synapomorphies.

EFFECTS OF ENRICHMENT TREATMENTS ON JAGUAR BEHAVIOR AT THE WARNER PARK ZOO. **Miranda Cagle**, *The University of Tennessee at Chattanooga, Chattanooga, Tennessee*. Jaguars at the Warner Park Zoo (one 9-year-old female and one 8-year-old male) were transferred to a new enclosure on

12 November 1995. Prior to that date, they had spent their adult lives in a small, circular cage with a concrete floor. While in the previous enclosure, both cats developed similar stereotypic pacing behavior. Despite the more naturalistic new enclosure and a substantial increase in space, as of May 1996, both cats continued to practice a high amount of pacing behavior in a small amount of space. The idea of an enrichment project for the jaguars was discussed with Mark Graves, assistant director of Warner Park Zoo, with the purpose of decreasing the stereotypic pacing of the jaguars and encouraging more natural, species-typical behavior. A May 1996 enquiry concerning popular or effective forms of jaguar enrichment was sent to zoos in the United States currently holding jaguars. From the suggestions of respondents as well as published articles, an enrichment project for the Zoo was designed. From preliminary behavioral observations, five categories of behavior were established: pacing; wandering; resting (rolling, sleeping, and bathing); interactive (time spent in physical contact with enrichment forms); inactive (time spent inside the exhibit building once access to the outdoor enclosure was available). Spanning the months from May to October 1996, focal sampling data on each cat were collected using a continuous recording method, resulting in 5 days of data/cat/treatment. There were nine treatments total: initial baseline; herb-spice scent enrichment; animal scent enrichment; meat enrichment; carcass enrichment; live fish enrichment; second baseline; combination of meat and animal scent enrichment; a third and final baseline. All treatments resulted in behavioral patterns that were statistically significantly different from the initial baseline (based on chi-square testing). The cats' reactions to the enrichment items were not the same as those of jaguars at other zoos. Both cats interacted most with the meat and scent enrichment combination. Overall amounts of the female's pacing activity decreased for two thirds of the study and then rose to initial levels. The male's pacing activity increased for most of the study. The observer concluded that the cats pace due to different motivations. While both cats exhibit pacing due to inadequate or inappropriate stimuli, the male also paces as a displacement activity due to stress from overstimulation or inability to cope with environmental changes.

A BIOLOGICAL EXPOSITION OF *PUERARIA LOBATA* (WILLD.) OHWL. **Luis D. Checo**, *Southern Adventist University, Collegedale, Tennessee*. *Pueraria lobata* (kudzu), a member of the family Fabaceae, is a deciduous twine that grows in the southeastern part of the United States. The vine is well known for its fast growth rate which can exceed 0.3 m/day during the summer months. In good soils, growth can exceed 18 m during the season establishing patches measuring ca. 1-2 m in thickness. This Japanese native was first introduced to the United States in 1897 at the Philadelphia Exposition as an exotic and ornamental plant. Later, it became a tool for the United States Soil Conservation Service to stop erosion on farms and along highways.

Today, it is considered a menace by most farmers and homeowners for its ability to crowd out other plants in numerous habitats. The limited amount of research done on kudzu over the last 30 years have resulted in poor understanding of the biological processes occurring at the molecular level. Most of the available literature focuses on its ability to control erosion or provide information on its control. However, studies of kudzu extracts have shown its ability to reduce cravings in alcoholics. Studies of kudzu and its association with root fungus (mycorrhizae) has given us added information on its nutrient uptake. Additional research is still needed to further help us understand the biological aspects of the vine. Growing kudzu control groups in different environments and climates would be a useful resource of data. This in turn can help us understand more about its molecular processes and help us control possible crowding out of other species of plants in areas where the vine might be present.

**MEMORY FORMATION IN *PODARCIS MURALIS*.** *Jon Davis, Maryville College, Maryville, Tennessee.* This thesis was designed to test memory formation in the lizard species *Podarcis muralis*. The sample size being tested was six. The medium in which the subjects were tested was an escape maze constructed of plexiglass. The subjects were divided into control and experimental groups. There were two lizards in the control group and four lizards in the experimental group. The experimental group was given an amino-acid neurotransmitter relevant to memory formation. Lizards were placed in the maze, and times of escape were monitored. Each lizard performed five trials with a maximum escape time limit of 10 min. Each lizard performed five trials each day for a total of 5 days. At the conclusion of 5 days, a new lizard was introduced. The results were recorded, and a two-way repeated measures analysis was used to compare mean trial times per day and day means per testing period for control and experimental groups. The analysis showed no significant difference between the control and experimental groups; however, anecdotal data offered important information.

**SURVEY OF FRESHWATER ALGAE OF AMNICOLA MARSH IN CHATTANOOGA, TENNESSEE.** *Danielle Wilson, The University of Tennessee at Chattanooga, Chattanooga, Tennessee.* Random samples of Amnicola Freshwater Marsh were obtained during 8 months between 30 May 1996 and 24 February 1997. A student-surveyed, detailed map was utilized for establishing the sample sites. Thirty-one genera were identified from the Marsh. The density of the populations were observed to be evenly distributed among the various sampling locations. The population densities varied with the seasonal changes.

**WINTER LAND TRACKING SURVEYS OF *CANIS LUPUS*.** *Kelly A. Lyon, Maryville College, Maryville, Tennessee.* *Canis lupus*, the gray wolf, is making a comeback in the lower 48 states. Several decades ago, the gray wolf was almost extinct in North America. Enactment of the Endangered Species Act in 1974 and the wolf's subsequent inclusion on the Endangered Species list have allowed its continued survival. Minnesota has taken further steps to help guarantee the wolf's revival. As a result, in 1978, it was downlisted to "threatened" in Minnesota. This study involved winter land tracking surveys of the gray wolf in two areas in Minnesota. It was done in January 1996 as part of a larger study to estimate the size of populations of wolves in Minnesota and to document their comeback into areas from which they had been extirpated. The results indicated that wolves

are returning into Nemadji State Forest, Minnesota, and that the Jonvik Deer Yard in Minnesota has a healthy breeding population of wolves.

**DEFINING THE NICHE OF *PITYOPSIS RUTHII* WITHIN ITS ECOSYSTEM.** *Jenni M. Park, M. B. Cruzan, and J. V. Perumal, Southern Adventist University, Collegedale, Tennessee.* *Pityopsis ruthii* (Ruth's golden aster), currently listed as an endangered species by the State of Tennessee and the United States Fish and Wildlife Service, is a perennial plant which belongs to the family Asteraceae. This plant was first discovered in 1894 by Albert Ruth of Knoxville, Tennessee. Presently, there are two populations of *P. ruthii* in Tennessee. These are found by the Ocoee and Hiwassee rivers. Although found in both river areas, this species has quite a specific habitat; it grows in the crevices of phyllite or graywacke boulders along the banks of the rivers. As a result of its declining population and distribution, research has been geared to better understand the species. In the present study, the focus has been on predation. During November 1996, an average of 480 flower heads were collected from the Hiwassee River site and then dried. The individual seeds were accordingly separated from each flower head, which contained an average of 35 seeds. The seeds were then separated into three different categories: round; flat; predated. Various trends, thus, were derived from this result. Currently, many more actions must be employed to fully understand the factors involved in the diminishing population of *P. ruthii*. Research conducted thus far on the species has focused on interspecific competition and its reproductive biology. In spite of earlier studies, very little is known about the biology of the plant. Moreover, "end of the pipe" types of solutions for endangered species have proven unsuitable to sustain the population. Therefore, understanding the species and being aware of its biology is pivotal in saving not only *P. ruthii* but also the ecosystem in which it lives.

**SALAMANDER SPECIES ON LULU LAKE LANDTRUST.** *Angelique Pierce, The University of Tennessee at Chattanooga, Chattanooga, Tennessee.* Lulu Lake Landtrust consists of 485.64 ha located in Walker Co. on top of Lookout Mountain in northern Georgia. Sites were selected based on visual observations and knowledge of habitat of salamanders. Collection of salamanders was random. Specimens were identified to species, measured (when possible), photographed (when possible), and released. Study areas included rock wall facings, stream beds, and leaf-littered banks and ditches. The most abundant salamanders were species of *Plethodon* and *Desmognathus*. One species of special note was *Desmognathus ochrophaeus*, the Mountain dusky salamander, not previously recorded for Walker Co.

## MIDDLE REGION

AUSTIN PEAY STATE UNIVERSITY  
CLARKSVILLE, TENNESSEE

**FAST SCAN CYCLIC VOLTAMMETRY OBSERVATION OF THE 9-*t*-BUTYL FLUORENYL RADICAL.** *Duane Brigman, Stephanie Steelman, and Rudy Gostowski, Austin Peay State University, Clarksville, Tennessee.* Radicals have been evaluated using fast scan cyclic voltammetry and digital simulation. In this study, the bimolecular reaction rate for 9-*t*-butyl

fluorenyl has been determined to be  $9 \times 10^5 \text{ M}^{-1}\text{s}^{-1}$ . Compared to previously studied molecules, the increased reaction rate (decreasing persistence) is credited to greater accessibility of the orbital containing the unpaired electron. The tertiary butyl function of 9-*t*-butyl fluorenyl is likely to provide hindrance comparable to aryl substituents previously studied.

**ESTIMATION OF HINDRANCE IN CARBON RADICALS BY MOLECULAR MODELING.** *Stephanie Steelman, Duane Briggman, and Rudy Gostowski, Austin Peay State University, Clarksville, Tennessee.* The geometry of carbon free radicals were calculated using PCmodel and MOPAC programs. In particular, the AM1 and PM3 methods of MOPAC were utilized. The steric hindrance of the radicals was estimated from the dihedral angle of attached aryl substituents. The bimolecular reaction rate of a series of radicals was found to be linearly related to the calculated dihedral angle.

**EFFLUENT VAPOR PRESSURE DURING THE ROTARY EVAPORATION OF ORGANIC SOLVENTS.** *Natalie Tate and Martin V. Stewart, Middle Tennessee State University, Murfreesboro, Tennessee.* Dissolved substances from chemical reactions and extraction procedures are often recovered through rotary evaporation at water aspirator pressure, a technique that allows solvents to be rapidly distilled at temperatures much lower than their normal boiling points. Safe and environmentally responsible application of this method requires that toxic solvents be retained in the receiver and not vented into the laboratory air or condensed in the water aspirator and, subsequently, flushed down the drain. Effluent vapor pressures during rotary evaporation were monitored and used to measure the retention of solvents commonly employed in organic chemistry laboratories. The type of water aspirator, the prior equilibration of the vacuum, the efficient stirring of the heating bath, the temperature of the water passing through the condenser, and the use of sufficient solvent to achieve thermal equilibrium were all found to be important variables whose strict control was necessary before reproducible data could be collected.

**SPECTROELECTROCHEMICAL INSTRUMENT UTILIZING A THIN-LAYER CELL.** *Rudy Gostowski and Chris K. Smalley, Austin Peay State University, Clarksville, Tennessee.* Spectroelectrochemistry combines the process of electrochemistry with spectroscopy. It is then possible to create a electrogenerated species with a subsequent spectrum. The sample cell designed and utilized for this study employs an optically transparent thin-layer electrode as the working electrode. This electrode allows for better control of the oxidative state and homogeneous nature of the sample. Following assembly, calibration of the instrument was conducted using Hg lamp to verify wavelength position. An evaluation was conducted utilizing the oxidation of *o*-tolidine.

**MOLECULAR MODELING AND COMPUTATIONAL STUDIES OF PLATINUM (II) AND (IV) ANTI-CANCER DRUGS.** *Thomas R. Klinckman and Lori L. Slavin, Austin Peay State University, Clarksville, Tennessee.* Computer-aided drug design is an example of the potential for modern computational chemistry to aid the traditional experimental search for new platinum (II) and (IV) anti-cancer compounds. Synergistic theory-experimental studies provide a powerful approach to finding second- and third-generation platinum drugs with a greater range of therapeutic activity and reduced toxicity. Quick and efficient mod-

eling is obtained despite simplifications used in constructing the force field. The new force field allows accurate structural prediction for bond lengths and bond angles as compared to x-ray crystallography data.

**LISE MEITNER: DISCOVERED FISSION AND DID NOT KNOW IT.** *Elizabeth Lock and Judith Iriarte-Gross, Middle Tennessee State University, Murfreesboro, Tennessee.* Lise Meitner was a nuclear physicist who conducted Nobel-Prize-winning research. It was her partner, Otto Hahn, however, who received the Nobel Prize in Chemistry for their discovery of fission. When Meitner and Hahn first began working together in Emil Fischer's chemistry institute, Meitner was not allowed in any part of the building except the basement. It was only after Prussia opened universities to women, that she was able to actually see the experiments on which she and Hahn were working. They were trying to create elements beyond uranium, which was the last of the 92 elements that were known at the time. Meitner and Hahn tried to use fusion, which is to fuse the nuclei of two elements to create an element with a larger nucleus. However, they had actually discovered fission, the forming of two middle-sized nuclei from a larger nucleus. It was only after Meitner had been forced to leave Germany because of Nazism that she realized that she and Hahn had been working on the opposite of what they had intended to find. When Meitner told Hahn her findings, the results were published and Hahn received the Nobel Prize in Chemistry. Meitner received nothing. An application of this work, the atomic bomb, which used the fission of uranium, was dropped on Hiroshima and ended World War II. Only then did Meitner become a celebrity. At this point, however, Hahn denied that Meitner had had anything to do with their discovery of fission. Years after Meitner's death, a team of German physicists fused isotopes of bismuth and iron to make element 109, which was named meitnerium in her honor. Peter Armbruster, the leader of the team, says that Meitner "should be honored as the most significant woman scientist of this century."

**REINVESTIGATION OF THE METHYLATION OF *l*-CARVONE USING TRITYLPOTASSIUM AS STRONG BASE.** *Lisa L. Lawrence, Scott A. Williams, and Fred J. Matthews, Austin Peay State University, Clarksville, Tennessee.* The alkylation of ketones is an important organic reaction in which new carbon-carbon bonds are formed. Alkylation of *l*-carvone is accomplished by deprotonation using tritylpotassium (KCPH<sub>3</sub>) as strong base followed by methylation with methyl iodide. Alkylation of *l*-carvone was performed under thermodynamic and kinetic conditions of enolate formation, the products of which were separated and identified. Preliminary identification of products by GC-MS was determined by identification of the molecular ion, base peak, and the retro-Diels-Alder peak for each cyclohexenoid product. Products from the thermodynamic enolate were generally  $\beta,\gamma$ -unsaturated, while the enolate anion produced under kinetic conditions generated the  $\alpha,\beta$ -unsaturated products.

**HYDROLYSIS OF PHOSPHATE ANTICORROSIVES.** *Melissa Smith and Ron Robertson, Austin Peay State University, Clarksville, Tennessee.* Ortho- and polyphosphates are used extensively as anticorrosive agents in municipal water supplies. Although generally recognized as safe, a resident of Dickson, Tennessee, has been positively diagnosed with an allergy to sodium hexametaphosphate. The purpose of this research was, first, to identify Tennessee municipalities using phosphate-based anticorrosive

products in public waters and, second, to analyze the commercial phosphate materials to determine the ortho- and polyphosphate levels via spectrophotometry and to determine the kinetics of the natural hydrolysis. A list of municipalities using the products in question was obtained from the state of Tennessee, Division of Water Supply, and a survey was compiled and distributed to these municipalities. It was found that 75% of the municipalities use polyphosphate-based anticorrosive products. Three products (sodium hexametaphosphate, Aquadene, and Calciquest) were analyzed. All of the products appeared to have a natural hydrolysis of their polyphosphates into their simpler ortho forms. The hexametaphosphate was determined to be a pseudo first-order reaction with a rate constant of 0.011 ( $\pm 0.001$ ) reciprocal seconds. The Aquadene product, though advertised as an ortho/polyphosphate blend, was experimentally determined to be solely a polyphosphate product. The Calciquest product appeared to have a great deal of variability among the data.

**ACUTE EFFECTS OF CADMIUM ON BIOGENIC AMINES IN SPONTANEOUSLY HYPERTENSIVE RAT BRAIN.** *Kimberly Fowler, Tameka Stowers, and Benny Washington, Tennessee State University, Nashville, Tennessee.* Cadmium is a major occupational and environmental pollutant. Moreover, we are exposed to cadmium through inhalation of unpure air, cigarette smoke, and emissions from combustion of fuel and plastic wastes. Studies from the Natural Resources and Conservation Services suggest that cadmium is leached into the ground water from nickel cadmium batteries in landfills. Thus, the water you drink is uprooted by the vegetables and fruits that you ingest. Catecholamines are formed, released, and metabolized in the cerebral regions of the brain known to regulate the cardiovascular system. Catecholamines are neurotransmitters that are released by neurons in the brain to aid in the communication with other neurons. The release of catecholamines in these brain areas is associated with changes in cardiovascular function. Changes in cerebral catecholamines have been found in arterial hypertensive organisms. Because of an interest in biogenic amines involvement in hypertension and effects of some environmental pollutants on biogenic amine release, we investigated the acute effects of cadmium on bodily organs, catecholamine levels, and catecholamine in vivo release in the brain. Our approach was to use microdialysis, an in vivo technique for monitoring levels of chemicals released over time in the extracellular space of the brain. Release of neurotransmitters from brain tissue of conscious, minimally disturbed animals also can be measured. The results indicate that cadmium may influence norepinephrine and dopamine levels of SH rat brain tissue. It appears that cadmium blocks epinephrine and dopamine release but has no effect on norepinephrine release. Preliminary results also indicate that cadmium reduces blood pressure and heart rate of spontaneously hypertensive rats.

**DIGESTIBILITY OF ENSILED GRAPE POMACE IN RUMINANTS.** *Marsha L. Mooney, Tony V. Johnston, and Jonathon L. Beckett, Middle Tennessee State University, Murfreesboro, Tennessee.* Grapes used in the wine industry are crushed and pressed to expel the juice, leaving a portion of the pulp and the skins (the pomace) to be disposed of. Grape pomace as a feedstuff has been verified by previous investigation, but nutritive value has not been adequately determined. The objectives of this research were to determine the feasibility of ensiling grape pomace and to determine the digestibility of the resultant ensiled

product. White and red muscadine grapes (*Vitis rotundifolia*) were crushed, pressed, and ensiled with the addition of lactic acid culture. Inoculated pomace, inoculated pomace with 1% urea, and inoculated pomace with 1% urea and 1% molasses were ensiled in 15- by 51-cm tall PVC pipe silos, which were tightly capped and equipped with a fermentation lock. Nutrient analyses of the ensiled pomace indicated that moisture (79.8%), fat (8.4%), acid detergent fiber (38.0%), total digestible nutrients (57.0%), and bound protein (3.4%) were similar for all three treatments. Crude protein of the inoculated pomace (10.6%) was increased with the addition of 1% urea (23.5%). Two fistulated dairy cows were used to determine the digestibility of the ensiled grape pomace. Twenty grams of pomace were weighed, placed into 10- by 23-cm nylon mesh bags and deposited in the rumen of the cows. At times of 1.5, 3.0, 6.0, 12.0, 24.0, 48.0, and 72.0 h after placement, one bag was removed and dried, and its contents were weighed to determine the dry matter digestibility. Maximal digestion ranged from 35 to 45% and was not affected by treatment ( $P > 0.05$ ). However, the addition of urea and molasses tended to increase total digestibility. In addition, rates of fermentation were not affected by treatment ( $P > 0.05$ ). In conclusion, grape pomace ensiles well, and digestibility in the rumen suggests that it may be useful in maintenance-type rations for cattle. Therefore, grape pomace has value as a by-product feed source.

**CHARACTERIZATION OF SIALIC ACID IN SMALL INTESTINAL SUBMUCOSA.** *Venessa Williams and Stephen Badylak, Tennessee State University, Nashville, Tennessee (VW), and Purdue University, West Lafayette, Indiana (SB).* Small Intestinal Submucosa is biomaterial taken from the porcine small intestine. It is essentially acellular, and the bulk of the material consists of extracellular connective tissue matrix. Small Intestinal Submucosa induces wound healing by regenerating in the tissues of various organs such as the stomach, urinary bladder, veins, and arteries and in ligaments and tendons. Sialic acid located on the cell surface has been implicated in cell-to-cell recognition. Identification of sialic acid is important because it may be significant in the wound healing process. The purpose of this project was to characterize sialic acid in Small Intestinal Submucosa. The main objectives in characterizing sialic acid in Small Intestinal Submucosa were to determine if sialic acid is really present in Small Intestinal Submucosa and, if so, how much. Our immunohistochemical studies with lectins showed that sialic acid may be present in Small Intestinal Submucosa. Further analysis with neuraminidase digestion, alcian blue (pH 2.5) with Schiff's reagent, high iron diamine/alcian blue (pH 2.5) and neuraminidase/chondroitinase digestions were later performed to obtain more specific results that indicated the presence of sialic acid in Small Intestinal Submucosa. The results of these procedures were consistent with the presence of sialic acid. It can be concluded, from the qualitative characterization of sialic acid, that sialic acid in Small Intestinal Submucosa will be necessary to confirm these findings.

**EFFECT OF SEASONAL ACCLIMATIZATION ON HEMATOOCRIT AND CARDIAC HYPERTROPHY IN CHANNEL CATFISH.** *Michelle M. Cooper and Jeff Kent, Volunteer State Community College, Gallatin, Tennessee.* Cold-blooded animals, or poikilotherms, are unable to regulate body temperature and must often contend with extreme variations in body temperature that can dramatically affect physiological function. Seasonal acclimatization is the adaptation of an organism to changes in temperature as well as a host of other factors. In a process called

cold acclimation, observed in animals exposed to low temperatures in the laboratory, heart mass is increased when normalized to body mass. This temperature-induced cardiac hypertrophy may relate to an increase in blood viscosity, which is known to be dramatically altered by a change in temperature or in number of red blood cells. To gain some insight into these processes, channel catfish (*Ictalurus punctatus*) were kept in a local pond during the fall and winter months of 1996–1997. After a minimum acclimatization period of 10 days, groups of five fish were removed at temperatures of 15, 7, and 4°C, transported to the laboratory, and anesthetized in Tricaine methanesulfate. Blood samples were drawn from the posterior vena cava and analyzed for hematocrit and number of red blood cells. The hearts were removed, weighed, and frozen at –20°C for later protein separation of cardiac muscle proteins by SDS polyacrylamide-gel electrophoresis. Hematocrit and number of red blood cells exhibited an overall decrease, while heart somatic index increased as temperatures in the pond decreased from 15 to 4°C. Following electrophoresis of cardiac-muscle proteins, a single band of 31.3 kDa was induced at 4°C but not observed at 15 or 7°C. It is suggested that the decrease in hematocrit and number of red blood cells at the colder temperatures may be a compensatory mechanism to reduce blood viscosity, thereby reducing the workload on the heart and preventing further hypertrophy. The cold-temperature induced protein may relate to either the hypertrophy response or to the adaptation to lower temperatures.

**EFFECT OF NICOTINE ON GROWTH AND DEVELOPMENT OF *DICTHYOSTELIUM DISCOIDEUM*.** *Jessica Gadsden and Arthur Washington, Tennessee State University, Nashville, Tennessee.* Nicotine, a heterocyclic compound produced in tobacco and other members of the solanaceous plant family, when used as a component of smoking or chewing tobacco has been implicated in inducing cancer and causing low birth weight in humans. *Dicthyostelium discoideum*, a cellular slime mold, is an excellent system for mimicking metabolic activity similar to that found in some human tissue and was used to study the effect of nicotine on growth and development. Results from this investigation showed that nicotine reduced the growth rate of cells that were grown axenically in HL-5 medium. At high concentrations, nicotine is toxic to cells. Cells that were washed free of axenic medium and put on Whatman number 50 filters supported by absorbent pads containing a phosphate buffer and nicotine for 24 h developed at a much slower rate, and aggregation centers and fruiting bodies were smaller than those of controls. Morphogenesis also was delayed in cultures that were incubated 4–8 h and then transferred to pads containing nicotine. However, development in cultures that were incubated with nicotine for 4 h after initiating development had smaller and fewer fruiting bodies than those incubated with nicotine for 8 h after initiating development. Perhaps, this delay in development is associated with nicotine-binding to receptor proteins at different periods of cell division during morphogenesis of *D. discoideum*. Studies on nicotine-binding to receptor proteins and the influence on G<sub>1</sub> proteins at various periods of morphogenesis of *D. discoideum* are in progress in our laboratory.

**RESPONSE OF *CERIODAPHNIA DUBIA* (CLADOCERA: DAPHNIIDAE) TO DUNBAR CAVE STATE NATURAL WATERS.** *Brian Kyte, Austin Peay State University, Clarksville, Tennessee.* The Dunbar Cave State Natural Area, Clarksville, Tennessee, is a source for ground water and surface water as

evidenced by sinkholes, streams within the cave, and Swan Lake. The adjacent golf course, the proximity of the sinkholes, and Swan Lake offer an avenue of pollution to the water system of the Natural Area. To assess the quality of the water, the chronic test protocol of the Environmental Protection Agency was used. Ten replicates of *Ceriodaphnia dubia* were exposed to a control and three different concentrations of effluent water. These data indicate the possibility of low-level contaminants in the water from the Natural Area as evidenced by a decrease in survivorship for organisms exposed to cave water concentrations and an increase in reproduction for organisms exposed to concentrations from Swan Lake. The low survivorship of organisms, such as *C. dubia*, within the Natural Area could, on a long-term temporal scale, result in decreased populations of species of zooplankton. Zooplankton occupies an important level in the grazing food chain of an aquatic ecosystem.

**BIOLOGICAL INDICATORS OF WATER QUALITY AT DUNBAR CAVE STATE NATURAL AREA, CLARKSVILLE, TENNESSEE.** *Frank Satterfield, Jennifer Koch, Don C. Dailey, and Cindy L. Taylor, Austin Peay State University, Clarksville, Tennessee.* For many years, fecal coliform and fecal streptococcal densities have been used as indicators of water quality at the state and federal level. Recently, many researchers in the United States have encouraged studies to investigate the relationship between poor water quality and amphibian decline. This study uses bacteria and amphibians as biological indicators of water quality at Dunbar Cave State Natural Area in Clarksville, Tennessee. For the amphibian portion of the study, experimental containers housing eggs of Cope's gray treefrog (*Hyla chrysoscelis*) were positioned at sites within the Natural Area. Two sites in common with the amphibian study and two additional sites within the cave were assessed for fecal coliform and fecal streptococci using a standard membrane-filter technique. Our bacterial data show that three of the four sites exceeded standards of the Environmental Protection Agency at least once during the study period. In addition, our amphibian data show a reduced survivorship (6.5%) for eggs incubated at the Natural Area as compared with controls (43.5%). These data demonstrate the need for further monitoring of the water quality at Dunbar Cave State Natural Area.

**EFFECTS OF ENVIRONMENTAL STRESSORS ON THE GROWTH OF *SALMONELLA*.** *Kimberly Washum, Leandrea Lockridge, Carolyn A. Caudle, and Yvonne Myles, Tennessee State University, Nashville, Tennessee.* An important property of microbial pathogens is the ability to survive extreme environmental conditions. In order to understand more about the mechanism of adaptive response and its role in bacterial virulence or resistance, three species of *Salmonella* (*S. enteritidis*, *S. pullorum*, and *S. typhimurium*) were exposed to various stressors: low or high temperature; acid or alkaline pH; a combination of these for various time periods. The results demonstrated that alkaline pH was more effective in controlling the growth of the bacteria than either temperature or acidic pH alone. The combination of high temperature (72°C) and acidic pH produced an increase in proteins synthesized by the organism, but there was a reduction of proteins synthesized under alkaline conditions at this temperature range. The new proteins produced will be identified to determine if they are known stress proteins which enhance the ability of the organism to withstand a number of chemical and physical changes.

EFFECTS OF ELECTROMAGNETIC FIELDS ON THE SWIMMING AND FEEDING BEHAVIOR OF *ICTALURUS PUNCTATUS* (SILURIFORMES: ICTALURIDAE). **Michael D. Phillips, William H. Wade, II, and Willodean D. S. Burton**, *Austin Peay State University, Clarksville, Tennessee*. The behavioral effects of short-term electromagnetic-field exposure on the passively electroreceptive channel catfish (*Ictalurus punctatus*) are not well known. This experiment was designed to test the swimming behavior and response to food stimulus of the channel catfish in the presence of an electromagnetic field. Two different experiments were conducted between 1 March 1997 and 2 April 1997, using 92 and 192 fish, respectively. The quantitative assessment of swimming behavior of fish was made based on each fish's time to complete a 2.44-m long maze in the presence of varying amounts of electromagnetic-field radiation. The data obtained from these experiments reveal a link between electromagnetic-field strength and increased time to complete the maze. A variety of statistical tools (analysis of variance, *F*-test, and *t*-test) was employed in the analysis of the data. Using an alpha of 5% ( $\alpha = 0.05$ ), sufficient evidence exists that the null hypothesis ( $H_0$ ) can be rejected, based on this experimental data. These data suggest that, near powerlines over shallow water sources, fish behavior in swimming and food procurement may be adversely affected. Additionally, this observed disturbance might not be limited to the channel catfish. Many other organisms use electroreception and geolocation to acquire resources for survival and may possibly be affected in the same manner.

DEVELOPMENT AND VALIDATION OF A LINEAR PROGRAM TO OPTIMIZE TENNESSEE AGRICULTURAL OPERATIONS. **Nathan A. Fuller and Jonathon L. Beckett**, *Middle Tennessee State University, Murfreesboro, Tennessee*. Tennessee claims a wide variety of agricultural ecosystems providing the opportunity to select from several crops in diversified farming operations. In addition to differences in prices for each product, producers must observe constraining conditions when considering various cropping scenarios. The objective of the current research was to develop a linear program that is flexible enough for farmers across the state to enter production values and rigorous enough to determine the extent of resources that should be committed to selected production enterprises for optimum profit. The developed model incorporates 14 different crops including tobacco, cotton, soybeans, corn, hay, and pumpkins. Constraining factors (42) include management hours available (by month), available capital for investment, land (owned and rented), and equipment. In addition, the model determines the number of hours of labor that must be hired (by month) and amount of capital that must be borrowed for maximum profit. The linear program is effective in determining the optimum acres that must be devoted to each crop for maximum profit within the constraining factors for maximum profit within a given farming situation. In addition to solving numbers of acres, shadow prices for non-binding constraints, and reduced costs for activities that are not included in the solution are calculated. These values can be incorporated into decision-making algorithms for risk analysis. The model is currently being tested in case studies throughout Tennessee for validation. In conclusion, the current research has resulted in a computer model that is useful to producers as a management tool in selecting diversification. In addition to prior experience, the model can be used in combination with futures prices and risk analysis for comprehensive decision-making.

EFFECTS OF CHALCONES ON SELECTED SOYBEAN CULTIVARS AND PROSTATE CELLS. **Bradford Mallory, E. Lewis Myles, Deborah Long, and Carolyn Caudle**, *Tennessee State University, Nashville, Tennessee*. Flavanols are compounds synthesized in plants as a secondary product. Many of these compounds have antimutagenic activity. Scientists have studied chalcones and chalcone analogs and found them to be antibacterial, antiviral, gastric protectant, antimutagenic, retinoid, antimutagenic, and antiinflammatory. Chalcones are abundantly present in nature from ferns to higher plants. They are aromatic compounds with an unsaturated side chain. Our investigation focused on chalcones and their effect on mammalian cells and plant tissue. Prostate adenocarcinoma is the most common cancer in males in the United States with incidence rates in African-Americans 40% higher than in Caucasians. The syntheses of chalcones were by a medical chemist at Meharry Medical College, Nashville, Tennessee. The exposures of the chalcones were to a prostate cell line and germinating seeds at the concentration of  $10^{-4}$  M. The growth rate of animal cells were by spectrophotometry. The measurements of the growth rates for plants were by comparison of various lengths (roots and hypocotyls) in control groups and the experimental groups. The use of electrophoretic analysis would confirm the obvious increase, decrease, or newly synthesized protein.

ISOLATION OF POLYPHENOL OXIDASE FROM *SCORZONERA HISPANICA*. **Wendy D. Wasden, Barry N. Lumpkins, Jacqueline K. McGee, Paul B. Hillesheim, and Kent Clinger**, *David Lipscomb University, Nashville, Tennessee*. Polyphenol oxidase from *Scorzonera hispanica* was partially purified using ammonium sulfate precipitation, size-exclusion column chromatography, and an immobilized copper affinity chromatography column. The amount of protein in each fraction was determined after every step using the Bradford assay. The enzyme activity was determined by spectrophotometry at 420 nm using catechol as the substrate. Prior to the chromatographic steps, ascorbic acid was used to prevent excessive inactivation of the enzyme. A 30-fold increase in the specific activity typically was observed during the purification process.

DROUGHT TOLERANCE IN SOYBEAN. **Katrina West, E. Lewis Myles, Larry Hall, Deborah Long, and Carolyn Caudle**, *Tennessee State University, Nashville, Tennessee*. Biological stress is any change in environmental conditions that might reduce or adversely change an organism's growth or development. Drought is one of many environmental stresses that crop plants may encounter. Prolonged periods without water can severely reduce crop vigor and ultimately reduce crop yield. This reduction in yield is often times transferred to the consumer as higher prices. Our laboratory is screening soybean for drought tolerance. The cultivars used in the study are Forrest and Hutcheson. The plants grew in 0.0, 0.4, and 0.8% NaCl for 7 days. At the end of the 7-day exposure period, total length, root length, and root weight are recorded. Analyses of the results with analysis of variance helped in determining the cultivar tolerant to salt. In comparing cultivars Forrest and Hutcheson, we found that Hutcheson is more tolerant than Forrest.



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**CONTROL OF DIAUXIC GROWTH OF AZOBACTER VINELANDII ON ACETATE AND GALACTOSE MEDIA.** *T. Y. Wong, Jeffrey Baker, and Susie Barton, The University of Memphis, Memphis, Tennessee, and Christian Brothers University, Memphis, Tennessee.* The purpose of this experiment was to better understand the physiology of the soil, aerobic bacterium *Azobacter vinelandii* in an attempt to develop a way to mass-produce the bacterium for the use of fertilizer. Batch cultures of *A. vinelandii*, a nitrogen-fixing bacterium, were inoculated with cells pregrown on 1–2% glycerol or galactose. When they were subsequently grown in a mixture of acetate and galactose, a typical diauxic growth pattern was experienced in the glycerol pregrown cells, with a preferential uptake of acetate in the first stage and galactose in the second stage of the biphasic growth pattern. A lag time of 2–6 h was seen between the two stages. The galactose pregrown cells displayed a uniphase growth pattern. Regardless of acetate concentration, no diauxic growth was shown. This leads to our concentration that acetate uptake is accomplished by two different pathways, one involving only acetate and one in which acetate and galactose are concurrently taken into the cell, and galactose appears to have a single inducible pathway, induced by the absence of acetate. These conclusions were supported by the growth patterns that the bacteria displayed when grown on specified media. Enzymatic essays are currently being conducted to further support our conclusions.

**EXERCISE-INDUCED CARDIOVASCULAR RESPONSES TO COLD STRESS IN AFRICAN-AMERICAN AND CAUCASIAN ADOLESCENCE.** *Jeffrey A. Brown, Hani Rashed, and Segio Cardoso, Christian Brothers University, Memphis, Tennessee, and The University of Tennessee at Memphis, Memphis, Tennessee.* Literature suggests that African-Americans and Caucasians may respond differently to stress. This differential response may predispose these individuals to blood-pressure abnormalities. We used the cold pressor test, which involves immersion of the hand in ice water for a period of 1 min, while monitoring autonomically controlled responses such as blood pressure, skin temperature, and blood flow. The cold pressor test has been proven reliable and reproducible. The subjects responses were compared to determine any differences on how they react to stress in terms of blood pressure. The subjects were monitored to record a basal blood pressure. The subjects then underwent the cold pressor test. No significant difference in blood pressure was seen. We then investigated the effects of exercise on blood pressure using the cold pressor test. After an exercise period of 10 min at 70% submaximal heart rate and a 10-min period of stabilization, the subjects again underwent the cold pressor test. We did not observe any significant differences in blood pressure between groups. The study shows that two populations of adolescents, African-American and Caucasian, with a mean age of 18 years, are identical in their responses to stress in terms of blood pressure.

**WHITE-BLOOD-CELL NITRIC-OXIDE-SYNTHASE ACTIVITY IN END-STAGE RENAL DISEASE.** *R. J. Cardenas, Y-B. Wang, and E. S. Kang, Christian Brothers University, Memphis, Tennessee, and The University of Tennessee at Memphis, Memphis, Tennessee.* Hypotension during hemodialysis is a serious complication in end-stage renal disease. We observed that hypotension was associated with rising plasma  $\text{NO}_2 + \text{NO}_3$  during hemodialysis. Studies were extended during 29 hemodialysis procedures in 10 patients with end-stage renal disease. Nitric-oxide-synthase activity was measured in white blood cells and plasma  $\text{NO}_2 + \text{NO}_3$  levels were quantitated by the Friess method. White-blood-cell nitric-oxide-synthase activity was found in 18 procedures (group B, mean =  $1.071 \pm 0.147$  nm/mg/min, range of 0.418 to 3.152) but not in 11 procedures (group A). With hemodialysis, nitric-oxide-synthase activity appeared in many patients of group A. Grouped by white-blood-cell nitric-oxide-synthase activity at 0 min, analysis of variance indicated that systolic blood pressure  $A > B$  ( $P = 0.01$ ); plasma  $\text{NO}_2 + \text{NO}_3$   $B > A$  ( $P = 0.02$ ); white-blood-cell nitric-oxide-synthase activity,  $B > A$  ( $P = 0.02$ ); change in white-blood-cell nitric-oxide-synthase activity,  $A > B$  ( $P = 0.02$ ). Supernatants were dialyzed in vitro versus 1,000-fold buffer and nitric-oxide-synthase activity was reanalyzed. Activity was found in many samples, even in those without previous nitric-oxide-synthase activity. These findings indicate induction of nitric oxide synthase in white blood cells in patients with end-stage renal disease who are undergoing hemodialysis. Our results suggest evidence of inhibitors of nitric oxide synthase that are removed by hemodialysis and also by in vitro dialysis. Differential amounts of inhibitors could account for the decrease in end-stage renal disease points when nitric-oxide-synthase activity is resumed.

**NITRIC-OXIDE-BINDING CAPACITY OF SERUM ALBUMIN.** *Brian Carpenter and Ellen Kang, Christian Brothers University, Memphis, Tennessee (BC), and The University of Tennessee at Memphis, Memphis, Tennessee (EK).* Nitric oxide is a highly reactive vasodilator. It is synthesized by enzymes localized in blood vessels for moment-to-moment alterations of the diameter of the blood vessel in response to physiological stimuli. Nitric oxide for this purpose also could come from pools carried as nitrosothiols such as plasma albumin. In this study, plasma albumin from control patients and patients with end-stage chronic renal failure were examined for their nitric-oxide-binding capacity. Plasma albumin was collected by molecular sieve chromatography, treated with  $\text{HgCl}_2$  to release nitric oxide which would quickly stoichiometrically form  $\text{NO}_2$ . The  $\text{NO}_2$  was detected by the Greiss reaction. The nitric-oxide-binding capacity of the albumin in 1 ml of plasma was  $0.425 \mu\text{M}$  for controls and  $0.341 \mu\text{M}$  for patients with end-stage renal disease. In the experimental group, a difference in nitric-oxide-binding capacity was noted between the pre-treatment and post-treatment samples ( $P = 0.056$ ). Also, male patients, who tended to be younger than female patients ( $P = 0.0211$ ), had significantly lower pre-dialysis nitric-oxide-binding capacity than did females ( $P = 0.0439$ ). No correlation was found between treatment methods, hemodialysis or continuous ambulatory peritoneal dialysis, and nitric-oxide-binding capacity. In conclusion, the nitric-oxide-binding capacity of patients with end-stage renal disease was low before treatment and increased after a treatment modality began. Also, males displayed lower pre-dialysis nitric-oxide-binding capacity than did females.

**TISSUE-CULTURE MANIPULATION OF RAPID-CYCLING BRASSICA RAPA.** *Michael Coleman and M. R. Uddin, Le-Moyne-Owen College, Memphis, Tennessee.* This study concerns the generation of clone or rapid-cycling brassica (*Brassica rapa*) using tissue-culture technology. Induction of adventitious-shoot production and somatic embryogenesis was attempted using cotyledon explant. Combination of benzyl 6-aminopurine and naphthalene-acetic acid were effective in inciting a morphogenic response from cotyledon explant. On some treatment, occasional adventitious-shoot initiation was observed. Benzyl 6-aminopurine and naphthalene-acetic acid alone were ineffective in eliciting morphogenic response. Callus production was achieved either with 2,4-D alone or in combination with benzyl 6-aminopurine. Semi-friable, transparent, and fast-growing calli were produced by a combination of 2,4-D and benzyl 6-aminopurine. Subculturing these calli on liquid culture media resulted in the production of early-stage somatic embryos.

**COMPARATIVE EFFECTS OF INTERFERON TAU TO INTERFERONS ALPHA AND BETA.** *Sammie Evans, Jr., The University of Tennessee at Memphis, Memphis, Tennessee.* Interferon is a natural cellular protein formed when cells are exposed to a virus, other foreign particles, or nucleic acids. Interferon is species-specific, meaning it acts on cells from the same species that produces it but not on others. Interferon's main property is that it inhibits virus replication, and it also slows cell proliferation. Interferons are classified into two groups, type I and type II. Type I includes alpha, beta, and newly found omega and tau interferons. Type II includes only interferon gamma. The purpose of this experiment was to compare the effectiveness of interferon tau to that of other type I interferons (alpha and beta) in antiproliferative and antiviral assays. An antiproliferative assay that measured the ability of interferon alpha, beta, and tau to slow down the cell growth was performed, followed by an antiviral assay, plaque assay (forming holes on the cultured plate of cells), to measure the antiviral effects of interferon alpha, beta, and tau. Previous results showed that interferon alpha and beta dramatically inhibited cell proliferation at 10 units or less. It was observed that a much higher (1,000-fold or greater) concentration of interferon tau was needed to result in a similar antiproliferative activity. Interferon tau's antiproliferative effects are comparable in interferon alpha and beta. However, it does not exhibit similar antiviral activity. This suggests that interferon alpha and beta does something that interferon tau does not. Hopefully, further testing will yield what is different about interferon tau.

**CATIONIC LIPID TRANSFECTION AS A MARKER GENE IN COTRANSFECTION SYSTEMS.** *Laurinda Foreman, Eldon Geisert, and LiJuan Yang, The University of Tennessee at Memphis, Memphis, Tennessee, and Christian Brothers University, Memphis, Tennessee.* Gene therapy holds the key to many diseases of the nervous system; however, the lack of an effective delivery system is hampering these efforts. The present study examined the use of several different delivery systems for gene therapy. We examined the expression of a small membrane protein, target of the antiproliferative antibody, which was cotransfected with a marker gene, either green fluorescent protein or  $\beta$ -galactosidase. Three different delivery systems were used: lipofection; lipofectamine (GIBCO BRL); the standard method of  $Ca^{++}$  precipitation. Cos7 and 3T3 cells were used in tissue culture. Following 2-3 days, gene expression was examined. Cells were immunostained for target of the antiproliferative antibody,

and marker-gene products were identified either by histochemical method for  $\beta$ -galactosidase or by direct ultraviolet illumination for green fluorescent protein. The transfection rates for all genes were rather low, ranging from 5.0 to 18.2%. In cos7 cells, lipofectin had the highest green-fluorescent-protein transfection rate with 18.2%, lipofectamine had 14.3%, and  $Ca^{++}$  precipitation had 5.0%. In cotransfection experiments, we were surprised by the general lack of co-expression, e.g., only 0.8% of cells expressed  $\beta$ -galactosidase only, 23.7% expressed target of the antiproliferative antibody only, and 0.2% expressed target of the antiproliferative antibody and  $\beta$ -galactosidase. Although these tissue-culture results hold some degree of promise, no consistent transfection was observed when these methods were used in the rat brain. If gene therapy is to be applied to the nervous system, an effective delivery system must be developed.

**EFFECTS OF DEXAMETHASONE ON MACROPHAGE PRODUCTION OF TNF- $\alpha$ .** *Radha K. Gandhi and Dennis T. Crouse, Christian Brothers University, Memphis, Tennessee (RKG), and The University of Tennessee at Memphis, Memphis, Tennessee (DTC).* The administration of systemic corticosteroids is a therapy for countering bronchopulmonary dysplasia in infants, but its role remains controversial. The newborns with the greatest chance of contracting bronchopulmonary dysplasia were those born premature and of low birthweight (<1500 g). Also, the presence of a mycoplasma in the mother has shown to double the baby's chance of contracting bronchopulmonary dysplasia. We investigated the effects of dexamethasone, a glucocorticoid which suppresses immune function, on the cytokine, TNF- $\alpha$ , production in mouse macrophages. The mycoplasmas *Ureaplasma urealyticum* and *Mycoplasma hominis* were separately added to a mouse macrophage suspension, and the addition of the organisms greatly increased the production of TNF- $\alpha$  in a concentration-dependent manner. Our results suggest that the mycoplasma infection might alter cytokine production as well as response to corticosteroids. The addition of dexamethasone significantly reduced the TNF- $\alpha$  production by the macrophages in a time and concentration-dependent manner where the higher the concentration of dexamethasone and the longer the preincubation with dexamethasone, the greater the inhibitory action.

**SIGNAL TRANSDUCTION MECHANISMS INVOLVED IN ANGIOTENSIN II-STIMULATED ARACHIDONIC-ACID RELEASE FOR PROSTANOID SYNTHESIS IN RABBIT AORTIC SMOOTH MUSCLE CELLS.** *Mubarack M. Muthalif, Ibrahim F. Benter, Mohammed R. Uddin, Jason L. Harper, and Kafait U. Malik, The University of Tennessee at Memphis, Memphis, Tennessee, and Christian Brothers University, Memphis, Tennessee.* Angiotensin II, a peptide product of the renin-angiotensin system, possesses potent pressor and angiogenic functions. This study was conducted to investigate the signal transduction mechanisms of angiotensin II-stimulated arachidonic acid release for prostaglandin production in rabbit aortic vascular smooth muscle cells. In cells prelabeled with [ $^3H$ ]-arachidonic acid, angiotensin II enhanced release of [ $^3H$ ]-arachidonic acid measured by liquid scintillation spectroscopy. The  $AT_1$  receptor antagonist DUP-753 and the  $AT_2$  receptor antagonist PD-123319 inhibited angiotensin II-induced [ $^3H$ ]-arachidonic acid release. In cells transiently transfected with cytosolic or secretory phospholipase  $A_2$  (PLA $_2$ ), mitogen-activated protein kinase or calcium/calmodulin kinase II antisense but not sense oligonucleotides, angiotensin II-induced [ $^3H$ ]-arachidonic acid release was attenuated.



The calcium/calmodulin kinase II inhibitor KN-93 and the mitogen-activated protein-kinase inhibitor PD-098059 also attenuated angiotensin II-induced [<sup>3</sup>H]-arachidonic acid release. Furthermore, angiotensin II increased calcium/calmodulin kinase II and mitogen-activated protein kinase activity, PD-098059, did not affect calcium/calmodulin kinase II activity. Angiotensin II caused translocation of cytosolic cPLA<sub>2</sub> to the nuclear envelope. These data show that angiotensin II stimulates calcium/calmodulin kinase II which, via mitogen-activated protein kinase activation, enhances cPLA<sub>2</sub> activity and release of arachidonic acid for prostaglandin synthesis.

**HOME-RANGE DYNAMICS OF FIELD MICE IN DIVERSE HABITATS AS DETERMINED BY POWDERTRACKING.** *Loren James, James Huggins, and H. Wayne Wofford, Union University, Jackson, Tennessee.* Home ranges of field mice have been studied extensively using methods such as radiotelemetry and live trapping. Powdertracking is an inexpensive technique that has been developed recently to provide accurate estimates of home ranges. The purpose of this study was to validate the technique of powdertracking by determining the home ranges of field mice and to investigate the influence of habitat and interspecific competition on home ranges. The study site was a farm ca. 16 km southeast of Jackson, Tennessee. The species captured were *Peromyscus leucopus*, *Peromyscus gossypinus*, and *Ochrotomys nuttalli*. When adequate recapture rates were obtained, home-range sizes were consistent with home ranges obtained by other methods. It was determined that *P. leucopus* and *O. nuttalli* preferred deciduous forest habitat and that *P. gossypinus* preferred more brushy terrain. It also was found that *P. leucopus* and *O. nuttalli* had overlapping home ranges and seemed to interact harmoniously. However, *P. gossypinus* had exclusive home ranges. Thus, it was concluded that powdertracking could provide information about home-range size and habitat preference of field mice that is comparable to that obtained from other methods.

**CYTOKINE INDUCTION BY POLYINOSINIC ACID IN A MOUSE MACROPHAGE CELL LINE.** *David Mathias and James Krueger, Christian Brothers University, Memphis, Tennessee (DM), and The University of Tennessee at Memphis, Memphis, Tennessee (JK).* Cytokines are involved in the regulation of a variety of physiological responses. The specific cytokine in which we were interested in this study was interleukin 1 Beta, which has been implicated in sleep production. Previous investigators have shown that sleep increases with a viral infection as well as circulating interleukin 1 Beta levels. Using a mouse macrophage cell line, we sought to determine if interleukin 1 Beta levels were increased with polyinosinic-acid infection. Polyinosinic acid is a double-stranded synthetic RNA polynucleotide, which was used to mimic a viral infection. Our results showed that the mouse macrophage cell-line did produce a significant increase in interleukin 1 Beta after stimulation with polyinosinic acid. This production of interleukin 1 Beta was temporally and dose dependent. These results suggest that viral infections stimulate the production of interleukin 1 Beta, which results in increased sleep during an infection.

**CELLULAR LOCALIZATION OF DARPP-32, WHICH IMPLICATES THE LOCATION OF D1 RECEPTORS, IN THE STRIATUM OF PIGEONS.** *Minoli Perera and Anton Reiner, Christian Brothers University, Memphis, Tennessee (MP), and The University of Tennessee at Memphis, Memphis, Tennessee (AR).* Dopamine input to the striatum originates in the substantia nigra and regulates basal ganglia output. The basal ganglia controls movement initiation, which is impaired in some neurodegenerative disorders. We sought to determine the distribution of D1 receptors, which are one type of dopamine receptor, on avian striatal neurons, by way of the marker DARPP-32. Previous studies in mammals indicated a preferential distribution of D1 receptors on striatal projection neurons. Upon binding of dopamine to D1 receptors, adenylate cyclase is activated which in turn activates enzymes that phosphorylate DARPP-32. We utilized an antibody against the DARPP-32 in conjunction with antibodies to the other known neurotransmitters to distinguish between the different types of projection neurons and interneurons in the striatum. In these experiments, the two major types of projection neurons were studied: the substance P-containing neurons; the enkephalin-containing neurons. Our results showed that 48% of those neurons containing the substance P also contained DARPP-32, while only 10% of neurons containing enkephalin also contained DARPP-32. Interneurons containing either neuropeptide Y or choline acetyl-transferase were not observed to contain DARPP-32. These results suggest that both types of striatal projection neurons possess D1 receptors, but a higher percentage of the substance P-containing neurons contain D1 receptors than of enkephalin-containing neurons. Striatal interneurons, which have axon projections restricted to the basal ganglia, do not possess the D1 dopamine receptors. Thus, dopamine input to these cells would potentially have different effects based on the population of receptor present on the cells.

**RESPONSES IN RENAL NERVE ACTIVITY, HEART RATE, AND MEAN ARTERIAL PRESSURE TO NORADRENERGIC RECEPTOR STIMULATION.** *Steven L. Bealer and Amit Jeevan, The University of Tennessee at Memphis, Memphis, Tennessee (SLB), and Christian Brothers University, Memphis, Tennessee (AJ).* This experiment was performed to test the role of hypothalamic noradrenergic receptors in renal sympathetic nerve activity, mean arterial pressure, and heart rate upon the pharmacological stimulation of the central nervous system in anesthetized rats. The administration of clonidine and phenylephrine into the hypothalamus via a stereotaxic placed cannula was conducted while measuring systemic physiological responses. Results for both drugs were as follows. Phenylephrine decreased heart rate, renal sympathetic nerve activity, and blood pressure. However, clonidine increased all three systemic physiological responses. The results indicate that phenylephrine decreases parasympathetic nervous system and sympathetic nervous system activity while clonidine increases the sympathetic nervous system activity. In conclusion, the alpha 1 norepinephrine receptor is responsible for phenylephrine activity, and the alpha 2 norepinephrine receptor is responsible for clonidine activity.

**RESPONSES TO PREY ODORS IN JUVENILES OF THE SNAKE *ELAPHE OBSOLETA SPILOIDES*, A PREDATORY GENERALIST.** *S. J. Mullin, The University of Memphis, Memphis, Tennessee.* Predatory generalists should respond similarly to odors from all types of acceptable prey. Limiting generalists to only one prey type may increase the response to that prey

type. Gray rat snakes (*Elaphe obsoleta spiloides*) may exhibit differential response to prey odors as subadults because morphological limits constrain prey ingestion. Ingestationally-naive neonates were presented with odors from mammalian and avian prey and again at 1 and 2 years of age. Snakes were fed only neonate *Mus domesticus* during this period. Tongue-flick rates were higher after initial feeding episodes but did not differ in between subsequent years. Response was stronger to prey odors than to control substances. Subjects did not prefer a specific prey odor in any of the years tested, even after having been fed only one prey type. However, regardless of age, snakes preferred pooled mammalian odors to avian odors when responses were pooled by prey taxon. The absence of any directional shift over time in response to odors in gray rat snakes fed only one prey type suggests a strong inherent component directing prey recognition.

**COMPARATIVE PHYSIOLOGY AND HISTOLOGY OF FROG AND TOAD SKELETAL MUSCLES.** *Christopher D. Moore and Jay A. Blundon, Rhodes College, Memphis, Tennessee.* The nature of frog and toad behavior under stress has been previously studied very thoroughly. A frog typically responds to a threat with rapid escape behavior involving powerful leaps, accompanied by low stamina and exhaustion in 2-5 min; the toad, however, exhibits much lower levels of activity almost indefinitely and avoids predation by inedible posture or poisonous skin secretions. Frozen cross sections of skeletal muscle from frog (*Rana pipiens*) and toad (*Bufo americanus*) were stained for NADH dehydrogenase to investigate the primary pathway of ATP production in each fiber, anaerobic glycolysis or oxidative phosphorylation. Myosin ATPase stains determined whether a fast or slow isoform of the myosin ATPase enzyme was associated with the myosinhead. Whole-muscle contractile performance was investigated by inducing tetanus contraction and measuring maximum tension production and fatigue time in the presence of glycolytic and oxidative inhibitors. Stains of the frog and toad gastrocnemius showed the frog muscle is composed of a uniform mix of fiber types; the toad muscle is composed of mixed types in addition to a band of slow oxidative fibers comprising ca. 15-20% of the whole muscle. Fatigue and tension capabilities are currently under investigation.

**MORPHOLOGICAL AND ZOOGEOGRAPHICAL CHARACTERIZATION OF A PARASITIC NEMATODE IN FROGS.** *Lynda Starks, John Olsen, and Stan Eisen, Christian Brothers University, Memphis, Tennessee, and Rhodes College, Memphis, Tennessee.* Parasites are found in a wide variety of organisms and are of medical and economic significance. Many parasites can co-exist without much detriment to the host while others can cause illness and death. An understanding of the host-parasite relationship and mechanism of transmission is essential to controlling parasitic infestation. We observed that several captured and tank-bred frogs contained an unknown intestinal parasite. We sought to identify the species of parasite and possible mode of transmission. Using light microscopy and scanning electron microscopy, we identified the parasitic organism as a nematode, *Rhabdias bufonis*. The larval form of this nematode is located in the intestinal tract of the frog, and the adult nematode migrates to the lungs. Once the parasite was identified, the life cycle was investigated to determine the possible mode of transmission in three disparate populations of frogs. These populations of frogs were those captured in either eastern Memphis or Raceland Louisiana and purchased frogs that were tank-bred by Carolina

Biological Supply Company. By investigating the water and the fish and snails that were kept with the frogs, we concluded that the transport host for this nematode was a snail. Our results show that this nematode has a wide geographic distribution and that tank-bred frogs can easily become infected with this nematode via other organisms.

**EVIDENCE FOR THE PRESENCE OF D1-LIKE DOPAMINE RECEPTORS ON PC12 CELLS.** *Vinh Q. Ngo, The University of Tennessee at Memphis, Memphis, Tennessee.* PC12 cells come from a tumor cell line derived from a rat chromaffin cell tumor. Chromaffin cells are found in the adrenal medulla, which is the inner layer of the adrenal glands. The adrenal chromaffin cells are responsible for the stress response in our body. These cells are responsible for releasing adrenalin into the blood stream resulting in our fight or flight response. The reason for the interest in studying chromaffin cells is that they are very similar to sympathetic neurons, with both arising from the same precursor cell. These cell types share similarities in how they are innervated and in that they both synthesize, store, and secrete catecholamine. One major difference is that sympathetic neurons release nor-adrenaline at the specific target organs, while the chromaffin cells send their messengers through the blood to target organs such as heart and liver. Study of chromaffin cells not only increases our knowledge about chromaffin cells and sympathetic neurons but also increases knowledge about the interaction of the sympathetic nervous system with the rest of our body. Experimentation permitted observation of the effects of different agents on catecholamine secretion from PC12 cells. Resulting data suggest that D1-like dopamine receptors are present on PC12 cells. Presumably, C1-APB is activating D1-like dopamine receptors, which in turn inhibit catecholamine secretion from PC12 cells. However, it is not clear whether the D1 or D5 dopamine receptor subtype is responsible for the negative modulation of catecholamine secretion seen in PC12 cells. Future studies will be required to answer that question.

**IMPLICATIONS OF ILLICIT DRUG USE AMONG YOUNG ADULT AFRICAN-AMERICANS.** *Sharon Reynolds, Daykeshia Weston, Latasha Dockins, Betty Winters, Anita Hunt, Wanda Davis, Ida Mosby, Earl Terrell, James Eoff, Albert Jones, Brinkley Spigh, Jesse McClure, and Eldridge Johnson, LeMoyne-Owen College, Memphis, Tennessee (SR, DW, LD), Memphis Police Department, Memphis, Tennessee (BW), The Regional Medical Center, Memphis, Tennessee (AH, WD), New Directions Drug Treatment Center, Memphis, Tennessee (AJ), Rust College, Holly Springs, Mississippi (BS), and The University of Tennessee at Memphis, Memphis, Tennessee (IM, ET, JE, JM, EJ).* The purpose of this investigation was to determine if a correlation existed between illicit drug abuse and violence among young adult African-Americans in a modern urban setting. An anonymous questionnaire was administered to 51 inpatients and outpatients of New Direction Drug Treatment Center, Pyramid Recovery Center, and the MED in Memphis, Tennessee. Many of the respondents (44%) were multiple drug users or had sequential experiences with several drugs. The average age for the initial experience was 15.9 years for alcohol, 17.3 years for marijuana, and 23.6 years for cocaine. Results of the survey indicate that 46.2% of the patients had been violent as a result of alcohol or drug abuse. Furthermore, 53% of this group revealed that they had been arrested at some time in the past. Additionally, one

third of these arrests and incarcerations were related to drug and other substance abuse.

**EFFECT OF ISCHEMIA/REPERFUSION ON FETAL MORTALITY AND UTERO-PLACENTAL BLOOD FLOW IN THE RAT.** *T. N. Tran and R. A. Ahokas, Christian Brothers University, Memphis, Tennessee (TNT), and The University of Tennessee at Memphis, Tennessee (RAA).* The objectives of this study were to confirm that ischemia/reperfusion induces intrauterine growth restriction without increasing fetal mortality and to determine whether ischemia/reperfusion induced vascular injury reduces blood flow to the placentas. Pregnant rats were anesthetized on day 16–18 of gestation, and blood flow to one horn was occluded for 60, 20, or 10 min (ischemia/reperfusion horn); the other horn served as the control. On day 21, live and dead placentas and fetuses were removed and weighed. Animals treated similarly were again anesthetized on day 18 (24 h) or 21 (96 h), and placental blood flow was measured using radioactive labeled microspheres. At 60 min of ischemia, fetal mortality was 94% in the ischemia/reperfusion horn compared to 10% in the control horn. Fetal mortality decreased when ischemia duration was shortened. There were significant decreases ( $P < 0.05$ ) in placental weights between ischemia/reperfusion-live and control-live groups, and ischemia/reperfusion-live and ischemia/reperfusion-dead groups. No significant difference was observed for fetal weights. A significant difference in placental blood flow was found between the ischemia-reperfusion-dead and control groups 24 h, but not 96 h, following ischemia. Our results demonstrate that uterine ischemia/reperfusion does not induce intrauterine growth restriction but causes a significant occurrence of fetal death, which may be caused by a reduction of placental blood flow.

**ANATOMICAL AND PHYSIOLOGICAL CORRELATIVE STUDY OF THE HINDPAW REPRESENTATION AND HINDPAW BARREL SUBFIELD OF LAYER IV OF RAT SOMATOSENSORY CORTEX.** *Amanda M. Weeden, Cynthia H. Daniel, Phillip P. Pearson, Akinniran Oladehin, Cheng X. Li, Eldridge F. Johnson, and Robert S. Waters, Christian Brothers University, Memphis, Tennessee (AMW), The University of Memphis, Memphis, Tennessee (CHD), and The University of Tennessee at Memphis, Memphis, Tennessee (AMW, CHD, PPP, AO, CXL, EFJ, RSW).* The purpose of this study was to describe the organization of the hindpaw barrel subfield in layer IV of rat somatosensory cortex and to relate this organization to the representation of the hindpaw. We found that the hindpaw barrel subfield comprised barrels and barrel-like structures, the most prominent of which consist of at least five elongated barrel bands. Posterior to these bands is a cluster of four barrels. Two additional barrels also are found, one lateral and the other medial. The hindpaw barrel subfield showed considerable variability in size and shape across animals; nevertheless, the overall pattern reflects a common plan of organization. We investigated the details of this hindpaw representation by using electrophysiological mapping. By this method, we confirmed that the representation was somatotopically organized. Our data shows that individual barrels in the hindpaw barrel subfield are associated with discrete regions of the hindpaw.

**SURFACE ENHANCED RAMAN SCATTERING SPECTROSCOPY OF  $\gamma$ -AMINO BUTYRIC ACID.** *Xiaoda Li, Y. S. Li, and J. C. Cheng, The University of Memphis, Memphis, Tennessee.* Surface enhanced Raman scattering spectroscopy has been successfully collected for aqueous solutions of  $\gamma$ -amino butyric acid at pH 6.5, 9.5, and 12.0. For more vibration spectroscopic information, the normal Raman and infrared spectra of the same compound also were obtained. With increasing pH values of solutions, structures of  $\gamma$ -amino butyric acid vary from amine ion form to zwitterion form to carboxylate ion form due to the pKa at 4.031 and 10.556. Based on the proposed absorption mechanism of an acid on silver particles, carboxylate ion form more easily forms the surface-enhanced Raman scattering active complex than do the other forms. These have been proven by our experimental results of surface-enhanced Raman scattering at pH  $> 6.5$ . At the same time, chlorine ion effort has been studied at various concentrations.

**RAMAN SPECTROSCOPY STUDY OF GLUTAMIC ACID AT VARIOUS pH SOLUTIONS.** *Tung Thanh To, Y. S. Li, and J. C. Cheng, The University of Memphis, Memphis, Tennessee.* Glutamic acid, an amino acid with two carboxylate groups and one amine group and three different pKa values of 2.2, 4.3, and 9.7, has different dissociation forms in various pH solutions. In this study, normal Raman and infrared spectra of glutamic acid or monosodium glutamate solutions of pH 1 to 11 have been collected. Poor solubility of glutamic acid in water solution for normal Raman under pH 5 has been overcome through a special heating device with a temperature controller. The infrared spectrum at different pHs were collected with the use of commercial polyethylene film. With the aid of a new silver sol developed in our laboratory, surface-enhanced Raman scattering spectra have been obtained at a rather wide pH range. The spectroscopy results are in agreement with the structure expected at related pH values.

**SYNTHESIS OF CYCLOPENTADIENYL LIGANDS THAT CAN BE USED IN THE FORMATION OF CATALYTIC METAL COMPLEXES.** *Rick LaRue and Randy F. Johnston, Union University, Jackson, Tennessee.* Substituted-cyclopentadienyl ligands were synthesized via nucleophilic substitution reactions between  $\text{NaC}_5\text{H}_5$  and the desired substituents. Salts of these ligands were reacted with  $\text{Mn}(\text{CO})_5\text{Br}$  and  $\text{C}_2(\text{CO})_8/\text{I}_2$  mixtures in the attempt to isolate  $(\eta^5 - \text{C}_5\text{H}_4\text{R})\text{Mn}(\text{CO})_3$  and  $(\eta^5 - \text{C}_5\text{H}_4\text{R})\text{Co}(\text{CO})_2$  (where  $\text{R} = \text{CH}_2\text{CO}_2\text{CH}_3$  or  $\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}_3$ ). The synthetic method and characterization of these products will be presented.

**MECHANISMS OF SYNAPTIC INHIBITION AT A CRAYFISH NEUROMUSCULAR JUNCTION.** *David Katz, Rhodes College, Memphis, Tennessee.* The neuromuscular junction of the opener muscle in the first walking leg of the crayfish consists of two presynaptic components (the opener excitor axon and the opener inhibitor axon) and a single postsynaptic component (the opener muscle fiber). The opener excitor axon releases the neurotransmitter glutamate which causes excitatory postsynaptic potentials in the muscle fiber. The opener inhibitor axon provides postsynaptic inhibition to this neuromuscular junction by releasing the inhibitory neurotransmitter  $\gamma$ -aminobutyric acid onto the opener muscle fiber to produce inhibitory postsynaptic potentials. However, the opener inhibitor axon also has axoaxonal synapses with the opener excitor axon, providing presynaptic inhibition. The goal of this experiment is to investigate the specific receptor

mechanisms of presynaptic and postsynaptic inhibition at the neuromuscular junction of the crayfish. There are currently three subtypes (a, b, and c) for the  $\gamma$ -aminobutyric acid receptor. The addition of picrotoxin, a subtype-a antagonist, completely eliminates presynaptic and postsynaptic inhibition. The addition of baclofen, a subtype-b agonist, causes a reduction in miniature end plate potential frequency and amplitude but has no effect on amplitude of excitatory postsynaptic potentials. In conclusion, presynaptic inhibition seems to be mediated solely through subtype-a receptor channels.

**HEAD COCKING IN THE BUSHBABY (*OTOLEMUR GARNETTII*): EFFECT OF STIMULUS PROPERTIES.** *D. H. McCain, C. Cantalupo, and J. P. Ward, The University of Memphis, Memphis, Tennessee.* Head cocking, a rotating of the head around its rostrocaudal axis while orienting in a fixed direction, was studied in adult and juvenile bushbabies (*Otolemur garnettii*). The animals were presented with a variety of novel stimuli, consisting of four animals and a nonliving object. Bidimensional and tridimensional representations as well as video images of the stimuli were used. Properties of the video stimuli (i.e., still image versus moving image, with or without sound) were varied to assess their effect on the head-cocking response. The animals' behavior was videotaped, and frequency and angle of head cocking were scored by advancing the videotapes frame by frame. The effects of the different stimuli and means of presenting the stimuli are reported. In particular, evidence was found suggesting that head cocking in the bushbaby is not elicited by acoustic stimulation. Finally, a possible functional role of head cocking as a form of visual investigation in response to novelty is discussed.

**COURTSHIP BEHAVIOR OF *SCHIZOCOSA AVIDA* (WALCKENAER) (ARANEAE: LYCOSIDAE) AND A PHYLOGENETIC ANALYSIS OF WOLF SPIDERS USING COURTSHIP BEHAVIOR.** *Elizabeth Grey and Gail Straton, Rhodes College, Memphis, Tennessee.* Wolf spiders (Araneae, Lycosidae) show species-specific courtship behavior. In this study, video-recording was used to record, analyze, and describe the courtship behavior of *Schizocosa avida*. Of the 26 pairings of *S. avida* observed, 12 males showed courtship behavior and three pairs copulated. The behaviors described during a male courtship sequence include extend and tap, extend and vibrate, step vibrate, and rapid palpal drumming. Rapid palpal drumming is the most distinctive behavior of courtship of *S. avida*. Courtship behavior also was used in the construction of a phylogeny of wolf spiders. Twenty-nine behaviors were used to discriminate 16 taxa. The behavioral phylogeny was inconclusive, but a mapping of behavioral characters onto a morphological phylogeny was informative.

**UNDERSTANDING THE CARCINOGENICITY OF N-AR(-)YLHYDROXAMIC ACIDS AND N-ARYLHYDROXYLAMINES.** *Angie Brown, Sarah Sanzenbacher, Amy Van de Water, and Michael Novak, Miami University, Oxford, Ohio.* The sulfuric acid esters of N-arylhydroxamic acids and N-arylhydroxylamines are known as the ultimate carcinogens resulting from the metabolic activation of aromatic amines and amides. The esters can convert into nitrenium ions which can then react with nucleophilic sites on DNA bases. The compounds can only react with DNA or other macromolecules if they are trapped at a slow enough rate by the solvent that the nucleophile can successfully compete. We can measure the  $k_{az}/k_s$ , the ratio of the second-order rate constant for trapping of the nitrenium ion by azide and the pseudo first-order rate constant for trapping of the nitrenium ion by the solvent. We believe that the more carcinogenic or mutagenic a compound is, the higher the  $k_{az}/k_s$  value. The two compounds with which we are working are N-acetyl-N-sulfonatoxy-1-aminonaphthalene (not a carcinogen) and N-acetyl-N-sulfonatoxy-2-aminonaphthalene (one of the most potent of the industrial bladder carcinogens). Our goal is to prove that the higher the  $k_{az}/k_s$  value, the higher the carcinogenicity.